Unit 4

Multiplication and Division With Multi-Digit Whole Numbers

Essential Questions

- What strategies for multiplication work no matter how many digits are in the factors?
- What strategies for division work no matter how many digits are in the dividend and divisor?

Unit Story: Andrea

You can read the Unit Story with your student by visiting the Unit Story page on the Caregiver Hub.

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Unit Investigation

Lesson 1 is the Unit Investigation. Students use estimation strategies to determine factors with a product close to a target number to build curiosity and apply their own knowledge in a variety of ways. Use the **Caregiver Connection** to help students continue to explore the math they will see in the unit.

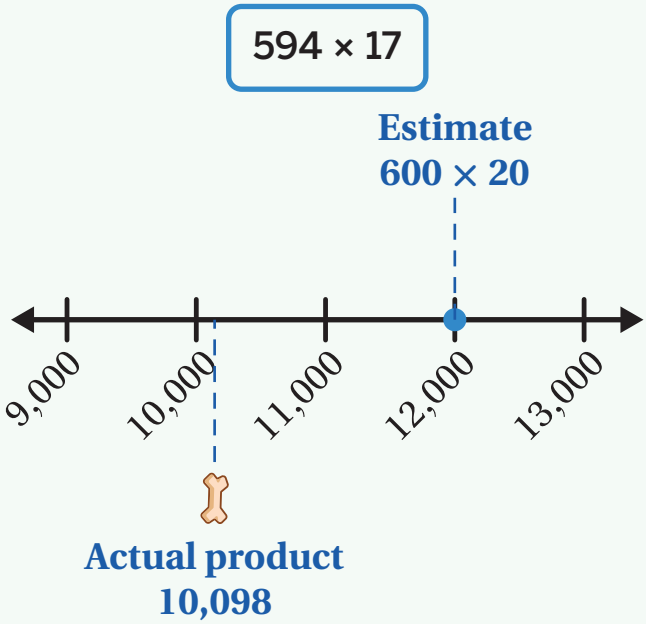
Caregiver Connection

Students may enjoy playing a factors and product game at home by choosing their own three or four-digit target value. They can ask others for expressions and tell them whether their estimate is too high, too low, or just right.

Summary | Lesson 2

When estimating products, it can be helpful to consider if your strategy will result in an estimate that is greater than or less than the actual product.

To estimate 594 × 17, I rounded 594 to 600 and 17 to 20. I know my estimate will be greater than the actual product because I rounded both factors up to the greater place value.



Try This

Write an equation to represent an estimate. Then determine the product and check for reasonableness.

Show your thinking.

1 48 × 45

estimate: _____

Summary | Lesson 3

You can represent partial products using area diagrams or equations.

284 × 37

	200	80	4
30	6,000	2,400	120
7	1,400	560	28

6,000
1,400
2,400
560
120
\+ 28
10,508

284 × 37

(200 + 80 + 4) × (30 + 7)
200 × 30 = 6,000
200 × 7 = 1,400
80 × 30 = 2,400
80 × 7 = 560
4 × 30 = 120
4 × 7 = 28
6,000 + 1,400 + 2,400 = 9,800
560 + 120 + 28 = 708
9,800 + 708 = 10,508

Try This

1 Use a partial products strategy to complete the area diagram.

	900	30	7
20		600	
5			35

Summary | Lesson 4

In a partial products algorithm, the value of each digit in one factor is multiplied by the value of each digit in the other factor, and all the partial products are recorded.

	356	
×	24	
	24	4 × 6
	200	4 × 50
	1,200	4 × 300
	120	20 × 6
	1,000	20 × 50
+	6,000	20 × 300
	8,544	

Try This

1 Write an expression to show how each partial product value was determined.

	74,193	
×	5	
	350,000	_____
	20,000	_____
	500	_____
	450	_____
+	15	_____
	370,965	

Summary | Lesson 5

When multiplying multi-digit numbers, one algorithm can list each partial product on a separate line, while the standard algorithm for multiplication lists some of them on the same line.

A partial products algorithm	Standard algorithm
1 2 2 × 3 4 8 — 4 × 2 8 0 — 4 × 20 4 0 0 — 4 × 100 6 0 — 30 × 2 6 0 0 — 30 × 20 + 3, 0 0 0 — 30 × 100 4, 1 4 8	1 2 2 × 3 4 4 8 8 — 4 × 122 + 3, 6 6 0 — 30 × 122 4, 1 4 8

Try This

1 Write an equation to represent an estimate of 323 × 32.
Then determine the product using the standard algorithm.

Show your thinking.

3 2 3
× 3 2

equation: _____

answer: _____

Summary | Lesson 6

In the standard algorithm, units are composed when the product of 2 digits is a two-digit number. The composed unit can be recorded above the factors.

$50 \times 30 = 1{,}500$ ⟶

$$\begin{array}{r} {\scriptstyle 1} \\ 252 \\ \times\ \ 31 \\ \hline 252 \\ +\ 7{,}560 \\ \hline 7{,}812 \end{array}$$

Try This

1 Will you need to compose units when evaluating 271 × 31? Explain your thinking.

Summary | Lesson 7

When using the standard algorithm to multiply multi-digit numbers, there could be several composed units, so it is important to keep track of them.

$$\begin{array}{r} {\scriptstyle 2\ 1} \\ {\scriptstyle 3\ 2} \\ 875 \\ \times \quad 34 \\ \hline 3,500 \\ +\ 26,250 \\ \hline 29,750 \end{array}$$

Try This

1 What is the product 477 × 53?

- (A) 29,752
- (B) 25,281
- (C) 22,121
- (D) 3,816

Summary | Lesson 8

Missing digits in multiplication equations can be determined in different ways.

available digits: 5, 1, 9, 4

8 _ 2 × 8 _ = 68,208

Using multiplication	Using reasoning
$\begin{array}{r} {\scriptstyle 1} \\ 812 \\ \times \quad 84 \\ \hline 3,248 \\ +\ 64,960 \\ \hline 68,208 \end{array}$	Both missing digits should be less than 5 because 800 × 80 = 64,000.

Try This

1 Determine the product 708 × 46 using the standard algorithm.

Show your thinking.

answer: _____

Summary | Lesson 9

You can choose different methods for multiplying based on the numbers in the problem.

Partial products	Friendly numbers	Standard algorithm
925 × 14 900 × 10 = 9,000 900 × 4 = 3,600 25 × 10 = 250 25 × 4 = 100 12,600 + 350 = 12,950	25 × 99 25 × 100 = 2,500 2,500 − 25 = 2,475	2 9 5 × 1 4 3 2 8 6 0 + 2, 9 5 0 4, 1 3 0

Try This

1 Which multiplication expression has a product of 16,525?

(A) 975 × 19 (B) 661 × 25 (C) 725 × 9 (D) 701 × 25

Show your thinking.

Sub-Unit 1 | Summary

In this sub-unit . . .

- We used partial products and the standard algorithm to multiply multi-digit whole numbers. We saw that the standard algorithm is a more condensed way of recording partial products.

A partial products algorithm	Standard algorithm
122 × 34 8 (4 × 2) 80 (4 × 20) 400 (4 × 100) 60 (30 × 2) 600 (30 × 20) + 3,000 (30 × 100) 4,148	122 × 34 488 (4 × 122) + 3,660 (30 × 122) 4,148

- We explored how composed units can be recorded when using the standard algorithm for multiplication.

$$\begin{array}{r} {\scriptstyle 2\ 1} \\ {\scriptstyle 3\ 2} \\ 875 \\ \times\quad 34 \\ \hline 3,500 \\ +\ 26,250 \\ \hline 29,750 \end{array}$$

Math tip: When you are multiplying using the standard algorithm and the second factor has 2 digits, the second partial product will always have a 0 in the ones place because you are multiplying by a number of tens.

Summary | Lesson 10

You can use different partial quotients to divide with multi-digit numbers. You can use your understanding of place value to choose 1 partial quotient for each place value in the dividend.

$$
\begin{array}{r|l}
24\overline{)7968} & \\
-7200 & 24 \times 300 \\
\hline
768 & \\
-\ 720 & 24 \times 30 \\
\hline
48 & \\
-\ 48 & 24 \times 2 \\
\hline
0 &
\end{array}
\qquad 300 + 30 + 2 = 332
$$

7,968 ÷ 24 = 332

Try This

1 Evaluate the expression 628 ÷ 4.

Show or explain your thinking.

answer: _____

Summary | Lesson 11

To determine a partial quotient, you can begin by asking yourself, "What is the place value of the quotient?" to help you determine the dividend for your first partial quotient.

$$
\begin{array}{r|l}
33\overline{)2046} & \\
-\ 990 & 33 \times 30 \\
\hline
1056 & \\
-\ 990 & 33 \times 30 \\
\hline
66 & \\
-\ 66 & 33 \times 2 \\
\hline
0 &
\end{array}
\qquad 30 + 30 + 2 = 62
$$

Try This

1 Washington, D.C. is about 68 square miles. Rhode Island is about 1,214 square miles. Which expression represents about how many times Washington, D.C. can fit inside Rhode Island?

(A) 1,200 ÷ 100

(B) 1,200 ÷ 60

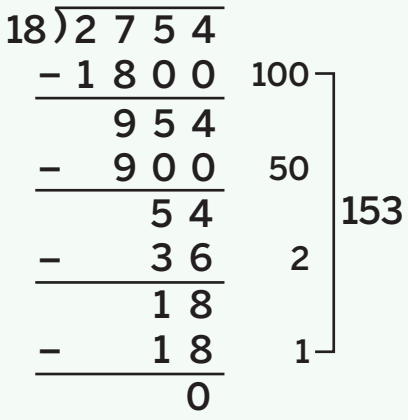
(C) 1,000 ÷ 1000

(D) 2,000 ÷ 60

2 Jada earns $15 an hour babysitting. She thinks she needs to babysit 3,850 hours to save $5,775 for her college fund. Do you agree with Jada? Why or why not?

Summary | Lesson 12

As you are determining your partial quotients, you might think about place value, estimation, doubling or halving, or using friendly numbers.



2,754 ÷ 18 = 153

Try This

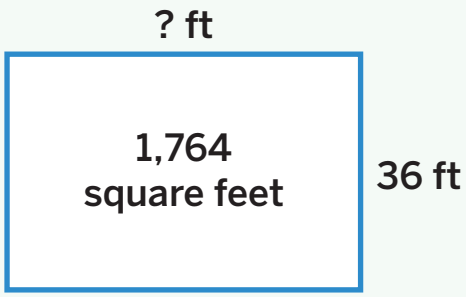
1 Evaluate the expression 4,221 ÷ 21 using partial quotients.

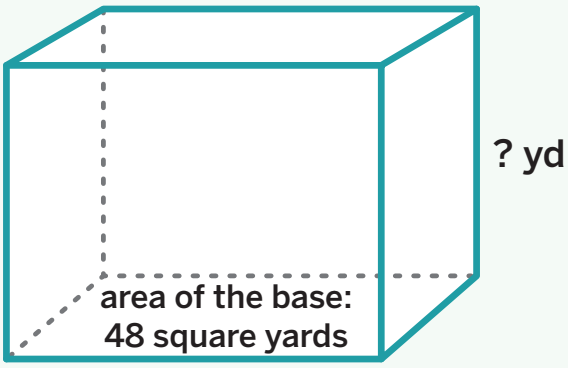
Show your thinking.

answer: _____

Summary | Lesson 13

You can use the relationship between multiplication and division to determine missing side lengths in area problems and missing edge lengths in volume problems.





V = 2,592 cubic yards

Try This

1 The area of a rectangular field is 8,320 square yards. The width is 65 yards. What is the length of the field in yards?

Show your thinking.

answer: _____

Summary | Lesson 14

You can use context to make sense of the answer to a division story problem. Sometimes, the answer might be a whole number, and sometimes, it might be a mixed number.

```
        6 ]
      2 0 ] 26
   ______
20 ) 5 2 5
   - 4 0 0
   -------
     1 2 5
   - 1 2 0
   -------
         5
```

A school bought 525 laptops, equally distributed them to 20 classrooms, and sent any remaining laptops to the library. How many laptops were sent to the library?

5 laptops

A pottery teacher has 525 ounces of clay and equally distributes the clay to 20 students. How many ounces of clay does each student receive?

$20\frac{5}{20}$ or $20\frac{1}{4}$ ounces

Try This

1 A farmer picks 485 quarts of blueberries and distributes them equally into 15 bushels. How many quarts of blueberries are in each bushel?

Show or explain your thinking.

answer: ______________________

Summary | Lesson 15

You can use context to make sense of the answer to a division story problem. Sometimes, you can distribute a remainder and make groups of different sizes.

$$1{,}089 \div 31 = 35\frac{4}{31}$$

$$31 \times 35 + 4 = 1{,}089$$

$$(1{,}089 - 4) \div 31 = 35$$

Try This

1 A school is building a new auditorium. They plan to have 1,252 seats with 24 seats in each row. How many rows of seats will there be?

Show your thinking.

answer: _____

Sub-Unit 2 | Summary

In this sub-unit . . .

- We divided multi-digit numbers using partial quotients strategies.

```
33)2046
 - 990      33 × 30  ┐
  1056               │
 - 990      33 × 30  ├  62
   66               │
 - 66       33 × 2   ┘
   0
```

2,046 ÷ 33 = 62

```
18)2754
 - 1800     100
   954
 - 900      50
   54
 - 36       2
   18
 - 18       1
   0
```

100 + 50 + 2 + 1 = 153

2,754 ÷ 18 = 153

Math tip: You can begin by asking yourself, "What is the place value of the quotient?" to help you determine a possible first partial quotient.

- We solved story problems that involved dividing with remainders. We interpreted answers using context from the problem.

Han is building a castle in his video game. He needs rows of 32 stones for one of the walls. He has 464 stones to build the wall. How many rows tall can Han make the wall?

```
32)464
 -320      10 × 32
  144
 -128      4 × 32
   16
```

answer: 14 rows

Summary | Lesson 16

Parentheses are grouping symbols that can be used in expressions and equations. They indicate what is evaluated first.

Context	Equation
A rectangular prism has a volume of 1,536 cubic feet. It has a width of 48 feet and a height of 2 feet. What is the length of the prism in feet?	$1{,}536 \div (48 \times 2) = 16$

Try This

Use the information for Problems 1 and 2.
A rectangular prism has a volume of 9,936 cubic centimeters. It has a width of 23 centimeters and a height of 4 centimeters.

1 What is the length of the prism in centimeters?

Show your thinking.

answer: _____

2 Write an equation to represent your work.

_____

Summary | Lesson 17

You can use grouping symbols, multiplication, division, addition, and subtraction to interpret and compare expressions without evaluating them.

$$2 \times (9 - 4) > 2 \times (9 - 5)$$

- Both expressions show 2 times an amount.
- 9 – 4 is greater than 9 – 5 because the distance between the numbers is greater.
- So, the value of 2 × (9 – 4) is greater.

Try This

For Problems 1–3, complete the comparison statement using <, >, or = without evaluating.

1 $2{,}010 - (563 \div 51)$ _____ $2{,}010 - (563 \div 15)$

2 $204 \div 12$ _____ $204 \div \left(\frac{1}{2} \times 24\right)$

3 $\frac{1}{100} \times 9{,}087$ _____ $9{,}087 \div \frac{1}{100}$

Summary | Lesson 18

Whole numbers can be represented as multiplication expressions using only prime factors. Because each expression involves only multiplication, parentheses are not necessary and the product will be the same no matter how the factors are ordered or grouped.

12	36
2×6	3×12
$2 \times 2 \times 3$	$3 \times 3 \times 4$
	$2 \times 2 \times 3 \times 3$

Try This

Represent the product as a multiplication expression using only its prime factors.

Show or explain your thinking.

1 product: 12

answer: _____

Sub-Unit 3 | Summary

In this sub-unit . . .

- We solved multi-step story problems and represented those story problems with equations that contained parentheses.

  Every month, a principal orders 848 pencils and equally shares them among the 16 classrooms in the school. If the principal does this every month for 11 months, how many total pencils does each classroom receive?

$$
\begin{array}{r}
\begin{array}{r} 3 \\ 1\ 0 \\ 4\ 0 \end{array}\ \Big] 53 \\
16\overline{)\,8\ 4\ 8} \\
-\ 6\ 4\ 0 \\
\hline
\quad 2\ 0\ 8 \\
-\ 1\ 6\ 0 \\
\hline
\quad\ \ 4\ 8 \\
-\quad 4\ 8 \\
\hline
\qquad\ \ 0
\end{array}
$$

$$11 \times (848 \div 16) = 583$$

Math tip: Parentheses are grouping symbols that indicate what to evaluate first.

- We interpreted and compared expressions without evaluating them.

$$3 \times (18{,}932 + 921) < (18{,}932 + 921) \times 5$$

The sum of the numbers in the parentheses is the same. 5 groups of that amount is greater than 3 groups of that amount.

Try This | Answer Key

Lesson 2

1 Sample response:

50 × 50
5 × 5 × 100
2,500

estimate: 2,500

Lesson 3

1

	900	30	7
20	18,000	600	140
5	4,500	150	35

Lesson 4

1

```
  74,193
×      5
---------
 350,000   70,000 × 5
  20,000   4,000 × 5
     500   100 × 5
     450   90 × 5
+     15   3 × 5
---------
 370,965
```

Lesson 5

1 Sample equation:

```
   323
×   32
-----
   646
+ 9,690
-----
 10,336
```

equation: 300 × 30 = 9,000
answer: 10,336

Lesson 6

1 Sample explanation:
Yes. There will be 2 thousands composed when 3 is multiplied by 7, which represents 30 times 70.

Lesson 7

1 B

Lesson 8

1

$$\begin{array}{r} {\scriptstyle 3\ \ \ } \\ {\scriptstyle 4\ \ \ } \\ 708 \\ \times\ \ 46 \\ \hline 4,248 \\ +\,28,320 \\ \hline 32,568 \end{array}$$

answer: 32,568

Lesson 9

1 B

Sample work:

$$\begin{array}{r} 661 \\ \times\ \ 25 \\ \hline 3{,}305 \\ +\,13{,}220 \\ \hline 16{,}525 \end{array}$$

Lesson 10

1 Sample work:

$$
\begin{array}{r}
208 \\
26\overline{)5408} \\
-5200 \\
\hline
208 \\
-\ 130 \\
\hline
78 \\
-\ 78 \\
\hline
0
\end{array}
\qquad
\begin{array}{l}
\\
26 \times 200 \\
\\
26 \times 5 \\
\\
26 \times 3 \\
\\
\end{array}
\qquad \Big\} 208
$$

answer: 208

Lesson 11

1 B

2 Sample explanation:
No. Jada needs to babysit 385 hours because 385 × 15 is $5,775.

Lesson 12

1 Sample work:

$$
\begin{array}{r}
\ 2\,0\,\overset{1}{0} \\
21\overline{)4221} \\
-4200 \\
\hline
21 \\
-\ 21 \\
\hline
0
\end{array}
\qquad \rceil 201
$$

answer: 201

Lesson 13

1 Sample work:

$$
\begin{array}{r}
65\overline{)8320} \\
-6500 \quad 65\times100 \\
\hline
1820 \\
-1300 \quad 65\times20 \\
\hline
520 \\
-\ 520 \quad 65\times8 \\
\hline
0
\end{array}
\qquad 128
$$

answer: 128 yards

Lesson 14

1 Sample work:

$$
\begin{array}{r}
2 \\
30 \\
15\overline{)485} \\
-450 \\
\hline
35 \\
-\ 30 \\
\hline
5
\end{array}
$$

answer: $32\frac{1}{3}$ quarts or equivalent

Lesson 15

1 Sample work:

$$
\begin{array}{r}
2 \\
50 \\
24\overline{)1252} \\
-1200 \\
\hline
52 \\
-\ 48 \\
\hline
4
\end{array}
$$

answer: 52 rows

Lesson 16

1 Sample work:

$4 \times 23 = 92$

$$\begin{array}{r} 100 \\ 92\overline{)9936} \\ -9200 \\ \hline 736 \\ -\ 736 \\ \hline 0 \end{array} \quad \begin{array}{l} \overset{8}{\rceil} 108 \end{array}$$

answer: 108 centimeters

2 Sample response:

$9{,}936 \div (4 \times 23) = 108$

Lesson 17

1 > **2** = **3** <

Lesson 18

1 The order of the factors in the expression may vary.

Sample work:

$2 \times 6 = 12$

$2 \times 2 \times 3 = 12$

answer: $2 \times 2 \times 3$