Introduction
This unit furthers understanding of multiplication of whole numbers using:
• pictures,
• mental math strategies,
• base ten models,
• expanded form,
• the standard algorithm, and
• estimation.

Meeting Your Curriculum

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Mental Math Minutes
The mental math minutes in this unit:
• use strategies to multiply single-digit numbers by multiples of 10 and 100
• practise doubling and halving

Generic BLMs
The Generic BLM used in this unit is:
BLM 1 cm Grid Paper (p. I-3)
This BLM can be found in Section I.
Assessment

The lessons covered by a quiz or test are as follows:

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Multiplying by Multiples of 10, 100, and 1000

Goals
Students will multiply by multiples of 10, 100, and 1000.

PRIOR KNOWLEDGE REQUIRED
Can use base ten materials to represent numbers
Can multiply single-digit numbers

MATERIALS
base ten blocks

Mental math minute—number talk. Present this problem: Double 169. (338)
The following strategies could arise:

\[ (2 \times 100) + (2 \times 60) + (2 \times 9) \]
\[ (2 \times 160) + (2 \times 9), (2 \times 170) - 2 \]

Multiplying one-digit numbers by 10. Give each student 9 ones blocks, 9 tens blocks, and 9 hundreds blocks. ASK: Which block is equal in value to 10 ones blocks? (1 tens block) Remind students:

\[ \begin{align*}
\square &= 1 \\
\begin{array}{c}
\text{\small \phantom{1}}
\end{array}&= 10 \\
\begin{array}{c}
\text{\small \phantom{1}}
\end{array}&= 100
\end{align*} \]

Ask students to take 4 ones blocks. Write on the board:

\[ 10 \times 4 = 10 \times \square \square \square \]

SAY: Since each ones block gets multiplied by 10, replace each ones block by a tens block. Continue writing on the board:

\[ 10 \times 4 = 10 \times \square \square \square = \square \square \square = 40 \]

**Exercises:** Use base ten blocks to model the multiplication. Multiply.

a) \[ 10 \times 3 \]  
b) \[ 6 \times 10 \]  
c) \[ 10 \times 9 \]  

**Answers:** a) 3 tens blocks, 30; b) 6 tens blocks, 60; c) 9 tens blocks, 90

For part b), you may have to remind students that \( 6 \times 10 = 10 \times 6 \). Write on the board:

\[ \begin{align*}
10 \times 3 &= 30 \\
10 \times 6 &= 60 \\
10 \times 9 &= 90
\end{align*} \]
ASK: What pattern is there when we multiply a one-digit number by 10? (the answer is the number with a 0 after it)

**Multiplying one-digit numbers by multiples of 10.** Draw on the board:

![Base ten blocks]

Explain that the straight lines represent tens blocks. ASK: How many groups are there? (4) How many tens are in each group? (5) What is 5 tens equal to? (50) What multiplication does this show? (4 × 50) Under the picture draw:

\[4 \times 50 = 4 \times 5 \text{ tens}\]

ASK: How many tens are there after we multiply by 4? (20) What number is 20 tens equal to? (200) Repeat for 3 × 40.

**Exercises:** Draw base ten blocks to represent the multiplication. Multiply.

a) 3 × 60  
   b) 7 × 30  
   c) 8 × 40

**Answers:**

a) 3 groups of 6 tens, 180; b) 7 groups of 3 tens, 210; c) 8 groups of 4 tens, 320

ASK: What shortcut can we use for multiplying a one-digit number by multiples of 10? (multiply the digits that aren’t 0, then write a 0 to the right of the number) If students are struggling for the answer, write on the board:

\[
\begin{align*}
3 \times 60 &= 180 \\
7 \times 30 &= 210 \\
8 \times 40 &= 320
\end{align*}
\]

**Multiplying 10 by multiples of 10.** Write on the board:

\[10 \times 30\]

ASK: How many tens are in 30? (3) Which block is the same as 10 tens blocks? (a hundreds block) Continue writing on the board:

\[10 \times 30 = 10 \times 3 \text{ hundreds} = 300\]

**Exercises:** Model using base ten blocks. Multiply.

a) 10 × 40  
   b) 80 × 10  
   c) 10 × 60

**Answers:**

a) 10 × 4 tens = 4 hundreds blocks, 400; b) 10 × 8 tens = 8 hundreds blocks, 800; c) 10 × 6 tens = 6 hundred blocks, 600
For part b), you may have to remind students that $80 \times 10 = 10 \times 80$.

ASK: What is a shortcut for multiplying a multiple of 10 by 10? (multiply the digits that are not zero, then write 2 zeros to the right of the answer)

If students are struggling for the answer, write on the board:

$10 \times 40 = 400$
$80 \times 10 = 800$
$10 \times 60 = 600$

**Multiplying 10 by multiples of 100.** Write on the board:

$10 \times 200$

ASK: How many hundreds are in 200? (2) What block is the same as 10 hundreds blocks? (a thousands block)

Draw on the board:

$10 \times 200 = 10 \times \boxed{200} = 2000$

Provide students with thousands blocks for the following exercises.

**Exercises:** Model using base ten blocks. Multiply.

a) $10 \times 800$

b) $10 \times 400$

c) $10 \times 500$

**Answers:**
a) $10 \times 8$ hundreds = 8 thousands, 8000;
b) $10 \times 4$ hundreds = 4 thousands, 4000;
c) $10 \times 5$ hundreds = 5 thousands, 5000

**Multiplying a multi-digit number by multiples of 10.** Write on the board:

$10 \times 3000$

ASK: How many thousands are in 3000? (3) What is 10 times 3? (30)

SAY: So there are 30 thousands blocks. Complete the multiplication sentence on the board:

$10 \times 3000 = 30000$

Write on the board:

$10 \times 14 = 140$
$100 \times 14 = 1400$
$1000 \times 14 = 14000$

Ask students if they see a pattern. SAY: When you multiply by 10, you write 1 zero to the right of the number, and when you multiply by 100, you write 2 zeros to the right of the number, and when you multiply by 1000, you write 3 zeros.
Exercises: Multiply.

a) $10 \times 14$

b) $100 \times 24$

c) $1000 \times 7$

d) $1000 \times 52$

e) $100 \times 67$

f) $1000 \times 43$

Bonus

g) $1000 \times 583$

h) $98 \times 1000$

Answers: a) 140, b) 2400, c) 7000, d) 52 000, e) 6700, f) 43 000, Bonus: g) 583 000, h) 98 000

Multiplying without blocks. Write on the board:

$30 \times 40 =$

ASK: How many tens are in 30? (3) How many tens are in 40? (4) How much is $3 \times 4$? (12) Write “12” on the board. SAY: There is a shortcut for answering multiplications in which both numbers end in zero, like 30 times 40. First, we multiply the digits that are not zero and write the answer down, so in this case 3 times 4 equals 12. Then we write all the zeros from the numbers being multiplied. In this example 30 and 40 have two zeros altogether, so we write two zeros after 12 and the answer is 1200. Finish writing “1200” on the board. Do another example, this time multiplying 500 times 50. (25 000)

Exercises: Multiply.

a) $20 \times 80$

b) $30 \times 50$

c) $50 \times 600$

Answers: a) 1600, b) 1500, c) 30 000

Identifying patterns when multiplying powers of 10. Write on the board:

$10 \times 10 = 100$

$10 \times 100 = 1000$

$10 \times 1000 = 10 000$

ASK: What do you notice about the total number of zeros in the answer of each equation compared to the total number of zeros in the question? (they are the same)

Write on the board:

$100 \times 1000$

ASK: How many zeros are in 100? (2) How many zeros are in 1000? (3) How many zeros are there in total? (5) What number starting with 1 has 5 zeros at the end? (100 000) SAY: So, $100 \times 1000 = 100 000$.

Exercises: Multiply.

a) $100 \times 100$

b) $1000 \times 100$

c) $10 000 \times 100$

d) $100 \times 100 000$

e) $1000 \times 1000$

f) $1 000 000 \times 100 000$
Answers: a) 10 000, b) 100 000, c) 1 000 000, d) 10 000 000, e) 1 000 000, f) 100 000 000 000

Extensions

1. Find the missing number.
   a) _____ × 200 = 60 000
   b) _____ × 400 = 80 000
   c) _____ × 1000 = 500 000
   **Bonus:** 400 × _____ = 2 400 000
   **Answers:** a) 300, b) 200, c) 500, Bonus: 6000

2. Find at least ten answers using multiples of 10 for each question.
   a) ________ × ________ = 40 000
   b) ________ × ________ = 120 000
   **Sample answers**
   a) 1 × 40 000, 5 × 8000, 8 × 5000, 4 × 10 000, 10 × 4000, 50 × 800, 80 × 500, 100 × 400, 200 × 200, 250 × 160
   b) 1 × 120 000, 2 × 60 000, 3 × 40 000, 4 × 30 000, 5 × 24 000, 6 × 20 000, 8 × 15 000, 10 × 12 000, 12 × 10 000, 15 × 8000, 20 × 6000, 24 × 5000, 25 × 4800, 30 × 4000, 40 × 3000, 48 × 2500, 50 × 2400, 60 × 2000, 80 × 1500, 100 × 1200, 120 × 1000, 150 × 800, 200 × 600, 240 × 500, 250 × 480, 300 × 400

3. How many dimes are in the dollar amount?
   a) $4 b) $100 c) $10 000
   **Answers:** a) 40, b) 1000, c) 100 000

4. Write the number in expanded form.
   a) 45 321 b) 1 052 670
   **Answers:** a) (4 × 10 000) + (5 × 1000) + (3 × 100) + (2 × 10) + (1 × 1), b) (1 × 1 000 000) + (5 × 10 000) + (2 × 1000) + (6 × 100) + (7 × 10)

5. Circle the correct answer.
   (500 × 300) + 300 = 600 × 300 (500 × 300) + 300 = 501 × 300
   (500 × 300) + 300 = 500 × 600
   **Answer:** (500 × 300) + 300 = 501 × 300
Goals
Students will use doubles and doubling and halving to multiply.

PRIOR KNOWLEDGE REQUIRED
Can double one-digit numbers
Can represent a two-digit number as the sum of tens and ones

MATERIALS
BLM Doubling and Halving (p. D-59)
BLM Using Triples to Multiply (p. D-60, see Extension 4)

Mental math minute. Have students skip count by tens, hundreds, or thousands within 10 000 starting at different numbers.

Using doubles to multiply. SAY: We know that 2 × 6 is 12. ASK: What is 4 × 6? (24) Point out that 4 is double 2, so 4 sixes is double 2 sixes. Write on the board:

3 × 7 is _____ 4 × 8 is _____
So 6 × 7 is _____  So 8 × 8 is _____

Have volunteers answer each question successively. (21, 42, 32, 64)
Point out that the first number in the multiplication, in these examples 3 and 4, doubles each time, so the product doubles as well. Whenever either number in the multiplication expression doubles, so does the product.

Review doubling two-digit numbers with a ones digit less than 5.
Remind students that they can double two-digit numbers by doubling the digits separately. Write on the board:

double 23 = double 20 + double 3

double 23 = 40 + 6

double 23 = 46

Exercises: Double the number.
a) 32 b) 41 c) 13 d) 24 e) 52 f) 34 g) 63 h) 54

Answers: a) 64, b) 82, c) 26, d) 48, e) 104, f) 68, g) 126, h) 108

Doubling two-digit numbers with a ones digit of 5 or more. SAY: When the ones digit is 5 or more, regrouping is required. Write on the board:

36 = 30 + 6

So the double of 36 is _____ + _____ = _____
To fill in the blanks, ASK: What is double 30? (60) What is double 6? (12)
So, what is double 36? (60 + 12 = 72) Write on the board:

\[
\begin{align*}
3 \times 9 & \text{ is } \underline{27} \\
\text{So } 6 \times 9 & \text{ is } \underline{54} \\
\text{So } 12 \times 9 & \text{ is } \underline{108} \\
\text{So } 24 \times 9 & \text{ is } \underline{216}
\end{align*}
\]

Have volunteers answer each question successively. (27, 54, 108, 216)

**Exercises:** Use doubling to solve the problem.

a) \(8 \times 3 \text{ is } \underline{24}, \text{ so } 16 \times 3 \text{ is } \underline{48}\)

b) \(4 \times 9 \text{ is } \underline{36}, \text{ so } 8 \times 9 \text{ is } \underline{72}\)

c) \(3 \times 9 \text{ is } \underline{27}, \text{ so } 3 \times 18 \text{ is } \underline{54}\)

**Bonus**

\(2 \times 13 \text{ is } \underline{26}, \text{ so } 4 \times 13 \text{ is } \underline{52}, \text{ so } 8 \times 13 \text{ is } \underline{104}, \text{ so } 16 \times 13 \text{ is } \underline{208}\)

**Answers:** a) 24, 48; b) 36, 72; c) 27, 54; Bonus: 26, 52, 104, 208

**Multiplying using pairs that make multiples of 10.** Write on the board:

\(5 \times 16 \times 2\)

SAY: It is not straightforward to multiply \(5 \times 16\) and then double it, but there is a method that makes this question easier. Reorder the numbers and write on the board:

\(5 \times 2 \times 16\)

ASK: What is \(5 \times 2\)? (10) What is \(10 \times 16\)? (160) Write “= 160” on the board. SAY: Sometimes you can find pairs that make a multiple of 10, like 20. ASK: What pairs multiply to make 20? (4 and 5, 2 and 10) Explain to students that the pair 2 and 10 already has 10 in it. Write on the board:

\[4 \times 23 \times 5\]

Reorder the numbers and continue writing on the board:

\[4 \times 23 \times 5 = 4 \times 5 \times 23\]

ASK: What is \(4 \times 5\)? (20) Ask a volunteer to find \(20 \times 23\). (460)

**Exercises:** Multiply by finding a multiple of 10.

a) \(5 \times 25 \times 2\)  

b) \(4 \times 34 \times 5\)  

c) \(2 \times 97 \times 5\)  

d) \(5 \times 52 \times 6\)

**Answers:** a) 250, b) 680, c) 970, d) 1560

**Using doubling and halving to find the product.** Give each student two arrays from BLM Doubling and Halving. Challenge them to move some of the dots in the array on the right so there are 2 rows of 12 by crossing out and redrawing dots, as shown on the following page.
ASK: Did moving some dots change how many there are? (no) Write on the board:

\[ 4 \times 6 = 2 \times 12 \]

Have students find a different product that also equals \(4 \times 6\) by moving the dots in a different way. \((4 \times 6 = 8 \times 3)\)

Draw an array with 5 rows of 6 dots. ASK: If I double the number of rows what do I have to do to the number of columns to keep the total number of dots the same? (cross out half of them)

**Exercises:** Double the first number and halve the second number to find an equal product. Use the new product to multiply.

a) \(12 \times 20\)  b) \(15 \times 6\)  c) \(23 \times 20\)  d) \(27 \times 4\)

**Bonus:** \(50 \times 28\)

**Answers:** a) \(24 \times 10 = 240\), b) \(30 \times 3 = 90\), c) \(46 \times 10 = 460\), d) \(54 \times 2 = 108\), Bonus: \(100 \times 14 = 1400\)

**Extensions**

1. Fill in the missing number.

   a) \(4 \times 6 \times 12 = \ldots \times 12 \times 12\)
   
   b) \(9 \times 4 \times 12 = \ldots \times 12 \times 12\)
   
   c) \(25 \times 7 \times 35 = \ldots \times 35 \times 35\)
   
   d) \(36 \times 8 \times 48 = \ldots \times 48 \times 48\)
   
   e) \(49 \times 2 \times 14 = \ldots \times 14 \times 14\)

   **Bonus:** \(100 \times 510 \times 5100 = \ldots \times 5100 \times 5100\)

   **Answers:** a) 2, b) 3, c) 5, d) 6, e) 7, Bonus: 10

2. Multiply by finding and then adding all the pairs of numbers that add to 10. Hint: The brackets mean find all pairs that add to 10 before multiplying.

   a) \(70 \times (2 + 1 + 8 + 9)\)
   
   b) \(120 \times (3 + 4 + 5 + 6 + 7)\)

   **Bonus:** \(2300 \times (8 + 3 + 1 + 7 + 6 + 2 + 9 + 4)\)
Answers

a) \(70 \times (2 + 8 + 1 + 9) = 70 \times (10 + 10) = 70 \times 20 = 1400\)
b) \(120 \times (3 + 7 + 4 + 6 + 5 + 5) = 120 \times (10 + 10 + 10) = 120 \times 30 = 3600\)

Bonus: \(2300 \times (8 + 2 + 3 + 7 + 1 + 9 + 6 + 4) = 2300 \times (10 + 10 + 10) = 2300 \times 40 = 92000\)

3. Multiply by finding and then multiplying all the pairs of numbers that multiply to multiples of 10.

a) \(3 \times (2 \times 4 \times 5 \times 5)\)
b) \(2 \times (2 \times 3 \times 5 \times 10)\)

Bonus: \(45 \times (4 \times 4 \times 5 \times 25)\)

Answers

a) \(3 \times (2 \times 5 \times 4 \times 5) = 3 \times (10 \times 20) = 3 \times 200 = 600\)
b) \(2 \times (2 \times 5 \times 3 \times 10) = 2 \times (10 \times 30) = 5 \times 300 = 1500\)

Bonus: \(45 \times (4 \times 5 \times 4 \times 25) = 45 \times (20 \times 100) = 45 \times 2000 = 90000\)

4. Teach students to use triples to multiply. For example, \(3 \times 7\) is 21 and 9 sevens is triple 3 sevens, so 9 sevens is 63. Have students complete BLM Using Triples to Multiply.

Answers: 1. a) 6, b) 9, c) 15; 2. a) 69, b) 96, c) 93, d) 126, e) 159, f) 123, Bonus: 639966396; 3. a) 10 + 7, 30 + 21 = 51, b) 20 + 6, 60 + 18 = 78, d) 60 + 24 = 84, e) 90 + 12 = 102, f) 150 + 27 = 177, Bonus: 12000 + 900 + 60 + 18 = 12978; 4. a) 8, 24; b) 10, 30; c) 12, 36; d) 18, 54; e) 24, 72; f) 16, 48; 5. a) 21, 63; b) 24, 72; c) 36, 108
**Arrays and Multiplication**

**Goals**
Students will write a product with or without an array using the distributive property.

**PRIOR KNOWLEDGE REQUIRED**
- Can write a product for a given array
- Can add multi-digit numbers
- Can multiply a single-digit number by a multiple of 10 or 100
- Can express numbers in expanded form

**Mental math minute.** Have students multiply one-digit numbers by multiples of 10. Write a list of one-digit numbers and a single multiple of 10 on the board, for example, 6, 9, 5, 3, 7, 8 and 60. The first student multiplies $6 \times 60 = 360$; the next student multiplies $9 \times 60 = 540$. After all the one-digit numbers have been multiplied by 60, repeat with a new multiple of 10.

**Using the distributive property to write a product for an array.** Draw a 3 by 14 grid on the board:

```
  3 x 14
```

ASK: What is a product that represents this array of squares? ($3 \times 14$)
Shade the last 4 columns of the array and continue drawing on the board:

```
  3 x 14
```

ASK: What products should we write for the unshaded part and the shaded part of the array? ($3 \times 10$ and $3 \times 4$) Did the total number of squares change? (no) So what can we say about the relationship between expressions $3 \times 14$ and $(3 \times 10) + (3 \times 4)$? (they are equal) Write on the board:

$$3 \times 14 = (3 \times 10) + (3 \times 4)$$

**Exercises:** Write a product for the entire diagram, the unshaded part, and the shaded part. Then write an equation for the diagram.

a) 

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```

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**CURRICULUM REQUIREMENT**
- AB: required
- BC: required
- MB: required
- ON: required

**VOCABULARY**
- array
- expanded form
- product
b) Answers: a) \(4 \times 13, 4 \times 10, 4 \times 3, 4 \times 13 = (4 \times 10) + (4 \times 3)\); b) \(5 \times 26, 5 \times 20, 5 \times 6, 5 \times 26 = (5 \times 20) + (5 \times 6)\)

SAY: We don’t have to draw all the squares. Draw on the board:

Instead of We draw

Exercises: Write a product for the entire diagram, the unshaded part, and the shaded part. Then write an equation for the diagram.

a)

\[6 \times 12, 6 \times 10, 6 \times 2, 6 \times 12 = (6 \times 10) + (6 \times 2)\]

b)

\[5 \times 23, 5 \times 20, 5 \times 3, 5 \times 23 = (5 \times 20) + (5 \times 3)\]

Using the distributive property to write a product without using an array. SAY: Let’s look at the answers from our last two exercises. Write on the board:

\[6 \times 12 = (6 \times 10) + (6 \times 2)\]
\[5 \times 23 = (5 \times 20) + (5 \times 3)\]

ASK: What pattern do you see in how the right side of the equation was created? (the first number is shared in each bracket; the second number is broken into a multiple of 10 and a one-digit number) If students have difficulty seeing the pattern, write on the board:

\[6 \times \boxed{12} = (6 \times \boxed{10}) + (6 \times \boxed{2})\]
\[5 \times \boxed{23} = (5 \times \boxed{20}) + (5 \times \boxed{3})\]
SAY: The products 6 × 12 and 5 × 23 are now in expanded form. Point to 6 × 12 and ASK: What is 6 × 10? (60) What is 6 × 2? (12) What is 60 + 12? (72)

Continue writing on the board:

\[ 6 \times 12 = (6 \times 10) + (6 \times 2) = 60 + 12 = 72 \]

Have students calculate 5 × 23 the same way. (5 × 23 = (5 × 20) + (5 × 3) = 100 + 15 = 115)

**Exercises:** Rewrite the product in expanded form. Solve.

a) 6 × 53  
  b) 7 × 64  
  c) 9 × 45

**Answers**

a) 6 × 53 = (6 × 50) + (6 × 3) = 300 + 18 = 318
b) 7 × 64 = (7 × 60) + (7 × 4) = 420 + 28 = 448
c) 9 × 45 = (9 × 40) + (9 × 5) = 360 + 45 = 405

**Bonus:** Write the product as a sum of three products and then solve.

a) 7 × 125  
  b) 5 × 348  
  c) 4 × 875  
  d) 9 × 686  
  e) 3 × 953

**Answers**

a) 7 × 125 = (7 × 100) + (7 × 20) + (7 × 5) = 700 + 140 + 35 = 875
b) 5 × 348 = (5 × 300) + (5 × 40) + (5 × 8) = 1500 + 200 + 40 = 1740
c) 4 × 875 = (4 × 800) + (4 × 70) + (4 × 5) = 3200 + 280 + 20 = 3500
d) 9 × 686 = (9 × 600) + (9 × 80) + (9 × 6) = 5400 + 720 + 54 = 6174
e) 3 × 953 = (3 × 900) + (3 × 50) + (3 × 3) = 2700 + 150 + 9 = 2859

**Applying multiplication.** Write on the board:

The dimensions of a hallway are shown. Write a product in expanded form and solve.

\[
3 \times 34
\]

Work through the problem as a class. The solution should look like this:

\[
3 \times 34 = (3 \times 30) + (3 \times 4) = 90 + 12 = 102
\]

Repeat with a cricket pitch with dimensions 3 by 22, a driveway with dimensions 5 by 13, and an aisle in a theatre with dimensions 4 by 53. Draw the three rectangles with their dimensions on the board and have students work through the solution on their own. (66, 65, 212)
Extensions

1. Fill in the missing information.
   a) \[ \underline{\phantom{1000}} \times 5 = (5 \times \underline{\phantom{0}}) + (5 \times \underline{\phantom{0}}) \]
      \[ \underline{\phantom{100}} = 350 + 10 \]
      \[ \underline{\phantom{100}} = \underline{\phantom{0}} \]
   
   b) \[ \underline{\phantom{100}} \times 4 = (\underline{\phantom{0}} \times 80) + (\underline{\phantom{0}} \times 1) \]
      \[ \underline{\phantom{100}} = \underline{\phantom{0}} + 4 \]
      \[ \underline{\phantom{100}} = \underline{\phantom{0}} \]

   c) \[ \underline{\phantom{100}} \times \underline{\phantom{0}} = (\underline{\phantom{0}} \times \underline{\phantom{0}}) + (2 \times \underline{\phantom{0}}) \]
      \[ \underline{\phantom{100}} = 140 + 8 \]
      \[ \underline{\phantom{100}} = \underline{\phantom{0}} \]

   Answers: a) 72 \times 5 = 360, b) 81 \times 4 = 324, c) 74 \times 2 = 148

2. Fill in the missing digits.
   a) \[ \underline{\phantom{100}} \times 4 = 2\underline{\phantom{0}}0 \]
   b) \[ \underline{\phantom{100}} \times 7 = 5\underline{\phantom{0}}0 \]
   c) \[ \underline{\phantom{100}} \times 9 = 7\underline{\phantom{0}}0 \]

   Answers
   a) \[ 7\underline{\phantom{0}} \times 4 = 2\underline{\phantom{0}}0 \]
   b) \[ 8\underline{\phantom{0}} \times 7 = 5\underline{\phantom{0}}0 \]
   c) \[ 3\underline{\phantom{0}} \times 9 = 2\underline{\phantom{0}}0 \]
**NS5-18 The Standard Method for Multiplication**

**Pages 60–61**

**CURRICULUM REQUIREMENT**

AB: required  
BC: required  
MB: required  
ON: required

**VOCABULARY**

product  
regrouping

---

**Goals**

Students will use the standard algorithm to multiply two-digit numbers by one-digit numbers.

**PRIOR KNOWLEDGE REQUIRED**

Can multiply one-digit numbers by one-digit numbers  
Can group ones into tens

**MATERIALS**

grid paper or BLM 1 cm Grid Paper (p. I-3)

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**Mental math minute.** Have students multiply one-digit numbers by multiples of 100. Write a list of one-digit numbers and a single multiple of 100 on the board, for example, 6, 9, 5, 3, 7, 8 and 300. The first student multiplies $6 \times 300 = 1800$; the next student multiplies $9 \times 300 = 2700$. After all the one-digit numbers have been multiplied by 300, repeat with a new multiple of 100.

**Review the standard algorithm for multiplication without regrouping ones.** Write on the board:

$$
\begin{array}{c}
4 & 2 \\
\times & 3 \\
\hline
1 & 2 & 6 \\
\end{array}
$$

Point to the 6 and ASK: Where does this six come from? (multiplying $3 \times 2$)

Point to the 12 and ASK: Where does the 12 come from? (multiplying $3 \times 4$)

As a class repeat with $53 \times 3$ using a grid. Provide students with grid paper or BLM 1 cm Grid Paper for the following exercises.

**Exercises:** Write the multiplication on grid paper. Find the product.

a) $41 \times 2$  
b) $23 \times 3$  
c) $51 \times 5$

**Answers:** a) 82, b) 69, c) 255

**Review regrouping.** Draw base ten models with up to 9 tens and more than 10 ones and have students practise trading 10 ones blocks for a tens block. They should draw models to record their trades in their notebooks. Example:

4 tens + 19 ones  

\[\rightarrow\]

5 tens + 9 ones
Review the standard algorithm for multiplication with regrouping. Write on the board:

\[
\begin{array}{c}
3 \\
4 5 \\
\times \\
7 \\
\hline \\
5
\end{array}
\]

ASK: What is \(7 \times 5\)? (35) How many of those 35 ones can we regroup? (30) How many ones are left over? (5) Point to the 3 and ASK: What does this 3 stand for? (3 tens) Point to the 5 at the bottom and ASK: What does this 5 stand for? (the 5 ones that are left after 30 have been regrouped) SAY: We multiplied the ones digits, 7 and 5, and we grouped as many ones as we could. Leave the diagram on the board.

**Exercises:** Using grid paper, multiply the ones digits and regroup.

a) \(34 \times 3\)  
b) \(68 \times 2\)  
c) \(27 \times 3\)  
d) \(45 \times 3\)  

**Bonus:** \(78 \times 4\)

**Answers**

a) 
\[
\begin{array}{c}
3 \\
4 \\
\times \\
3 \\
\hline \\
2
\end{array}
\]

b) 
\[
\begin{array}{c}
6 \\
8 \\
\times \\
2 \\
\hline \\
6
\end{array}
\]

c) 
\[
\begin{array}{c}
2 \\
7 \\
\times \\
3 \\
\hline \\
1
\end{array}
\]

d) 
\[
\begin{array}{c}
4 \\
5 \\
\times \\
3 \\
\hline \\
5
\end{array}
\]

**Bonus**

\[
\begin{array}{c}
3 \\
7 \\
8 \\
\times \\
4 \\
\hline \\
2
\end{array}
\]

Refer to the diagram on the board and SAY: This shows that the ones digits have been multiplied: 30 of them are being regrouped as 3 tens and 5 are left. ASK: What is \(7 \times 4\) tens? (28 tens) SAY: So now we have 28 tens plus 3 more tens that we regrouped. ASK: How many tens is 28 tens plus 3 tens? (31 tens) The completed multiplication should look like this:
Exercises

1. Using grid paper, complete the multiplication. The ones have already been multiplied.

   a) \[
   \begin{array}{c}
   1 \\
   \hline
   3 & 4 \\
   \hline
   \times & 3 \\
   \hline
   2 \\
   \end{array}
   \]

   b) \[
   \begin{array}{c}
   1 \\
   \hline
   6 & 8 \\
   \hline
   \times & 2 \\
   \hline
   6 \\
   \end{array}
   \]

   c) \[
   \begin{array}{c}
   2 \\
   \hline
   2 & 7 \\
   \hline
   \times & 3 \\
   \hline
   1 \\
   \end{array}
   \]

   d) \[
   \begin{array}{c}
   1 \\
   \hline
   4 & 5 \\
   \hline
   \times & 3 \\
   \hline
   5 \\
   \end{array}
   \]

   Bonus: \[
   \begin{array}{c}
   3 \\
   \hline
   7 & 8 \\
   \hline
   \times & 4 \\
   \hline
   2 \\
   \end{array}
   \]

   Answers: a) 102, b) 136, c) 81, d) 135, Bonus: 312

2. Complete all steps of the multiplication using grid paper.

   a) \[
   29 \times 5
   \]

   b) \[
   16 \times 7
   \]

   c) \[
   46 \times 5
   \]

   d) \[
   54 \times 6
   \]

   Bonus: \[
   86 \times 3
   \]

   Answers

   a) \[
   \begin{array}{c}
   4 \\
   \hline
   2 & 9 \\
   \hline
   \times & 5 \\
   \hline
   1 & 4 & 5 \\
   \end{array}
   \]

   b) \[
   \begin{array}{c}
   4 \\
   \hline
   1 & 6 \\
   \hline
   \times & 7 \\
   \hline
   1 & 1 & 2 \\
   \end{array}
   \]

   c) \[
   \begin{array}{c}
   3 \\
   \hline
   4 & 6 \\
   \hline
   \times & 5 \\
   \hline
   2 & 3 & 0 \\
   \end{array}
   \]

   d) \[
   \begin{array}{c}
   2 \\
   \hline
   5 & 4 \\
   \hline
   \times & 6 \\
   \hline
   3 & 2 & 4 \\
   \end{array}
   \]

   Bonus

   \[
   \begin{array}{c}
   8 \\
   \hline
   6 \\
   \hline
   \times & 3 \\
   \hline
   2 & 5 & 8 \\
   \end{array}
   \]

   

   Extensions

   1. Draw five different rectangles with dimensions so that the product of the length and width equals 120.

   Answers: \(1 \times 120, 2 \times 60, 3 \times 40, 4 \times 30, 6 \times 20\)
2. All 15 multiplications below are equal to 720. Twelve of them can be grouped into six pairs because of a feature they have. This feature makes the pairing possible. Three cannot be paired up because they do not have this feature.

\[
\begin{align*}
1 \times 720 & \quad 2 \times 360 & \quad 3 \times 260 & \quad 4 \times 180 & \quad 5 \times 144 \\
6 \times 120 & \quad 8 \times 90 & \quad 10 \times 72 & \quad 15 \times 48 & \quad 16 \times 45 \\
20 \times 36 & \quad 30 \times 26 & \quad 40 \times 18 & \quad 60 \times 12 & \quad 80 \times 9
\end{align*}
\]

a) Which 12 multiplications can be paired up?

b) What do the 12 multiplications have in common?

c) What is the strategy for pairing them up?

d) Which three multiplications cannot be paired up?

**Answers**

a) 1 \times 720 and 10 \times 72, 2 \times 360 and 20 \times 36, 3 \times 260 and 30 \times 26, 4 \times 180 and 40 \times 18, 6 \times 120 and 60 \times 12, 8 \times 90 and 80 \times 9

b) one of the numbers is divisible by 10

c) multiply one number by 10 and divide the other number by 10. For example, in 1 \times 720 if you multiply 1 by 10 and divide 720 by 10 you get its pair which is 10 \times 72

d) 5 \times 144, 15 \times 48, 16 \times 45
 Goals
Students will multiply a multi-digit number by a one-digit number using the standard algorithm.

 PRIOR KNOWLEDGE REQUIRED
Can multiply a two-digit number by a one-digit number using the standard algorithm

 MATERIALS
base ten materials
BLM Circle Magic (p. D-61, see Extension 6)

 Mental math minute. Remind students that they can double twice to multiply by 4 and double three times to multiply by 8. For example: to multiply 4 \times 6, do 2 \times 6 = 12, then do 2 \times 12 = 24. Then you can double 24 to get 8 \times 6 = 64. Remind students also that order does not matter in multiplication, so they can find an answer to 9 \times 4 by doubling 9 twice. Ask students multiplication questions where one of the factors is 4 or 8; for example, 7 \times 4.

 Using expanded form to multiply a 3-digit number by a 1-digit number without regrouping. Tell students you want to multiply 423 \times 2.
ASK: How can we write 423 in expanded form? (4 hundreds + 2 tens + 3 ones) Write on the board:

\[
\begin{align*}
4 \text{ hundreds} &+ 2 \text{ tens} + 3 \text{ ones} \\
\times 2 & \\
8 \text{ hundreds} &+ 4 \text{ tens} + 6 \text{ ones}
\end{align*}
\]
ASK: What is 4 hundreds \times 2? (8 hundreds) What is 2 tens \times 2? (4 tens) What is 3 ones \times 2? (6 ones) What is the product? (846)

 Using base ten materials to multiply a 3-digit number by a 1-digit number without regrouping. Draw on the board:

\[
\begin{align*}
423 & \times 2 \\
\end{align*}
\]
ASK: How many hundreds are there altogether? (8) How many tens are there altogether? (4) How many ones are there altogether? (6) What is the product? (846)

**Using the standard algorithm to multiply a 3-digit number by a 1-digit number without regrouping.** Write on the board:

```
  4 2 3
× 2
---
  8 4 6
```

ASK: What is $3 \times 2$? (6) What is $2 \times 2$? (4) What is $4 \times 2$? (8) SAY: So $423 \times 2 = 846$.

**Using expanded form to multiply a 3-digit number by a 1-digit number with regrouping.** SAY: Sometimes regrouping may be involved. Write on the board:

```
467
× 2
---

4 hundreds + 6 tens + 7 ones
× 2
8 hundreds + 12 tens + 14 ones
```

ASK: What is $4$ hundreds $\times 2$? (8 hundreds) What is $6$ tens $\times 2$? (12 tens) What is $7$ ones $\times 2$? (14 ones) Write on the board:

```
8 hundreds + 12 tens + 14 ones
= 8 hundreds + (___ hundred + ___ tens) + (___ ten + ___ ones)
```

Ask a volunteer to come up to fill in the blanks. (1, 2, 1, 4) Write on the board:

```
= ___ hundreds + ___ tens + ___ ones
```

Ask another volunteer to gather up the hundreds, tens, and ones to fill in the blanks. (9, 3, 4) Write the answer on the board:

```
= 934
```

**Using base ten materials to multiply a 3-digit number by a 1-digit number with regrouping.** Draw on the board:

```
467
× 2
---
```

Number Sense 5-19
ASK: How many hundreds are there altogether? (8) How many tens are there altogether? (12) How many ones are there altogether? (14) SAY: If we exchange 10 ones for a tens block, and 10 tens for a hundreds block, the diagram will look like this. Draw on the board:

\[
\begin{array}{c}
\text{12 tens} \\
\text{become} \\
\text{1 hundred} \\
\text{+ 2 tens}
\end{array} \\
\begin{array}{c}
\text{14 ones} \\
\text{become} \\
\text{1 ten} \\
\text{+ 4 ones}
\end{array}
\]

ASK: How many hundreds are there altogether? (9) How many tens are there altogether? (3) How many ones are there altogether? (4) What is the final product? (934)

**Using the standard algorithm to multiply a 3-digit number by a 1-digit number with regrouping.** Write on the board, without the top row filled in:

\[
\begin{array}{c}
\text{1} \\
\text{4 6 7} \\
\times \\
\text{2}
\end{array} \\
\begin{array}{c}
\text{3 4}
\end{array}
\]

ASK: What is \(7 \times 2\)? (14) How do we write 14 in expanded form? (1 ten + 4 ones) SAY: We write the 1 ten in the row above the grid, and we write the 4 in the ones column in the bottom row of the grid. As you fill in the numbers, ask students what each number represents and add their answer to the algorithm as shown below:

\[
\begin{array}{c}
\text{1 hundred} \\
\text{4 6 7} \\
\times \\
\text{2}
\end{array} \\
\begin{array}{c}
\text{1 ten} \\
\text{3 tens} \\
\text{3 4}
\end{array}
\]

ASK: What are 6 tens \(\times 2\)? (12 tens) SAY: But we have 1 ten from multiplying 7 \(\times 2\), so we really have 13 tens altogether. ASK: How do we write 13 tens in expanded form? (1 hundred + 3 tens) SAY: So we write the 3 in the tens column in the bottom row, and we write the 1 in the hundreds column in the row above the grid.

\[
\begin{array}{c}
\text{1} \\
\text{1} \\
\text{4 6 7} \\
\times \\
\text{2}
\end{array} \\
\begin{array}{c}
\text{1} \\
\text{3}
\end{array}
\]
ASK: What is 4 hundreds \( \times 2 \)? (8 hundreds)  SAY: But we have 1 hundred from multiplying 6 tens \( \times 2 \), so really we have 9 hundreds. Write “9” in the hundreds column in the bottom row of the grid.

Together, solve the following:

- problems that require regrouping ones to tens  
  (examples: 219 \( \times 3 \), 312 \( \times 8 \), 827 \( \times 2 \))
- problems that require regrouping tens to hundreds  
  (examples: 391 \( \times 4 \), 282 \( \times 4 \), 172 \( \times 3 \))
- problems that require regrouping both ones and tens  
  (examples: 479 \( \times 2 \), 164 \( \times 5 \), 129 \( \times 4 \))

Have students solve additional problems in their notebooks.

**Exercises:** Use base ten materials, expanded form, and the standard algorithm to solve the problem.

a) 112 \( \times 5 \)  b) 321 \( \times 8 \)  c) 215 \( \times 7 \)  d) 312 \( \times 9 \)

**Answers:** a) 560, b) 2568, c) 1505, d) 2808

Tell students to be sure that they get the same answer all three ways. If they do not, they should check their work to find the mistake.

**Bonus:** Find the product.

a) 2456 \( \times 3 \)  b) 5 234 562 \( \times 7 \)

**Answers:** a) 7368, b) 36 641 934

**Exploring the special case in which the 3-digit number has a 0 digit.**

Write on the board:

\[
\begin{array}{c|c|c}
3 & 0 & 6 \\
\hline
\times & 9 & \\
\hline
2 & 7 & 5 & 4 \\
\end{array}
\]

Describe each step of the process, pointing to each digit as you say it:

- 6 ones \( \times 9 \) is 54 ones, so that’s 5 tens and 4 ones
- 0 tens \( \times 9 \) is 0 tens, then add the 5 tens
- 3 hundreds \( \times 9 \) is 27 hundreds, so that’s 2 thousands and 7 hundreds

**Exercises:** Find the product.

a) 406 \( \times 9 \)  b) 460 \( \times 8 \)  c) 807 \( \times 6 \)  d) 870 \( \times 5 \)  e) 708 \( \times 3 \)

**Bonus:** 12 009 \( \times 7 \)

**Answers:** a) 3654, b) 3680, c) 4842, d) 4350, e) 2124, Bonus: 84 063

**NOTE:** Extension 1 is required to cover the Manitoba curriculum.
Extensions

1. a) Find the product using expanded form.
   
   i) \(3125 \times 4\)  
   ii) \(1828 \times 3\)  
   iii) \(6742 \times 6\)  
   iv) \(5297 \times 4\)

   **Bonus:** \(46913 \times 5\)

   b) Find the products from part a) using a grid.

   **Answers**
   
   a) i) \((4 \times 3000) + (4 \times 100) + (4 \times 20) + (4 \times 5) = 12000 + 400 + 80 + 20 = 12500\)
   
   ii) \((3 \times 1000) + (3 \times 800) + (3 \times 20) + (3 \times 8) = 3000 + 2400 + 60 + 24 = 5484\)
   
   iii) \((6 \times 6000) + (6 \times 700) + (6 \times 40) + (6 \times 2) = 36000 + 4200 + 240 + 12 = 40452\)
   
   iv) \((4 \times 5000) + (4 \times 200) + (4 \times 90) + (4 \times 7) = 20000 + 800 + 360 + 28 = 21188\)

   **Bonus:** \((5 \times 40000) + (5 \times 6000) + (5 \times 900) + (5 \times 10) + (5 \times 3) = 200000 + 30000 + 4500 + 50 + 15 = 234565\)

   b) 
   
   i)  
   
   ii)  
   
   iii)  
   
   iv)  

   **Bonus**
   
   2. Using only the digits 2, 3, 4, and 6, find the greatest product that can be made by multiplying a 3-digit number by a 1-digit number.

   **Answer:** 2592

3. Using only the digits 4, 5, 6, and 9, find the least product that can be made by multiplying a 3-digit number by a 1-digit number.

   **Answer:** 2276

4. What is the greatest product possible when multiplying a 3-digit number by a 1-digit number?

   **Answer:** \(999 \times 9 = 8991\)
5. Try the following number trick with a friend.
   a) Pick a number from 1 to 9.
   b) Multiply your number by 100.
   c) Add 3 to your answer.
   d) Multiply your answer by 6.
   e) Subtract 18.
   f) Ask for the answer.

   To guess the number, remove the zeros at the end of the number, then divide by 6. That will be the number your friend started with.

   Try it with your friend, then have your friend try it with you. Can you figure out why it works?

   **Sample answer:** I tried the trick with 7 and 9. I kept track of the answers I got at each stage:

   \[
   \begin{array}{c|c|c|c|c|c}
   \hline
   & \times 100 & +3 & \times 6 & -18 & \text{remove 0s} & \div 6 \\
   \hline
   7 & 700 & 703 & 4,218 & 4,200 & 42 & 7 \\
   9 & 900 & 903 & 5,418 & 5,400 & 54 & 9 \\
   \hline
   \end{array}
   \]

   When I multiplied by 6, I always got tens digit 1 and ones digit 8. That’s because I multiplied by 100 in the first step, so the tens and ones digits are determined by \(3 \times 6 = 18\). So when I subtracted 18, I always got two zeros at the end of the number. And when you remove the zeros, all that is left is the original number multiplied by 6.

6. Complete **BLM Circle Magic**.

   **Answers:** a) 1 4 2 8 5 7, b) 2 8 5 7 1 4, c) 4 2 8 5 7 1, d) 5 7 1 4 2 8, e) 7 1 4 2 8 5, f) 8 5 7 1 4 2; all the products contain the digits 1 4 2 8 5 7

7. Use mental math to multiply by 9. To multiply by 10, add a zero. To multiply by 9, multiply by 10, then subtract. Example:

   \[
   3 \times 9 = (3 \times 10) - (3 \times 1)
   \]

   To calculate \(457 \times 9\):

   **Step 1:** Calculate \(457 \times 10 = 4570\)
   
   **Step 2:** Calculate \(457 \times 1 = 457\)
   
   **Step 3:** Subtract: \(4570 - 457 = 4113\)

   Use mental math to calculate.

   a) \(127 \times 9\)   b) \(248 \times 9\)   c) \(1234 \times 9\)

   **Answers:** a) 1143, b) 2232, c) 11 106
Doubling and Halving
Using Triples to Multiply

Remember, to double a number means to multiply the number by 2.
In the same way, to triple a number means to multiply the number by 3.

1. Triple the number.
   a) triple 2 is ______
   b) triple 3 is ______
   c) triple 5 is ______

2. Triple the number mentally by tripling the tens digit and the ones digit separately.
   a) triple 23 is ______
   b) triple 32 is ______
   c) triple 31 is ______
   d) triple 42 is ______
   e) triple 53 is ______
   f) triple 41 is ______

   BONUS ► triple 213 322 132 is _________________________

3. Triple the tens and ones separately and add the result.
   a) 14 is ______ so ______ + ______ = ______
   b) 17 is ______ so ______ + ______ = ______
   c) 26 is ______ so ______ + ______ = ______

   triple 14 is ______
   triple 17 is ______
   triple 26 is ______

   d) triple 28 is ______
   e) triple 34 is ______
   f) triple 59 is ______

   BONUS ► triple 4326 is _________________________

If you know 2 times a number, you can triple it to find 6 times the number.

4. Triple 2 times the number to find 6 times the number.
   a) 2 × 4 = ______
   b) 2 × 5 = ______
   c) 2 × 6 = ______

   So 6 × 4 = ______
   So 6 × 5 = ______
   So 6 × 6 = ______

   d) 2 × 9 = ______
   e) 2 × 12 = ______
   f) 2 × 8 = ______

   So 6 × 9 = ______
   So 6 × 12 = ______
   So 6 × 8 = ______

5. Triple 3 times the number to find 9 times the number.
   a) 3 × 7 = ______
   b) 3 × 8 = ______
   c) 3 × 12 = ______

   So 9 × 7 = ______
   So 9 × 8 = ______
   So 9 × 12 = ______
Circle Magic

The number 142857 is one of those numbers in mathematics that just seems to be magical. Perform the following multiplications:

a) \[ \begin{array}{c} 1 \ 4 \ 2 \ 8 \ 5 \ 7 \\ \times \ 1 \end{array} \]

b) \[ \begin{array}{c} 1 \ 4 \ 2 \ 8 \ 5 \ 7 \\ \times \ 2 \end{array} \]

c) \[ \begin{array}{c} 1 \ 4 \ 2 \ 8 \ 5 \ 7 \\ \times \ 3 \end{array} \]

d) \[ \begin{array}{c} 1 \ 4 \ 2 \ 8 \ 5 \ 7 \\ \times \ 4 \end{array} \]

e) \[ \begin{array}{c} 1 \ 4 \ 2 \ 8 \ 5 \ 7 \\ \times \ 5 \end{array} \]

f) \[ \begin{array}{c} 1 \ 4 \ 2 \ 8 \ 5 \ 7 \\ \times \ 6 \end{array} \]

What do you notice about the digits in each of the answers? ______________________________________________________________________

Now here’s the magic!

Place the digits in 142857 in a circle. We can find any of the products above in a split second!

Example: To find 142857 × 6, use the chart below to find the starting point:

<table>
<thead>
<tr>
<th>Factor</th>
<th>× 1</th>
<th>× 2</th>
<th>× 3</th>
<th>× 4</th>
<th>× 5</th>
<th>× 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Point</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

The starting point for 142857 × 6 is 8. To get the answer, read the numbers in the circle starting at 8 and travelling clockwise: 8, 5, 7, 1, 4, 2. So 142857 × 6 is 857142.

Check your answers by using the circle magic!
1 cm Grid Paper