In Topic B, place value understanding moves toward understanding the distributive property by using area diagrams to generate and record partial products (5.OA.1, 5.OA.2) which are combined within the standard algorithm (5.NBT.5). Writing and interpreting numerical expressions in Lessons 1 and 2, and comparing those expressions using visual models lay the necessary foundation for students to make connections between the distributive property as depicted in area models and the partial products within the standard multiplication algorithm. The algorithm is built over a period of days increasing in complexity as the number of digits in both factors increases. Reasoning about zeros in the multiplier along with considerations about the reasonableness of products also provides opportunities to deepen understanding of the standard algorithm. Although word problems provide context throughout Topic B, the final lesson offers a concentration of multi-step problems that allow students to apply this new knowledge.
A Teaching Sequence Towards Mastery of the Standard Algorithm for Multi-Digit Whole Number Multiplication

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 1</td>
<td>Connect visual models and the distributive property to partial products of the standard algorithm without renaming. (Lesson 3)</td>
</tr>
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<td>Objective 2</td>
<td>Convert numerical expressions into unit form as a mental strategy for multi-digit multiplication. (Lesson 4)</td>
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<td>Objective 3</td>
<td>Connect visual models and the distributive property to partial products of the standard algorithm without renaming. (Lesson 5)</td>
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<td>Objective 4</td>
<td>Connect area diagrams and the distributive property to partial products of the standard algorithm without renaming. (Lesson 6)</td>
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<td>Objective 5</td>
<td>Connect area diagrams and the distributive property to partial products of the standard algorithm with renaming. (Lesson 7)</td>
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<td>Objective 6</td>
<td>Fluently multiply multi-digit whole numbers using the standard algorithm and using estimation to check for reasonableness of the product. (Lesson 8)</td>
</tr>
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<td>Objective 7</td>
<td>Fluently multiply multi-digit whole numbers using the standard algorithm to solve multi-step word problems. (Lesson 9)</td>
</tr>
</tbody>
</table>
Lesson 3

Objective: Write and interpret numerical expressions and compare expressions using a visual model.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (7 minutes)
- Concept Development (31 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

Fluency Practice (12 minutes)

- Multiply by Multiples of 10 5.NBT.2 (3 minutes)
- Estimate Products 5.NBT.6 (5 minutes)
- Decompose a Factor: The Distributive Property 3.OA.5 (4 minutes)

Multiply by Multiples of 10 (3 minutes)

Note: This review fluency drill will help preserve skills students learned and mastered in Module 1 and lay the groundwork for future concepts.

Follow the same process and procedure as G5–M2–Lesson 2 for the following possible sequence: 21 × 40, 213 × 30, and 4,213 × 20.

Estimate Products (5 minutes)

Materials: (S) Personal white boards

T: (Write 421 × 18 ≈ ____ × ___ = ___.) Round 421 to the nearest hundred.
S: 400.
T: (Write 421 × 18 = 400 × ___ = ____.) Round 18 to the nearest ten.
S: 20.
T: (Write 421 × 18 = 400 × 20 = ___.) What’s 400 × 20?
S: 8,000.
T: (Write 421 × 18 = 400 × 20 = 8,000.)
T: (Write 323 × 21 ≈ ____ × ____ = ___.) On your boards, write the multiplication sentence rounding each factor to arrive at a reasonable estimate of the product.
Lesson 3: Write and interpret numerical expressions and compare expressions using a visual model.

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:
A review of relevant vocabulary may be in order for some students. Words such as sum, product, difference, and quotient might be reviewed or a scaffold such as a word wall in the classroom might be appropriate.

Robin is 11 years old. Her mother, Gwen, is 2 years more than 3 times Robin’s age. How old is Gwen?

Note: This problem is simple enough that students can solve it prior to Lesson 3; however, in the Debrief, students are asked to return to the Application Problem and create a numerical expression to represent Gwen’s age (i.e., \(3 \times 11 + 2\)). Accept any valid approach to solving the problem. The tape diagram is but one approach. Allow students to share.

Concept Development (31 minutes)

Materials: (S) Personal white boards

Problems 1–3: From word form to numerical expressions and diagrams.

3 times the sum of 26 and 4
6 times the difference between 60 and 51
The sum of 2 twelves and 4 threes

T: What expression describes the total value of these 3 equal units?
S: 3 × 5.

T: How about 3 times an unknown amount called A. Show a tape diagram and expression.
S: 3 × A.

T: 3 times the sum of 26 and 4? Show a tape diagram and expression.
S: 3 × (26 + 4) or (26 + 4) × 3.

T: Why are parentheses necessary around 26 + 4? Talk to your partner.
S: We want 3 times as much as the total of 26 + 4. If we don’t put the parentheses, it doesn’t show what we are counting. We are counting the total of 26 and 4 three times.

T: Evaluate the expression.
S: 90.

T: (Write 6 times the difference between 60 and 51 on the board.) Work with a partner to show a tape diagram and expression to match these words.
S: 6 × (60 − 51) or (60 − 51) × 6.
T: You’ve offered two different expressions for these words: \( 6 \times (60 - 51) \) and \((60 - 51) \times 6 \). Are these expressions equal? Why or why not?

S: Yes, they are equal. The two factors are just reversed.

T: What is the name of this property?

S: The commutative property

T: Explain it in your own words to your partner.

S: (Share with partners.)

T: (Write the sum of 2 twelves and 4 threes on the board.) Represent this with a tape diagram and expression.

\[
\begin{align*}
(2 \times 12) & + (4 \times 3) \\
12 & 10 \quad 3 \quad 3 \quad 3
\end{align*}
\]

Repeat as necessary with examples such as the sum of 2 nineteens and 8 nineteens or 5 times the sum of 16 and 14.

Problems 4–6: From numerical expressions to word form.

\[
\begin{align*}
8 \times (43 - 13) \\
(16 + 9) \times 4 \\
(20 \times 3) + (5 \times 3)
\end{align*}
\]

T: (Show \( 8 \times (43 - 13) \) on the board.) Read this expression in words.

S: Eight times 43 minus 13.

T: Let me write down what I hear you saying. (Write \( 8 \times (43 - 13) \).) It sounds like you are saying that we should multiply 8 and 43 and then subtract 13. Is that what you meant? Is this second expression equivalent to the one I wrote at first? Why or why not?

S: No. It’s not the same. \( \rightarrow \) You didn’t write any parentheses. Without them you will get a different answer because you won’t subtract first. \( \rightarrow \) We are supposed to subtract 13 from 43 and then multiply by 8.

T: Why can’t we simply read every expression left to right and translate it?

S: We need to use words that tell that we should subtract first and then multiply.

T: Let’s name the two factors we are multiplying. Turn and talk.

S: 8 and the answer to 43 – 13. \( \rightarrow \) We need to multiply the answer to the stuff inside the parentheses by 8.

T: Since one of the factors is the answer to this part (make a circular motion around \( 43 - 13 \)), what could we say to make sure we are talking about the answer to this subtraction problem? (What do we call the answer to a subtraction problem?)

S: The difference between 43 and 13.

T: What is happening to the difference of 43 and 13?

S: It’s being multiplied by 8.
T: We can say and write, “8 times the difference of 43 and 13.” Compare these words to the ones we said at first. Do they make sure we are multiplying the right numbers together? What other ways are there to say it?

S: Yes, they tell us what to multiply better. \( \rightarrow \) The product of 8 and the difference between 43 and 13. \( \rightarrow \) 8 times as much as the difference between 43 and 13. \( \rightarrow \) The difference of 43 and 13 multiplied 8 times.

Repeat the process with the following:

\[(16 + 9) \times 4\]

Students should write the sum of 16 and 9 times 4. If students say 16 plus 9 times 4, follow the sequence above to correct their thinking.

\[(20 \times 3) + (5 \times 3)\]

Students may write the sum of 20 threes and 5 threes or the sum of 3 twenties and 3 fives, or the product of 20 and 3 plus the product of 5 and 3, and so on. Similarly, discuss why twenty times 3 plus 5 times 3 is unclear and imprecise.

Problems 7–9: Comparison of expressions in word form and numerical form.

<table>
<thead>
<tr>
<th>Expression 1</th>
<th>Expression 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 \times 13</td>
<td>8 thirteens</td>
</tr>
<tr>
<td>The sum of 10 and 9, doubled</td>
<td>((2 \times 10) + (2 \times 9))</td>
</tr>
<tr>
<td>30 fifteens minus 1 fifteen</td>
<td>29 \times 15</td>
</tr>
</tbody>
</table>

T: Let’s use <, >, or = to compare expressions. (Write 9 \times 13 and 8 thirteens on the board.) Draw a tape diagram for each expression and compare them.

S: (Draw and write 9 \times 13 > 8 thirteens.)

T: We don’t even need to evaluate the solutions in order to compare them.

T: Now compare the next two expressions without evaluation using diagrams.

S: They are equal because the sum of 10 and 9, doubled is \((10 + 9) \times 2\). The expression on the right is the sum of 2 tens and 2 nines. There are 2 tens and 2 nines in each bar.

Repeat the process with the final example.
Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Write and interpret numerical expressions and compare expressions using a visual model.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- Return to the Application Problem. Create a numerical expression to represent Gwen’s age.
- In Problem 1(b) some of you wrote $12 \times (14 + 26)$ and others wrote $(14 + 26) \times 12$. Are both expressions acceptable? Explain.
- When evaluating the expression in Problem 2(a), a student got 85. Can you identify the error in thinking?
- Look at Problem 3(b). Talk in groups about how you know the expressions are not equal. How can you change the second expression to make it equivalent to $18 \times 27$?
In Problem 4, be sure to point out that MeiLing’s expression, while equivalent, does not accurately reflect what Mr. Huyhn wrote on the board. As an extension, ask students to put the expressions that MeiLing and Angeline wrote into words.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
1. Draw a model. Then write the numerical expressions.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The sum of 8 and 7, doubled</td>
<td>b. 4 times the sum of 14 and 26</td>
</tr>
<tr>
<td>c. 3 times the difference between 37.5 and 24.5</td>
<td>d. The sum of 3 sixteens and 2 nines</td>
</tr>
<tr>
<td>e. The difference between 4 twenty-fives and 3 twenty-fives</td>
<td>f. Triple the sum of 33 and 27</td>
</tr>
</tbody>
</table>
2. Write the numerical expressions in words.

<table>
<thead>
<tr>
<th>Expression</th>
<th>Words</th>
<th>The Value of the Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $12 \times (5 + 25)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. $(62 - 12) \times 11$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. $(45 + 55) \times 23$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. $(30 \times 2) + (8 \times 2)$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Compare the two expressions using $>$, $<$, or $=$. In the space beneath each pair of expressions, explain how you can compare without calculating. Draw a model if it helps you.

a. $24 \times (20 + 5)$  $\bigcirc$  $(20 + 5) \times 12$

b. $18 \times 27$  $\bigcirc$  20 twenty-sevens minus 1 twenty-seven

c. $19 \times 9$  $\bigcirc$  3 nineteens, tripled
4. Mr. Huynh wrote the sum of 7 fifteens and 38 fifteens on the board.
   a. Draw a model and write the correct expression.

5. Two students wrote the following numerical expressions.
   Angeline: \((7 + 15) \times (38 + 15)\)
   MeiLing: \(15 \times (7 + 38)\)

   Are the students’ answers equivalent to your answer in Problem 4(a)? Explain your answer.

6. A box contains 24 oranges. Mr. Lee ordered 8 boxes for his store and 12 boxes for his restaurant.
   a. Write an expression to show how to find the total number of oranges ordered.

   b. Next week, Mr. Lee will both double the number of boxes he orders. Write a new expression to represent the number of oranges in next week’s order.

   c. Evaluate your expression from Part (b) to find the total number of oranges ordered in both weeks.
Lesson 3 Exit Ticket

NYS COMMON CORE MATHEMATICS CURRICULUM

Lesson 3: Write and interpret numerical expressions and compare expressions using a visual model.

Name ___________________________ Date ________________

1. Draw a model then write the numerical expressions.

   a. The difference between 8 forty-sevens and 7 forty-sevens
   b. 6 times the sum of 12 and 8

2. Compare the two expressions using >, <, or =.

   \[ 62 \times (70 + 8) \quad \bigcirc \quad (70 + 8) \times 26 \]
1. Draw a model then write the numerical expressions.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a.</strong> The sum of 21 and 4, doubled</td>
<td><strong>b.</strong> 5 times the sum of 7 and 23</td>
</tr>
<tr>
<td><strong>c.</strong> 2 times the difference between 49.5 and 37.5</td>
<td><strong>d.</strong> The sum of 3 fifteens and 4 twos</td>
</tr>
<tr>
<td><strong>e.</strong> The difference between 9 thirty-sevens and 8 thirty-sevens</td>
<td><strong>f.</strong> Triple the sum of 45 and 55</td>
</tr>
</tbody>
</table>
2. Write the numerical expressions in words.

<table>
<thead>
<tr>
<th>Expression</th>
<th>Words</th>
<th>The Value of the Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 10 \times (2.5 + 13.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. (98 – 78) \times 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. (71 + 29) \times 26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. (50 \times 2) + (15 \times 2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Compare the two expressions using >, <, or =. In the space beneath each pair of expressions, explain how you can compare without calculating. Draw a model if it helps you.

<table>
<thead>
<tr>
<th>Expression</th>
<th>Comparison</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 93 \times (40 + 2)</td>
<td>&gt;</td>
<td>93 twenty-fives minus 1 twenty-five</td>
</tr>
<tr>
<td>(40 + 2) \times 39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. 61 \times 25</td>
<td>&gt;</td>
<td>60 twenty-fives minus 1 twenty-five</td>
</tr>
<tr>
<td>60 twenty-fives minus 1 twenty-five</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Larry claims that \((14 + 12) \times (8 + 12)\) and \((14 \times 12) + (8 \times 12)\) are equivalent because they have the same digits and the same operations.
   a. Is Larry correct? Explain your thinking.

   b. Which expression is greater? How much greater?
Lesson 4

Objective: Convert numerical expressions into unit form as a mental strategy for multi-digit multiplication.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (6 minutes)
- Concept Development (32 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)

Fluency Practice (12 minutes)

- Estimate Products 5.NBT.6 (4 minutes)
- Decompose Multiplication Sentences 3.OA.5 (4 minutes)
- Write the Value of the Expression 5.OA.1 (4 minutes)

Estimate Products (4 minutes)

Materials: (S) Personal white boards

T: (Write 409 × 21 ≈ ____ × ____ = ____.) On your boards, write the multiplication sentence rounding each factor to arrive at a reasonable estimate of the product.

S: (Write 409 × 21 ≈ 400 × 20 = 8,000.)

Repeat the process and procedure for 287 × 64; 3,875 × 92; and 6,130 × 37.

Decompose Multiplication Sentences (4 minutes)

Materials: (S) Personal white boards

T: (Write 12 × 3 = ____.) Write the multiplication sentence.

S: (Write.)

T: (Write (8 × 3) + (____ × 3) = ____ below 12 × 3 = ____.) 12 is the same as 8 and what number?

S: 4.

T: (Write (8 × 3) + (4 × 3) = ____. Below it, write 24 + ____ = ____.) Fill in the blanks.

S: (Write 12 × 3 = 36. Below it, they write (8 × 3) + (4 × 3) = 36. Below that line, they write 24 + 12 = 36.)

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Lesson 4

NYS COMMON CORE MATHEMATICS CURRICULUM

Convert numerical expressions into unit form as a mental strategy for multi-digit multiplication.

Date: 7/4/13

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NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

This lesson requires students to work mentally with two-digit and three-digit numbers. If basic multiplication facts are not yet mastered, be prepared to adjust numbers in calculations to suit the learner’s level. A good time to review mental math strategies is during Sprints and fluency activities. Spending time working on basic facts (with flash cards, computer games, etc.) may be necessary prior to this lesson.
Lesson 4

Lesson 4: Convert numerical expressions into unit form as a mental strategy for multi-digit multiplication.

Date: 7/4/13

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NOTES ON MULTIPLE MEANS OF REPRESENTATION:
Possibly challenge students to (a) solve the problem designating 31 as the unit, (b) think of other ways to decompose 31 units of 8.

T: Could we have decomposed 31 eights in another way? Turn and talk.
S: (Students share.)
T: Yes! 31 eights is also equivalent to 20 eights plus 11 eights. Would this way of decomposing 31 change the product of 8 x 31?
S: No. It would be the same because 20 eights is 160 and 11 eights is 88, which is the same as 160 + 88, which is 248.

S: No.
T: Why not? What property allows for this?
S: The commutative property (any-order property) says that the order of the factors doesn’t matter. The product will be the same.

T: Let’s designate 8 as the unit. I’ve drawn diagrams of 8 \times 31 and 8 \times 30.

T: Use the diagrams to consider how 8 \times 30 helps us to solve 8 \times 31 when we designate eight as the unit, (point to the diagram) and the other factor as the number of units, 31 and 30. (Run your finger down the length of each bar.) Turn and talk.

S: 31 eights is the same as 30 eights plus 1 eight. \rightarrow 30 eights is 240 and one more eight makes 248. \rightarrow 30 eights is easy, 240. 240 + 8 = 248.

T: How many more eights are in the first bar than in the second bar?
S: 1 more eight.
T: Let’s record our thinking. (Write 31 eights = 30 eights + 1 eights. 31 \times 8 = (30 \times 8) + (1 \times 8).)

T: What is the value of 30 eights and 1 more eight? Say it in an addition sentence that corresponds to our last equation. (Point to (30 \times 8) + (1 \times 8).)
S: 240 + 8 = 248.
T: 31 times 8 is?
S: 248.
T: (Show 8 \times 29 on the board.) What does this expression mean when we designate eight as the unit?
S: Add 29 eight times. \rightarrow Add 8 over and over 29 times.
Lesson 4

Convert numerical expressions into unit form as a mental strategy for multi-digit multiplication.

T: How does $8 \times 30$ help us to solve $8 \times 29$? Turn and talk.
S: (Discuss.)
T: I heard Jackie say that 30 eights minus 1 eight is equal to 29 eights. $(30 \times 8) - (1 \times 8) = 8 \times 29$.

T: What is the value of 30 eights minus 1 eight?
S: 292.

T: Could we have decomposed 29 eights in another way to help us evaluate the expression mentally? Turn and talk.
S: (Share.)
T: Yes! 29 eights is also equivalent to 20 eights plus 9 eights. Would this way of decomposing 29 change the product of $8 \times 29$?
S: No.
T: Why not?
S: Because it is still 29 eights even though we found 20 eights then 9 eights. $20 \times 8 = 160$ and $9 \times 8 = 72$. That’s still 232.

Problems 3–4

$49 \times 20$

$20 \times 51$

T: (Write $49 \times 20$.) To solve this mentally using today’s strategy, first determine which factor will be designated as the unit. Why is 49 twenties or 20 forty-nines easier to work with? Turn and talk.
S: It is easier to think of 20 as the unit because then we can say 40 twenties and 9 twenties. It’s easier to think of twenty as the unit because it is 1 less than 50 twenties. (Students might also share why 49 is easier.)

T: Let’s agree to designate 20 as the unit. Go ahead and find the value of the expression using today’s unit form strategy. Use a tape diagram if you so choose.

S: (Work and share.)

T: What is the value of $49 \times 20$?
S: 980.

T: Work with a partner to create an equivalent expression that you can use to help you solve $20 \times 51$ mentally. Write the equivalent expression and its value on your personal board. As before, you may draw a tape diagram if you choose.
Lesson 4

**S**: (Work and share.)

**T**: (Circulate and assess for understanding. Be receptive to any valid mental approach.)

**Problems 5–6**

101 × 12

12 × 98

**T**: Work independently to evaluate these two expressions mentally. (Write 12 × 98 and 12 × 101 on the board.) Compare your work with a neighbor when you’re finished. Draw tape diagrams if you choose.

**S**: (Work.)

**Problem Set (10 minutes)**

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

**Student Debrief (10 minutes)**

**Lesson Objective**: Convert numerical expressions into unit form as a mental strategy for multi-digit multiplication.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- What mental math strategy did you learn today? (Unit form.) Choose a problem in the Problem Set to support your answer.
Lesson 4

How did the Application Problem connect to today’s lesson? Which factor did you decide to designate as the unit?

In Problem 1(b) the first two possible expressions are very similar. How did you decide which one was not equivalent?

Look at Problem 2. How did the think prompts help to guide you as you evaluated these expressions? Turn and talk.

What was different about the think prompts in Problem 2 and Problem 3? (Problem 2 prompts give the units, but not the number of units. Problem 3 prompts give the number of units, but not the name of the units.)

Explain to your partner how to solve Problem 1(e). (Some students may have thought 101 \times 15 = (101 \times 10) + (101 \times 5), while others may see that 101 \times 15 = (100 \times 15) + (1 \times 15). Both are acceptable.)

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 4 Problem Set

Name ________________________________ Date ______________

1. Circle each expression that is not equivalent to the expression in bold.
   a. 16 × 29
      29 sixteens  16 × (30 − 1)  (15 − 1) × 29  (10 × 29) − (6 × 29)
   b. 38 × 45
      (38 + 40) × (38 + 5)  (38 × 40) + (38 × 5)  45 × (40 + 2)  45 thirty-eights
   c. 74 × 59
      74 × (50 + 9)  74 × (60 − 1)  (74 × 5) + (74 × 9)  59 seventy-fours

2. Solve using mental math. Draw a tape diagram and fill in the blanks to show your thinking. The first one was done for you.

   a. 19 × 25 = _______ twenty-fives
      
      Think: 20 twenty-fives − 1 twenty-five.
      
      = (______ × 25) − (______ × 25)
      
      = _______ - _______ = _______

   b. 24 × 11 = _______ twenty-fours
      
      Think: _______ twenty fours + ____ twenty four
      
      = (______ × 24) + (______ × 24)
      
      = _______ + _______ = _______
Lesson 4 Problem Set

<table>
<thead>
<tr>
<th>c. 79 × 14 = _______ fourteen</th>
<th>d. 21 × 75 = _______ seventy-fives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think: _____ fourteen – 1 fourteen</td>
<td>Think: ___ seventy-fives + ___ seventy-five</td>
</tr>
<tr>
<td>= (_____ × 14) – (_____ × 14)</td>
<td>= (_____ × 75) + (_____ × 75)</td>
</tr>
<tr>
<td>= _______ - _______ = _______</td>
<td>= _______ + _______ = _______</td>
</tr>
</tbody>
</table>

3. Define the unit in word form and complete the sequence of problems as was done in Problems 3–4 in the lesson.

<table>
<thead>
<tr>
<th>a. 19 × 15 = 19 ________________</th>
<th>b. 14 × 15 = 14 ________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think: 20 ___________ – 1 ___________</td>
<td>Think: 10 __________ + 4 __________</td>
</tr>
<tr>
<td>= (20 × _____) – (1 × _____)</td>
<td>= (10 × _____) + (4 × _____)</td>
</tr>
<tr>
<td>= _______ - _______ = _______</td>
<td>= _______ + _______ = _______</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c. 25 × 12 = 12 ________________</th>
<th>d. 18 × 17 = 18 ________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think: 10 ___________ + 2 ___________</td>
<td>Think: 20 _______ – 2 _______</td>
</tr>
<tr>
<td>= (10 × _____) + (2 × _____)</td>
<td>= (20 × _____) – (2 × _____)</td>
</tr>
<tr>
<td>= _______ + _______ = _______</td>
<td>= _______ - _______ = _______</td>
</tr>
</tbody>
</table>
4. How can $14 \times 50$ help you find $14 \times 49$?

5. Solve mentally.
   
   a. $101 \times 15 =$ _________________

   b. $18 \times 99 =$ _________________

6. Saleem says $45 \times 32$ is the same as $(45 \times 3) + (45 \times 2)$. Explain Saleem’s error using words, numbers, and pictures.

7. Juan delivers 174 newspapers every day. Edward delivers 126 more newspapers each day than Juan.
   
   a. Write an expression to show how many newspapers Edward will deliver in 29 days.

   b. Use mental math to solve. Show your thinking.
1. Solve using mental math. Draw a tape diagram and fill in the blanks to show your thinking.

   a. \[49 \times 11 = \underline{\phantom{1}} \text{elevens}\]
      
      Think: \[50 \text{ elevens} - 1 \text{ eleven} = (\underline{\phantom{1}} \times 11) - (\underline{\phantom{1}} \times 11)\]
      
      \[= \underline{\phantom{1}} - \underline{\phantom{1}} = \underline{\phantom{1}}\]

   b. \[25 \times 13 = \underline{\phantom{1}} \text{twenty-fives}\]
      
      Think: \[\underline{\phantom{1}} \text{twenty-fives} + \underline{\phantom{1}} \text{twenty-fives} = (\underline{\phantom{1}} \times 25) + (\underline{\phantom{1}} \times 25)\]
      
      \[= \underline{\phantom{1}} + \underline{\phantom{1}} = \underline{\phantom{1}}\]
Lesson 4 Homework

Lesson 4: Convert numerical expressions into unit form as a mental strategy for multi-digit multiplication.

Name _______________________________ Date ______________________

1. Circle each expression that is not equivalent to the expression in bold.
   a. $37 \times 19$
      - 37 nineteens
      - $(30 \times 19) - (7 \times 29)$
      - $37 \times (20 - 1)$
      - $(40 - 2) \times 19$
   
   b. $26 \times 35$
      - 35 twenty-sixes
      - $(26 + 30) \times (26 + 5)$
      - $(26 \times 30) + (26 \times 5)$
      - $35 \times (20 + 60)$
   
   c. $34 \times 89$
      - $34 \times (80 + 9)$
      - $(34 \times 8) + (34 \times 9)$
      - $34 \times (90 - 1)$
      - 89 thirty-fours

2. Solve using mental math. Draw a tape diagram and fill in the blanks to show your thinking. The first one was done for you.

   a. $19 \times 50 = \underline{\hspace{2cm}}$ fifties
      
      Think: 20 fifties – 1 fifties
      
      $= (\underline{\hspace{2cm}} \times 50) - (\underline{\hspace{2cm}} \times 50)$
      
      $= \underline{\hspace{2cm}} - \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$

   b. $11 \times 26 = \underline{\hspace{2cm}}$ twenty-sixes
      
      Think: _____ twenty-sixes + _____ twenty-sixes
      
      $= (\underline{\hspace{2cm}} \times 26) + (\underline{\hspace{2cm}} \times 26)$
      
      $= \underline{\hspace{2cm}} + \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$
Lesson 4 Homework

Lesson 4: Convert numerical expressions into unit form as a mental strategy for multi-digit multiplication.

Date: 7/4/13

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3. Define the unit in word form and complete the sequence of problems as was done in Problems 3–4 in the lesson.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>c. $49 \times 12 = \underline{\quad}$ twelves</td>
<td>d. $12 \times 25 = \underline{\quad}$ seventy-fives</td>
</tr>
<tr>
<td>Think: ___ twelves – 1 twelves</td>
<td>Think: ___ twenty-fives + ___ twenty-fives</td>
</tr>
<tr>
<td>= ($\underline{\quad} \times 12) – (\underline{\quad} \times 12)$</td>
<td>= ($\underline{\quad} \times 25) + (\underline{\quad} \times 25)$</td>
</tr>
<tr>
<td>= $\underline{\quad} – \underline{\quad} = \underline{\quad}$</td>
<td>= $\underline{\quad} + \underline{\quad} = \underline{\quad}$</td>
</tr>
</tbody>
</table>

3. Define the unit in word form and complete the sequence of problems as was done in Problems 3–4 in the lesson.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $29 \times 12 = 29 \underline{\quad}$</td>
<td>b. $11 \times 31 = 31 \underline{\quad}$</td>
</tr>
<tr>
<td>Think: 30 $\underline{\quad} – 1 \underline{\quad}$</td>
<td>Think: 30 $\underline{\quad} + 1 \underline{\quad}$</td>
</tr>
<tr>
<td>= $30 \times \underline{\quad} – (1 \times \underline{\quad})$</td>
<td>= $(30 \times \underline{\quad}) + (1 \times \underline{\quad})$</td>
</tr>
<tr>
<td>= $\underline{\quad} – \underline{\quad} = \underline{\quad}$</td>
<td>= $\underline{\quad} + \underline{\quad} = \underline{\quad}$</td>
</tr>
<tr>
<td>c. $19 \times 11 = 19 \underline{\quad}$</td>
<td>d. $50 \times 13 = 13 \underline{\quad}$</td>
</tr>
<tr>
<td>Think: 20 $\underline{\quad} – 1 \underline{\quad}$</td>
<td>Think: 10 $\underline{\quad} + 3 \underline{\quad}$</td>
</tr>
<tr>
<td>= $(20 \times \underline{\quad}) – (1 \times \underline{\quad})$</td>
<td>= $(10 \times \underline{\quad}) + (3 \times \underline{\quad})$</td>
</tr>
<tr>
<td>= $\underline{\quad} – \underline{\quad} = \underline{\quad}$</td>
<td>= $\underline{\quad} – \underline{\quad} = \underline{\quad}$</td>
</tr>
</tbody>
</table>
4. How can 12 × 50 help you find 12 × 49?

5. Solve mentally.
   a. 16 × 99 = __________________________
   b. 20 × 101 = __________________________

6. Joy is helping her father to build a deck that measures 14 ft by 19 ft. Find the area of the deck using a mental strategy. Explain your thinking.

7. The Lason School turns 101 years old in June. In order to celebrate, they ask each of the 23 classes to collect 101 items and make a collage. How many total items will be in the collage? Use mental math to solve. Explain your thinking.
Lesson 5

Objective: Connect visual models and the distributive property to partial products of the standard algorithm without renaming.

Suggested Lesson Structure

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency Practice</td>
<td>12 min</td>
</tr>
<tr>
<td>Application Problem</td>
<td>5 min</td>
</tr>
<tr>
<td>Concept Development</td>
<td>33 min</td>
</tr>
<tr>
<td>Student Debrief</td>
<td>10 min</td>
</tr>
<tr>
<td>Total Time</td>
<td>60 min</td>
</tr>
</tbody>
</table>

Fluency Practice (12 minutes)

- Estimate Products by Rounding 5.NBT.6 (4 minutes)
- Multiply Mentally 5.NBT.5 (4 minutes)
- Multiply by Multiples of 100 5.NBT.2 (4 minutes)

Estimate Products by Rounding (4 minutes)

Materials: (S) Estimate Products by Rounding Pattern Sheet

Multiply Mentally (4 minutes)

Materials: (S) Personal white boards

Notes: This fluency drill will help bolster the students’ understanding of and automaticity with the distributive property of multiplication.

T: (Write 9 \times 10 =.) Say the multiplication sentence.
S: 9 \times 10 = 90.
T: (Write 9 \times 9 = 90 – ____ below 9 \times 10 =.) On your personal boards, write the number sentence, filling in the blank.
S: (Students write 9 \times 9 = 90 – 9.)
T: What’s 9 \times 9?
S: 81.

Repeat the process and procedure for 9 \times 100, 9 \times 99, 15 \times 10, 15 \times 9, 29 \times 100, and 29 \times 99.
Multiply by Multiples of 100 (4 minutes)

Materials: (S) Personal white boards

Notes: This review fluency drill will help preserve skills students learned and mastered in Module 1 and lay the groundwork for future concepts.

T: (Write $31 \times 100 = \underline{\quad}$. ) Say the multiplication sentence.
S: $31 \times 100 = 3,100$.

T: (Write $3,100 \times 2 = \underline{\quad}$ below $31 \times 100 = 3,100$. ) Say the multiplication sentence.
S: $3,100 \times 2 = 6,200$.

T: (Write $31 \times 200 = \underline{\quad}$ below $31 \times 100 = 3,100 \times 2 = 6,200$. ) Say $31 \times 200$ as a three-step multiplication sentence, taking out the hundred.
S: $31 \times 100 \times 2 = 6,200$.

T: (Write $31 \times 200 = 6,200$.)

Direct students to solve using the same method for $24 \times 300$ and $34 \times 200$.

Application Problem (5 minutes)

Aneisha is setting up a play space for her new puppy. She will be building a fence around part of her yard that measures 29 feet by 12 feet. How many square feet of play space will her new puppy have? If you have time, solve it in more than one way.

Note: This problem is a bridge from G5–M2–Lesson 4’s unit form mental math strategy. Students have significant practice in finding area and multiplying two digits by two digits in Grade 4.

Concept Development (33 minutes)

Problem 1: Represent units using first the tape diagram, then the area model.

$21 \times 5$

T: (Write on the board $21 \times 5$. ) Can you solve mentally using the unit form strategy?
S: Think $(20 \times 5)$ plus 5 more. This is twenty 5’s and 1 more 5. The product is 105.

T: Represent that thinking with a tape diagram.
S: (Draw.)
Lesson 5:

Connect visual models and the distributive property to partial products of the standard algorithm without renaming.

Date: 7/4/13

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Today’s lesson focuses on multiplication without renaming, which limits the digits and combination of digits that can be used when creating problems. Foster a student’s curiosity about numbers and encourage them to notice and explore the patterns in today’s problems. Have students share their observations and challenge them to create more multiplication problems that do not require renaming. Students might record their thoughts in a journal.

T: So you chose the factor 5 to be the unit. Can you imagine the area in each unit? (Draw the first image.)

T: Imagine that all 21 boxes are stacked vertically. (Draw second image.)

T: There are so many units in this drawing. Let’s represent all the boxes using an area model like the type you used in fourth grade. (Draw third image.)

T: What values could you put in the area model? (How many units are in each part of the rectangle?)

S: 1 × 5 = 5 and 20 × 5. 1 five and 20 fives. 100 and 5, 105.

T: How are the area model and the tape diagram similar? How are they different?
S: They both show the same number of units. The tape diagram helped us think of $21 \times 5$ as $(20 \times 5)$ plus 5 more. The area model helped us show all the boxes in the tape diagram without having to draw every single one. It made it easier to see $(20 \times 5)$ plus $(1 \times 5)$.

T: Can we turn this area model so that we count 5 groups of 21? What effect will turning the rectangle have on our area (product)? (Draw.)

S: Yes, we could have counted twenty-ones instead of fives by drawing lines horizontally across. We could count 5 twenty-ones or 21 fives and it would be the same because of the commutative property. The area wouldn’t change. $5 \times 21$ is the same as $21 \times 5$. $5 \times 21 = 21 \times 5$.

Problem 2: Products of two-digit and two-digit numbers, the area model and standard algorithm.

$23 \times 31$

T: Now that we have discussed how the area model can show multiplication, let’s connect it to a written method—the standard algorithm.

T: (Write $23 \times 31$ on the board.) Let’s think about which factor we want to name as our unit. Which do you think is easier to count, 31 twenty-three’s or 23 thirty-ones? Turn and talk.

S: I think it’s easier to count units of twenty-three because we can find 30 of them and then just add 1 more. → I think 20 twenty-threes plus 3 twenty-threes is easier.

T: Either works! Let’s label the top with our unit of 23. (Label top of area model.)

T: We showed units of five before. How can we show units of twenty-three now?

S: The 1 group of 23 is on top and the 30 group is on the bottom.

T: Does it matter how we split the rectangle? Does it change the area (product)?

S: No it doesn’t matter. The area will be the same.

S: (Talk and solve.)

T: What’s the product of 1 and 23?

S: 23.

T: What’s the product of 30 and 23?

S: 690.

T: Now, add your partial products to find the total area of our rectangle.
S: (Add.)
T: What is 23 \times 31?
S: 713.
T: Now, let’s solve 23 \times 31 using the standard algorithm. Show your neighbor how to set up this problem using the standard algorithm.
S: (Show and talk.)
T: Work with your neighbor to solve using the standard algorithm.
S: (Solve.)
T: Take a look at the area model and the standard algorithm. Compare them. What do you notice?
S: We added 1 unit of 23 to 30 units of 23. \rightarrow In the area model we added two parts just like in the algorithm. \rightarrow First we wrote the value of 1 twenty-three. Then we wrote the value of 30 twenty-threes.
T: Explain the connections between (30 \times 23) + (1 \times 23), the area model and the algorithm.
S: (Explain the connections.)

Problem 3: Products of two-digit and three-digit numbers.

343 \times 21
231 \times 32

T: (Write 343 \times 21 on the board.) What should we designate as the unit?
S: Three hundred forty-three.
T: Let’s find the value of 21 units of 343. Draw an area model and solve. Then solve with the algorithm. Compare. What do you notice?

S: (Draw and solve.)
T: Explain the connections between (20 \times 343) + (1 \times 343), the area model, and the algorithm.
S: (Explain connections.)
Problem Set (10 minutes)

Students should do their personal best to complete the problem set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Connect visual models and the distributive property to partial products of the standard algorithm without renaming.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- Look back at the area models in Problems 1 and 2. What is the same about these two problems? How could you use Problem 1 to help you solve Problem 2?
- How is multiplying three digits by two digits different than multiplying two digits by two digits? How is it the same? (Make sure that students notice that the number of partial products is determined by the multiplier. Two-by-two and two-by-three digit multiplication still only has two partial products in the algorithm. The only real difference is that the unit being counted is a larger number.)
What is different about Problem 4? (Decimal values.) Does using a decimal value like 12.1 as the unit being counted change the way you must think about the partial products? Have students share their area models with the class and discuss.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
<table>
<thead>
<tr>
<th></th>
<th>Estimate and then multiply:</th>
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<tbody>
<tr>
<td>1</td>
<td>29 x 11 ≈</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>29 x 21 ≈</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>29 x 31 ≈</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>23 x 12 ≈</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>23 x 22 ≈</td>
<td>27</td>
</tr>
<tr>
<td>6</td>
<td>23 x 32 ≈</td>
<td>28</td>
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<tr>
<td>7</td>
<td>23 x 42 ≈</td>
<td>29</td>
</tr>
<tr>
<td>8</td>
<td>37 x 13 ≈</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>37 x 23 ≈</td>
<td>31</td>
</tr>
<tr>
<td>10</td>
<td>36 x 24 ≈</td>
<td>32</td>
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<tr>
<td>11</td>
<td>24 x 36 ≈</td>
<td>33</td>
</tr>
<tr>
<td>12</td>
<td>43 x 11 ≈</td>
<td>34</td>
</tr>
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<td>13</td>
<td>43 x 21 ≈</td>
<td>35</td>
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<td>14</td>
<td>403 x 21 ≈</td>
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<td>15</td>
<td>303 x 21 ≈</td>
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<td>16</td>
<td>203 x 21 ≈</td>
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<td>17</td>
<td>41 x 11 ≈</td>
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<td>41 x 21 ≈</td>
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<td>19</td>
<td>41 x 31 ≈</td>
<td>41</td>
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<tr>
<td>20</td>
<td>401 x 31 ≈</td>
<td>42</td>
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<tr>
<td>21</td>
<td>501 x 31 ≈</td>
<td>43</td>
</tr>
<tr>
<td>22</td>
<td>601 x 31 ≈</td>
<td>44</td>
</tr>
</tbody>
</table>

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Lesson 5 Problem Set

1. Draw an area model and then solve using the standard algorithm. Use arrows to match the partial products from the area model to the partial products of the algorithm.
   a. $34 \times 21$
      \[ 34 \]
      \[ \times 21 \]
   b. $434 \times 21$
      \[ 434 \]
      \[ \times 21 \]

2. Solve using the standard algorithm.
   a. $431 \times 12 = \underline{}$
   b. $123 \times 23 = \underline{}$
   c. $312 \times 32 = \underline{}$
3. Betty saves $161 a month. She saved $141 less each month than Jack. How much will Jack save in 2 years?

4. Farmer Brown feeds 12.1 kg of alfalfa to each of his 2 horses daily. How many kilograms of alfalfa will all his horses have eaten after 21 days? Draw an area model to solve.
Lesson 5 Exit Ticket

1. Complete the area model then solve using the standard algorithm.

   a. \(21 \times 23 = \underline{\phantom{000}}\)

   \[
   \begin{array}{c}
   21 \\
   \times 23 \\
   \end{array}
   \]

   b. \(143 \times 12 = \underline{\phantom{000}}\)

   \[
   \begin{array}{c}
   143 \\
   \times 12 \\
   \end{array}
   \]
Lesson 5 Homework

Name ________________________________ Date ________________

1. Draw an area model then solve using the standard algorithm. Use arrows to match the partial products from the area model to the partial products in the algorithm.

   a. \(24 \times 21 = \) _______________

      \[
      \begin{array}{c}
      24 \\
      \times 21
      \end{array}
      \]

   b. \(242 \times 21 = \) _______________

      \[
      \begin{array}{c}
      242 \\
      \times 21
      \end{array}
      \]

2. Solve using the standard algorithm.

   a. \(314 \times 22 = \) ____________  

   b. \(413 \times 22 = \) ____________  

   c. \(213 \times 32 = \) ____________
3. A young snake measures 0.23 m long. During the course of his lifetime, he will grow to be 13 times his current length. What will his length be when he’s full grown?

4. Zenin earns $142 per shift at his new job. During a pay period, he works 12 shifts. What would his pay be for that period?
Lesson 6
Objective: Connect area diagrams and the distributive property to partial products of the standard algorithm without renaming.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (6 minutes)
- Concept Development (32 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

Fluency Practice (12 minutes)

- Multiply Mentally 5.NBT.5 (4 minutes)
- Multiply by Multiples of 100 5.NBT.2 (4 minutes)
- Multiply Using the Area Model 5.NBT.6 (4 minutes)

Multiply Mentally (4 minutes)

Materials: (S) Mental Multiplication Pattern Sheet

Note: This fluency drill will help bolster the students’ understanding of and automaticity with the distributive property of multiplication.

Distribute the Mental Multiplication pattern sheet and give students two minutes to do as many problems as they can. Probe the room correcting misunderstandings and encouraging students to use mental math strategies.

Multiply by Multiples of 100 (4 minutes)

Follow the same process and procedure as G5–M2–Lesson 5 for the following possible sequence: 21 × 400, 312 × 300, and 2,314 × 200.

Multiply Using the Area Model (4 minutes)

Materials: (S) Personal white boards

T: (Write 43 × 12 = ____.) Draw an area model on your personal board to solve.

S: (Students write 43 × 12 = ____.)
Lesson 6

NYS COMMON CORE MATHEMATICS CURRICULUM

Date: 7/4/13

Lesson 6: Connect area diagrams and the distributive property to partial products of the standard algorithm without renaming.

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T: Fill in your area model and number sentence.
S: (Write: 43 × 12 = 516.)
T: Solve using the algorithm.
S: (Solve.)

Repeat the procedure using the following sequence: 243 × 12 and 312 × 23.

Application Problem (6 minutes)

Scientists are creating a material that may replace damaged cartilage in human joints. This hydrogel can stretch to 21 times its original length. If a strip of hydrogel measures 3.2 cm, what would its length be when stretched to capacity?

Note: This problem is designed to bridge to Lesson 5 where students are multiplying without renaming; however, it adds the twist of multiplying by a decimal. Students should be encouraged to estimate for a reasonable product prior to multiplying. The use of a tape diagram may be beneficial for some students.

(To show your students a short video of the hydrogel in action, go to http://www.seas.harvard.edu/news-events/press-releases/tough-gel-stretches-to-21-times-its-length.)

Concept Development (32 minutes)

Materials: (S) Personal white boards

Problem 1

64 × 73

Method 1: Area Model

T: Please divide your personal board into two sections. On one side, we’ll solve with an area model, and on the other, we will connect it to the standard algorithm.

T: (Write 64 × 73 on the board.) Let’s represent units of 73. Draw an area model with your partner and label the length as 73.

T: How many seventy-threes are we counting?
S: 64.
T: How can we decompose 64 to make our multiplication easier? Show this on your model.
S: Split it into 4 and 60. (Draw.)
Lesson 6: Connect area diagrams and the distributive property to partial products of the standard algorithm without renaming.

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T: 73 × 4 and 73 × 60 are both a bit more difficult to solve mentally. How could we decompose 73 to make finding these partial products easier to solve?

S: Split the length, too, into 3 and 70.

T: Let’s record that and begin solving. What’s the product of 4 and 3?

S: 12.

T: (Continue recording the products in the area model.) Now, add each row’s partial products to find the value of 64 × 73.

S: (Add.)

T: What is 64 groups of 73?

S: 4,672

**Method 2: Standard Algorithm**

T: Show your neighbor how to write 64 × 73 in order to solve using the standard algorithm.

T: First we’ll find the value of 4 units of seventy-three.

T: 4 times 3 ones equals?

S: 12 ones.

T: 12 ones equal 1 ten and how many ones?

S: 2 ones.

T: Watch how I record. (Write the 1 on the line under the tens place first, and the 2 in the ones place second.)

T: 4 times 7 tens equals?

S: 28 tens.

T: 28 tens plus 1 ten equals? (Point to the 1 you placed on the line under the tens place.)

S: 29 tens.

T: I’ll cross out the 1 ten and record 29 tens. 29 tens equal how many hundreds and how many tens?

S: 2 hundreds 9 tens.

T: What did we multiply to find this product? Find this product in your area model.

S: 4 × 73. It is the sum of the two products in the top row of the model.

T: Now, we’ll find the value of 60 units of 73. What is 6 tens times 3 ones?

S: 18 tens.
Lesson 6: Connect area diagrams and the distributive property to partial products of the standard algorithm without renaming.

T: How many hundreds can I make with 18 tens?
S: 1 hundred, 8 tens.
T: We’ll record the hundred between the partial products. (Write a small 1 just below the 2 in 292, and the 8 in the tens place beneath the 9 in 292.)
T: What is 6 tens times 7 tens?
S: 42 hundreds.
T: 42 hundreds plus 1 hundred equals? (Point to the regrouped 1.)
S: 43 hundreds.
T: I’ll cross out the 1 hundred and record 43 hundreds. 43 hundreds equal how many thousands and how many hundreds?
S: 4 thousands 3 hundreds.
T: What did we multiply to find this other product? Find it in your area model.
S: 60 \times 73. It is the sum of the two products in the bottom row of the model.
T: Turn and tell your partner what the next step is.
T: I hear you saying that we should add these two products together.
T: Compare the area model with the algorithm. What do you notice?
S: Both of them have us multiply first then add, and the answers are the same. In the partial products we had to add four sections of the rectangle that we combined into two products, and in the standard algorithm there were only two the whole time. The partial products method looks like the standard algorithm method, but the parts are decomposed.

Once having discussed, have the students do the entire problem independently and then working with a partner. Allowing students to generate other examples to calculate may also be fruitful.

Problems 2–3 (Partners)
814 \times 39
624 \times 82

T: (Write 814 \times 39 on the board.) Partner A, use the standard algorithm to solve. Partner B, draw an area model to solve.
S: (Draw and solve.)
T: Compare your solutions.
T: (Post completed algorithm on board, for students to check.) Be sure you are recording your regrouped units correctly.

S: (Check.)

Repeat for the second problem with partners switching roles.

**Problem Set (10 minutes)**

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

**Student Debrief (10 minutes)**

**Lesson Objective:** Connect area diagrams and the distributive property to partial products of the standard algorithm without renaming.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.
- What pattern did you notice between Parts (a) and (b) of Problem 1? How did this slight difference in factors impact your final product?
- Explain to your partner how you recorded the regrouping in Problem 2(a). What were you thinking and what did you write as you multiplied 9 tens times 5 tens?
- Let’s think about a problem like $23 \times 45$ and solving it with the algorithm. What is the first partial product that we would find? ($3 \times 45$) The second? ($20 \times 45$) Would this be the only order in which we could find the partial products? What else could we do? (Point out to students that it would also be appropriate to find 20 units of 45 and then 3 units of 45. It is simply a convention to find the smaller place value first. Use the area model to support this discussion.)
- What information did you need before you could find the cost of the carpet in Problem 3? (The area of the room.) How did you find that information? (Remind us how to find the area of a room.) Why is area measured in square units?
- Look at Problem 4. Discuss your thought process as you worked on solving this problem. There is more than one way to solve this problem. Work with your partner to show another way. How does your expression change? (Compare expressions that communicate the students’ thinking.)

**Exit Ticket (3 minutes)**

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
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<td>50 × 100 =</td>
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Lesson 6
Problem Set

Name ____________________________ Date __________________

1. Draw an area model, and then solve using the standard algorithm. Use arrows to match the partial products from your area model to the partial products in the algorithm.
   
a. \(48 \times 35\)

\[
\begin{array}{c}
48 \\
\times 35 \\
\end{array}
\]

b. \(648 \times 35\)

\[
\begin{array}{c}
648 \\
\times 35 \\
\end{array}
\]

2. Solve using the standard algorithm.
   
a. \(758 \times 92\)
   
   b. \(958 \times 94\)
   
   c. \(476 \times 65\)
   
   d. \(547 \times 64\)
3. Carpet costs $16 a square foot. A rectangular floor is 14 feet long by 16 feet wide. How much would it cost to carpet the floor?

4. General admission to The American Museum of Natural History is $19.
   a. If a group of 125 students visits the museum, how much will the group’s tickets cost?
   b. If the group also purchases IMAX movie tickets for an additional $4 per student, what is the new total cost of all the tickets? Write an expression that shows how you calculated the new price.
Lesson 6 Exit Ticket

Name ______________________________ Date ____________________

1. Draw an area model, and then solve using the standard algorithm. Use arrows to match the partial products from your area model to the partial products in the algorithm.

   a. \( 78 \times 42 = \) ________________

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

   b. \( 783 \times 42 = \) __________

      \[
      \begin{array}{c}
      7 8 3 \\
      \times 4 2 \\
      \end{array}
      \]
Lesson 6 Homework

Name ____________________________ Date ________________

1. Draw an area model, and then solve using the standard algorithm. Use arrows to match the partial products from your area model to the partial products in the algorithm.

   a. \(27 \times 36 = \boxed{972}\)

   \[
   \begin{array}{c}
   27 \\
   \times 36 \\
   \end{array}
   \]

   b. \(527 \times 36 = \boxed{18912}\)

   \[
   \begin{array}{c}
   527 \\
   \times 36 \\
   \end{array}
   \]

2. Solve using the standard algorithm.

   a. \(649 \times 53\)

   c. \(758 \times 46\)

   b. \(496 \times 53\)

   d. \(529 \times 48\)
3. Each of the 25 students in Mr. McDonald’s class sold 16 raffle tickets. If each ticket cost $15, how much money did Mr. McDonald’s students raise?

4. Jayson buys a car and pays by installments. Each installment is $567 per month. After 48 months, Jayson owes $1250. What was the total price of the vehicle?
Lesson 7

Objective: Connect area diagrams and the distributive property to partial products of the standard algorithm with renaming.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (6 minutes)
- Concept Development (32 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)

Fluency Practice (12 minutes)

- Sprint: Multiply by Multiples of 10 and 100 5.NBT.2 (8 minutes)
- Multiply Using the Area Model 5.NBT.6 (4 minutes)

Sprint: Multiply by Multiples of 10 and 100 (8 minutes)

Materials: (S) Multiply by Multiples of 10 and 100 Sprint

Note: This review fluency drill will help preserve skills students learned and mastered in Module 1 and lay the groundwork for multiplying with three-digit factors in the lesson.

Multiply Using the Area Model (4 minutes)

Note: Since the area model will be used again in this lesson, a short review supports the solidity of the prior learning before adding on the complexity of factors with more digits.

Follow the same process and procedure as G5–M2–Lesson 6 using the following possible sequence: 24 × 15 and 824 × 15.

Application Problem (6 minutes)

The length of a school bus is 12.6 meters. If 9 school buses park end to end with 2 meters between each one, what’s the total length from the front of the first bus to the end of the last bus?
Lesson 7:

Connect area diagrams and the distributive property to partial products of the standard algorithm with renaming.

Date: 7/4/13

Lesson 7

NYS COMMON CORE MATHEMATICS CURRICULUM

5•2

Note: This problem is designed to bridge to the current lesson with multi-digit multiplication while also reaching back to decimal multiplication work from Module 1. Students should be encouraged to estimate for a reasonable product prior to multiplying. Encourage students to use the most efficient method to solve this problem.

Concept Development (32 minutes)

Problem 1

524 × 136

T: Compare the problem on the board with the problems we did yesterday. What do you notice?

S: Yesterday, we multiplied using only two-digit numbers as the number of units. → The problems yesterday had a two-digit number in them.

T: So which one of these factors should we designate as our unit? Turn and talk.

S: I think it’s easier to count 136 units of 524 than 524 units of 136. It seems like a lot less units to count that way. → I’m not sure which one to use as the unit. It seems like it won’t really matter this time because they are both three-digit numbers. → I think we should count 136 units of 524 because then we just have to multiply by 100 and 30 and 6. These seem easier to me than multiplying by 500, 20, and 4. → I’m going to count 524 units of 136. I don’t think multiplying by 500 then 20 then 4 will be any harder than the other way.

T: Very thoughtful conversations. Let’s designate 524 as our unit. How will the area model for this problem be different than yesterday’s models?

S: There will be 3 columns and 3 rows. Yesterday we only had 2 rows because we used the smaller number to tell the number of units. We used our larger numbers yesterday as our units.

T: Partner A, draw an area model to find the product. Partner B, solve using the standard algorithm.

S: (Work.)

T: What’s the product of 524 × 136?

S: 71,264.

T: Compare your solutions by matching your partial products and final product.

Problem 2

4,519 × 326

T: What is different about this problem?

S: We have a four-digit number this time.

T: Which factor will be our unit? Is one more efficient to use than the other? Turn and talk.

S: (Discuss as in Problem 1.)

T: Does the presence of the fourth digit change anything about how we multiply? Why or why not?
Lesson 7: Connect area diagrams and the distributive property to partial products of the standard algorithm with renaming.

Date: 7/4/13

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NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

When multiplying multi-digit numbers, (especially those with three-digit multipliers) encourage students to remember which partial product they are finding. This will help to remind students about the zeros in the partial products. Ask, “Are we multiplying by ones, tens or hundreds? When multiplying by a ten, what will the digit in the ones place be? When multiplying by hundreds, what will the digits in the ones and tens place always be?”

S: We will have an extra column in the area model, but we just multiply the same way.
T: Before we solve this problem, let’s estimate our product. Round the factors and make an estimate.
S: 5,000 × 300 = 1,500,000.
T: Now, solve this problem with your partner. Partner B should do the area model this time, and Partner A should do the algorithm. As you work, explain to your partner how you organized your thoughts to make this problem easier. (How did you decompose your factors?)

S: (Work and explain to partners.)
T: (Circulate and then review the answers. Return to the estimated product and ask if the actual product is reasonable given the estimate.)

Problem 3

4,509 × 326 (Estimate the product first.)

T: We will count 326 units of 4,509.
T: Compare 4,519 and 4,509. How are they different?
S: There’s a zero in the tens place in 4,509.
T: What does 4,509 look like in expanded form?
S: 4,000 + 500 + 9.
T: Can you imagine what the length of our rectangle will look like? How many columns will we need to represent the total length?
S: We will need only three columns.
T: This is a four-digit number. Why only three columns?
S: The rectangle shows area. So if we put a column in for the tens place, we would be drawing the rectangle bigger than it really is. ⇒ We are chopping the length of the rectangle into three parts—4,000, 500, and 9. That is the total length already. The width of the tens column would be zero, so it has no area.
T: Work with a partner to solve this problem. Partner A will use the area model, and Partner B will solve using the algorithm. Compare your work when you finish.
T: (Circulate and review answers. Have students assess the reasonableness of the product given the estimate.)

Problem 4

4,509 × 306 (Estimate the product first.)

T: This time we are counting 306 units of 4,509. How is this different from Problem 3?
S: It’s going to be 20 units less of 4,509 than last time. ⇒ There is a zero in both factors this time.
T: Thinking about the expanded forms of the factors, imagine the area model. How will the length and
width be decomposed? How will it compare to Problem 3?

S: Like Problem 3, there are only three columns in the length again even though it’s a four-digit number. → The model doesn’t need three rows because there’s nothing in the tens place. We only need to show rows for hundreds and ones.

T: (Allow students time to solve with the model.) What two partial products do these two rows represent?

S: $6 \times 4,509$ and $300 \times 4,509$.

T: Let’s record what we just drew with the algorithm. We’ll begin with the first partial product $6 \times 4,509$. Find that partial product.

S: (Record first partial product.)

T: Now let’s record $300 \times 4,509$. When we multiply a number by 100, what happens to the value and position of each digit?

S: Each becomes 100 times as large and shifts two places to the left.

T: In the case of 4,509, when we multiply it by 300, what would need to be recorded in the ones and tens place after the digits shift?

S: Zeros would go in those places.

**Problem Set (10 minutes)**

Students should do their personal best to complete the problem set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.
Student Debrief (10 minutes)

Lesson Objective: Connect area diagrams and the distributive property to partial products of the standard algorithm with renaming.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- Explain why a multiplication problem with a three-digit multiplier will not always have three partial products. Use Problem 1 (a) and (b) as examples.
- How are the area models for Problem 2 (a) and (b) alike and how are they different?
- What pattern did you notice in Problem 3?
- Take time to discuss with students that the choice of decomposition in the area model and the order in which the partial products are found can be highly variable. Use a context such as a rug or garden to make the thinking even more concrete.
- It is important for students to understand that the standard algorithm’s sequence of decomposition by place value unit is a convention. It is a useful convention as it allows us to make efficient use of multiples of ten which makes mental math easier. However, it is not a rule. Allow students to explore a multi-digit multiplication case like 52 × 35 by decomposing the area in many ways and comparing the results. A few examples are included below.
Lesson 7: Connect area diagrams and the distributive property to partial products of the standard algorithm with renaming.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.

- Does it matter which factor goes on the top of the model or the algorithm? Why or why not? (The orientation of the rectangle does not change its area.)
- How many ways can you decompose the length? The width?
- What are you thinking about as you make these decisions on how to split the area into parts? (Mental math considerations, easier basic facts, etc.)
- Do any of these choices affect the size of the area (the product)? Why or why not? (The outer dimensions of the rectangle are unchanged regardless of the way in which it is partitioned.)
- What new (or significant) math vocabulary did we use today to communicate precisely?
- How did the Application Problem connect to today’s lesson?
## Lesson 7: Connect area diagrams and the distributive property to partial products of the standard algorithm with renaming.

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### Lesson 7 Sprint

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Lesson 7 Problem Set

1. Draw an area model, and then solve using the standard algorithm. Use arrows to match the partial products from the area model to the partial products in the algorithm.

   a. 481 × 352

      \[
      \begin{array}{c}
      481 \\
      \times 352 \\
      \end{array}
      \]

   b. 481 × 302

      \[
      \begin{array}{c}
      481 \\
      \times 302 \\
      \end{array}
      \]

   c. Both 1(a) and 1(b) have three-digit multipliers. Why are there three partial products in 1(a) and only two partial products in 1(b)?
2. Solve by drawing the area model and using the standard algorithm.
   a. $8,401 \times 305$
   
   $\begin{array}{c}
   8,401 \\
   \times 305
   \end{array}$
   
   b. $7,481 \times 350$
   
   $\begin{array}{c}
   7,481 \\
   \times 350
   \end{array}$

3. Solve using the standard algorithm.
   a. $346 \times 27$
   c. $346 \times 207$
   
   b. $1,346 \times 297$
   d. $1,346 \times 207$
4. A school district purchased 615 new laptops for their mobile labs. Each computer cost $409. What’s the total cost for all of the laptops?

5. A publisher prints 1,512 copies of a book in each print run. If they print 305 runs, how many books will be printed?

6. As of the 2010 census, there were 3,669 people living in Marlboro, New York. Brooklyn, New York, has 681 times as many people. How many more people live in Brooklyn than in Marlboro?
Lesson 7 Exit Ticket

1. Draw an area model, and then solve using the standard algorithm.

   a. \(642 \times 257 = \) ________________ 

   \[
   \begin{array}{c}
   642 \\
   \times 257 \\
   \end{array}
   \]

   \(642 \times 207 = \) ________________ 

   \[
   \begin{array}{c}
   642 \\
   \times 207 \\
   \end{array}
   \]
1. Draw an area model, and then solve using the standard algorithm. Use arrows to match the partial products from your area model to the partial products in your algorithm.

   a. \(273 \times 346 = \phantom{0000} \) 
      \[
      \begin{array}{c}
      273 \\
      \times 346
      \end{array}
      \]

   b. \(273 \times 306 = \phantom{0000} \) 
      \[
      \begin{array}{c}
      273 \\
      \times 306
      \end{array}
      \]

   c. Both Parts (a) and (b) have three-digit multipliers. Why are there three partial products in (a) and only two partial products in (b)?
2. Solve by drawing the area model and using the standard algorithm.
   a. \(7,481 \times 290 = \) ____________
   b. \(7,018 \times 209 = \) ____________

3. Solve using the standard algorithm.
   a. \(426 \times 357\)
   b. \(1,426 \times 357\)
   c. \(426 \times 307\)
   d. \(1,426 \times 307\)

4. The Hudson Valley Renegades Stadium holds a maximum of 4,505 people. During the heights of their popularity, they sold out 219 consecutive games. How many tickets were sold during this time?

5. At the farmer’s market, each of the 94 vendors makes $502 in profit each weekend. How much profit will all vendors make on Saturday?
Lesson 8

Objective: Fluently multiply multi-digit whole numbers using the standard algorithm and using estimation to check for reasonableness of the product.

Suggested Lesson Structure

- Fluency Practice (7 minutes)
- Application Problem (10 minutes)
- Concept Development (33 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)

Fluency Practice (7 minutes)

- State in Exponential Form Name 5.NBT.2 (3 minutes)
- Multiply Using the Area Model with a Zero in One Factor 5.NBT.6 (4 minutes)

State in Exponential Form (3 minutes)

Materials: (S) Personal white boards

Note: This maintains earlier skills and encourages insights into the place value structure of multi-digit multiplication’s partial products. A quick review of relevant vocabulary (base, exponent, power) may be in order.

T: (Write $10^2 = \_\_\_\_\_\_\_)$ Say the base.
S: 10.
T: Say the exponent.
S: 2.
T: Say 10 squared as a multiplication sentence starting with 10.
S: $10 \times 10 = 100$.
T: Say it as a number sentence without using a multiplication sentence.
S: 10 squared equals 100.

Repeat the process with $10^3$, $10^4$, $10^5$, and $10^7$. 

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Fluently multiply multi-digit whole numbers using the standard algorithm and using estimation to check for reasonableness of the products.
Multiply Using the Area Model with a Zero in One Factor (4 minutes)

Note: As mentioned in Lesson 7, students will need additional practice when there is a zero in one of the factors. If deemed appropriate, students may be asked to share their observations about what they notice in these cases and then justify their thinking.

Follow the same process and procedure as G5–M2–Lesson 7, juxtaposing similar problems such as $342 \times 251$ and $342 \times 201$ whereby one factor has a zero.

Application Problem (10 minutes)

Erin and Frannie entered a rug design contest. The rules stated that the rug’s dimensions must be 32 inches $\times$ 45 inches and that they must use rectangles. They drew the following for their entries. Show at least three other designs they could have entered in the contest, and calculate the area of each section and the total of your rugs.

Note: This Application Problem echoes the debrief discussion from Lesson 7. Accept any design whose partitions are accurate. Have students compare the total area of their design to check.

Concept Development (33 minutes)

Problem 1

$314 \times 236$

T: (Write $314 \times 236$ on the board.) Round each factor to estimate the product. Turn and talk.

S: $314$ is closer to 3 hundreds than 4 hundreds on the number line. $\rightarrow$ 236 is closer to 2 hundreds than 3 hundreds on the number line.

T: Multiply your rounded factors to estimate the product. What is 300 times 200?
Lesson 8

Fluently multiply multi-digit whole numbers using the standard algorithm and using estimation to check for reasonableness of the products.

Date: 7/4/13

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

If students are not yet ready for independent work, have them work in pairs and talk as they estimate, solve, and check their solutions. These types of strategy-based discussions deepen understanding for students and allow them to see problems in different ways.

S: Hundreds times hundreds makes ten thousands. $3 \times 2$ is 6. So we'll get 6 ten-thousands, or 60,000.
T: Express 60,000 as a multiplication expression with an exponent.
S: $6 \times 10^4$.
T: I noticed that we rounded both of our factors down to the nearest hundred. Will our actual product be more than or less than our estimated product? Why? Tell a neighbor.
S: The answer should be more than 60,000. Our actual factors are greater, therefore our actual product will be greater than 60,000.
T: Work with a partner to solve using the standard algorithm.
S: (Solve to find 74,104.)
T: Look back to our estimated product. Is our answer reasonable? Turn and talk.
S: Yes, it's greater like we thought it would be. Our answer makes sense.

Problem 2

1,882 $\times$ 296

T: (Write 1,882 $\times$ 296 on the board.) Round each factor and estimate the product. Will the actual product be greater than or less than your estimate? Turn and talk.
S: 1,882 rounds to 2,000. 296 rounds up to 300. The estimated product is 600,000. We rounded both factors up this time. Since our actual factors are less than 2,000 and 300, our actual product must be less than 600,000.
T: Work independently to solve 1,882 $\times$ 296.
S: (Solve.)
T: What is the product of 1,882 and 296?
S: 557,072.
T: Is our product reasonable considering our estimate? Turn and talk.
S: Yes, it is close to 600,000, but a bit less than our estimated product like we predicted it would be.

Possibly have students compare the estimates of Problems 1 and 2.
Lesson 8

Fluently multiply multi-digit whole numbers using the standard algorithm and using estimation to check for reasonableness of the products.

Date: 7/4/13

Problem 3

4,902 \times 408

T: (Write 4,902 \times 408 on the board.) Work independently to find an estimated product for this problem.

T: (Pause.) Let’s read the estimated multiplication sentence without the product.

S: 4,902 \times 408 is about as much as 5,000 \times 400.

T: As I watched you work, I saw that some of you said our estimated product was 200,000, and others said 2,000,000. One is 10 times as much as the other. Analyze the error with your partner.

S: 5,000 \times 400 is like (5 \times 1,000) \times (4 \times 100). That’s like (5 \times 4) \times 100,000, so 20 copies of 1 hundred-thousand. That’s 20 hundred thousands which is 2 million.

T: Simply counting the zeros in our factors is not an acceptable strategy. We should always be aware of our units and how many of those units we are counting.

T: Should our actual product be more or less than our actual product? How do you know? Turn and talk.

S: We rounded one factor up and one factor down. Our actual product could be more or less. \( \rightarrow \) We can’t really tell yet, since we rounded 4,902 up and 408 down. Our actual product might be more or less than 2,000,000, but it should be close.

T: Work independently to solve 4,902 \times 408.

S: (Solve to find 2,000,016.)

T: Is the actual product reasonable?

S: Yes.

Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.
Student Debrief (10 minutes)

Lesson Objective: Fluently multiply multi-digit whole numbers using the standard algorithm and using estimation to check for reasonableness of the product.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- How can estimating before solving help us?
- Look at Problem 1 (b) and (c). What do you notice about the estimated products? Analyze why the estimates are the same yet the products are so different. (You might point out the same issue in Problem 1 (e) and (f).)
- How could the cost of the chairs have been found using the unit form mental math strategy? (Students may have multiplied 355 × 200 and subtracted 355.)
- In Problem 4, Carmella estimated that she had 3,000 cards.
  - How did she most likely round her factors?
  - Would rounding the number of boxes of cards to 20 have been a better choice? Why or why not? (Students might consider that she is done collecting cards and won’t need any more space. Others might argue that she is still collecting and could use more room for the future.)
  - Do we always have to round to a multiple of 10, 100, or 1,000? Is there a number between 10 and 20 that would have been a better choice for Carmella?
- Can you identify a situation in the real world where overestimating would be most appropriate? Can you identify a situation in the real world where underestimation would be most appropriate? (For example, ordering food for a party where 73 people are invited. The answer, of course, depends on the circumstances, budget, the likelihood of the attendance of all who were invited, etc.)
Exit Ticket  (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 8 Problem Set

Name ________________________________ Date ______________________

1. Estimate the product first. Solve by using the standard algorithm. Use your estimate to check the reasonableness of the product.

   a. $213 \times 328$
      \[
      \approx 200 \times 300 \\
      = 60,000 \\
      \]
      
      $213$
      \[
      \times \ 328
      \]

   b. $662 \times 372$

   c. $739 \times 442$

   d. $807 \times 491$

   e. $3,502 \times 656$

   f. $4,390 \times 741$

   g. $530 \times 2,075$

   h. $4,004 \times 603$

   i. $987 \times 3,105$
2. Each container holds 1 L 275 mL of water. How much water is in 609 identical containers? Find the difference between your estimated product and precise product.

3. A club had some money to purchase new chairs. After buying 355 chairs at $199 each, there was $1,068 remaining. How much money did the club have at first?

4. So far, Carmella has collected 14 boxes of baseball cards. Each box has 315 cards in it. Carmella estimates that she has about 3,000 cards, so she buys 6 albums that hold 500 cards each.
   a. Will the albums have enough space for all of her cards? Why or why not?

   b. How many cards does Carmella have?

   c. How many albums will she need for all of her baseball cards?
Name ________________________________ Date ________________

1. Estimate the product first. Solve by using the standard algorithm. Use your estimate to check the reasonableness of the product.

a. $283 \times 416 = \underline{\quad} \\
\approx \underline{\quad} \times \underline{\quad} \\
= \underline{\quad}$

b. $2,803 \times 406 = \underline{\quad} \\
\approx \underline{\quad} \times \underline{\quad} \\
= \underline{\quad}$
1. Estimate the product first. Solve by using the standard algorithm. Use your estimate to check the reasonableness of the product.

<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>a. 312 × 149</td>
<td>b. 743 × 295</td>
<td>c. 428 × 637</td>
</tr>
<tr>
<td>= 300 × 100</td>
<td>= 30,000</td>
<td></td>
</tr>
<tr>
<td>= 30,000</td>
<td></td>
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<tr>
<td>3 1 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x 1 4 9</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>d. 691 × 305</td>
<td>e. 4,208 × 606</td>
<td>f. 3,068 × 523</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. 430 × 3,064</td>
<td>h. 3,007 × 502</td>
<td>i. 254 × 6,104</td>
</tr>
</tbody>
</table>

3. A publisher prints 1,912 copies of a book in each print run. If they print 305 runs, the manager wants to know about how many books will be printed. What’s a reasonable estimate?
Lesson 9

Objective: Fluently multiply multi-digit whole numbers using the standard algorithm to solve multi-step word problems.

Suggested Lesson Structure

- Fluency Practice (10 minutes)
- Concept Development (40 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

Fluency Practice (10 minutes)

- Multiply and Divide by Exponents 5.NBT.2 (4 minutes)
- Estimate Products by Rounding 5.NBT.6 (6 minutes)

Multiply and Divide by Exponents (4 minutes)

Materials: (S) Personal white boards

Note: This review fluency drill will encourage flexible thinking because of the inclusion of division. The notation of the exponent form is also important to revisit and reuse so that it becomes natural to the students to think of powers of 10 written either as multiples of 10 or as exponents.

T: (Project place value chart from millions to thousandths.) Write 45 tenths as a decimal.
S: (Write 4 in the ones column and 5 in the tenths column.)
T: Say the decimal.
S: 4.5.
T: Multiply it by 10^2.
S: (Cross out 4.5 and write 450.)

Repeat the process and sequence for 0.4 x 10^2, 0.4 ÷ 10^2, 3.895 x 10^3, and 5,472 ÷ 10^3.

Estimate the Product (6 minutes)

Materials: (S) Personal white boards

Note: Just before beginning the lesson, estimating reminds students to apply this during the lesson.

T: (Write 412 x 231 = ___ x ___) Round both factors to the nearest hundred.
S: 400 x 200.
T: Write 412 \times 231 \approx 400 \times 200. What is 400 \times 200?
S: 80,000.

Repeat the process and procedure for 523 \times 298 = 500 \times 300, 684 \times 347, and 908 \times 297.

**Concept Development (40 minutes)**

**Materials:** (T/S) Problem Set, pencils

**Note:** This lesson omits the Application Problem component since the entire lesson is devoted to problem solving. Problems for this section are found in this lesson’s Problem Set

**Problem 1**

An office space in New York City measures 48 feet by 56 feet. If it sells for $565 per square foot, what is the selling price of the office space?

T: We will work Problem 1 on your Problem Set together. (Project problem on board.) Let’s read the word problem aloud.
S: (Read chorally.)
T: Now, let’s re-read the problem sentence by sentence and draw as we go.
S: (Read the first sentence.)
T: What do you see? Can you draw something?
S: (Draw.)
T: Read the next sentence. (Give students time to read.) What is the important information and how can we show that in our drawing?
S: The office space sells for $565 for each square foot. We can draw a single square unit inside our rectangle to remind us. \( \rightarrow \) We can write that 1 unit = $565.

\[
\begin{align*}
A &= l \times w \\
&= 56 \times 48 \\
&= 2,688 \\
\text{1 unit} &= 565
\end{align*}
\]

\[
\begin{align*}
2688 \times 565 &= 1,518,720 \\
2688 \times 298 &= 794,840 \\
\end{align*}
\]

The selling price of the office space was $1,518,720.
T: How do we solve this problem? Turn and talk.
S: We have to multiply. We have to find the total square feet of the office space then multiply by $565.
   → We have to first find the area of the office space then multiply by $565.
T: What information are we given that would help us figure out the area?
S: We can multiply the length times the width.
S: (Solve to find 2688 ft².)
T: Have we answered the question?
S: No. We need to multiply the area by the cost of one square foot, $565, to find the total cost.
T: Solve and express your answer in a complete sentence.
S: (Work.) The cost of the office space is $1,518,720.

NOTES ON MULTIPLE MEANS OF REPRESENTATION:
Guide students to select and practice using various models (tape diagram, area model, etc.) to represent the given information in each problem.

Problem 2
Gemma and Leah are both jewelry makers. Gemma made 106 beaded necklaces. Leah made 39 more necklaces than Gemma.

a. Each necklace they make has exactly 104 beads on it. How many beads did both girls use altogether while making their necklaces?

b. At a recent craft fair, Gemma sold her necklaces for $14 each. Leah sold her necklaces for $10 more. Who made more money at the craft fair? How much more?

T: (Allow students to read the problem chorally, in pairs, or in silence.)
T: Can you draw something?
S: Yes.
T: What can you draw?
S: A bar for Gemma’s necklaces and a second, longer bar for Leah’s.
T: Go ahead and draw and label your tape diagrams. (Allow time for students to work.)
T: What is the question asking?
S: We have to find the total number of beads on all the necklaces.
T: What do we need to think about to solve this problem? What do you notice about it?
S: It is a multi-step problem. We need to know how many necklaces Leah made before we can find the total number of necklaces. Then we need to find the number of beads.

T: Work together to complete the first steps by finding the total number of necklaces.

T: We haven’t answered the question yet. Turn and talk to your partner about how we can finish solving Part (a).

S: We have to multiply to find the total beads for both girls. Multiply Gemma’s number of necklaces times 104 beads, multiply Leah’s number of necklaces times 104, and then add them together. Add Gemma and Leah’s necklaces together then multiply by 104.

T: Use an expression to show your strategy for solving.

S: (106 \times 104) + (145 \times 104) or (106 + 145) \times 104.

T: Solve the problem with your partner and make a statement to answer the question.

S: Gemma and Leah used 26,104 beads altogether.

T: Let’s read Part (b) together.

S: (Read.)

T: Who made more money? Without calculating, can we answer this question? Turn and talk.

S: Leah made more necklaces than Gemma, and she charged more per necklace, so it makes sense that she made more money.

T: Find out how much more money Leah made.

S: (Work.)

S: Leah made $1,996 more than Gemma.

T: Complete Problems 3, 4, 5, and 6 of the Problem Set independently or in pairs.

**Problem Set (10 minutes)**

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.
Lesson Objective: Fluently multiply multi-digit whole numbers using the standard algorithm to solve multi-step word problems.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- Share and explain to your partner the numerical expression you wrote to help you solve Problems 3 and 5.
- Explain how Problems 3 and 5 could both be solved in more than one way.
- What type of problem are Problem 1 and Problem 5? How are these two problems different from the others? (Problem 1 and 5 are measurement problems.)

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Solve.

1. An office space in New York City measures 48 feet by 56 feet. If it sells for $565 per square foot, what is the total cost of the office space?

2. Gemma and Leah are both jewelry makers. Gemma made 106 beaded necklaces. Leah made 39 more necklaces than Gemma.
   a. Each necklace they make has exactly 104 beads on it. How many beads did both girls use altogether while making their necklaces?
   b. At a recent craft fair, Gemma sold each of her necklaces for $14. Leah sold each of her necklaces for 10 dollars more. Who made more money at the craft fair? How much more?

3. Peng bought 26 treadmills for her new fitness center at $1,334 each. Then she bought 19 stationary bikes for $749 each. How much did she spend on her new equipment? Write an expression, and then solve.
4. A Hudson Valley farmer has 26 employees. He pays each employee $410 per week. After paying his workers for one week, the farmer has $162 left in his bank account. How much money did he have at to begin with?

5. Frances is sewing a border around 2 rectangular tablecloths that each measure 9 feet long by 6 feet wide. If it takes her 3 minutes to sew on 1 inch of border, how many minutes will it take her to complete her sewing project? Write an expression, and then solve.

6. Each grade level at Hooperville Schools has 298 students.
   a. If there are 13 grade levels, how many students attend Hooperville Schools?
   b. A nearby district, Willington, is much larger. They have 12 times as many students. How many students attend schools in Willington?
1. Juwad picked 30 bags of apples on Monday and sold them at his fruit stand for $3.45 each. The following week he picked and sold 6 bags more.
   a. How much money did Juwad earn in the first week?
   b. How much money did he earn in the second week?
   c. How much did Juwad earn selling bags of apples these two weeks?
   d. (Bonus) Each bag Juwad picked holds 15 apples. How many apples did he pick in two weeks? Write an expression to represent this statement.
Lesson 9 Homework

Name __________________________ Date _______________________

Solve.

1. Jeffery bought 203 sheets of stickers. Each sheet has a dozen stickers. He gave away 907 stickers to his family and friends on Valentine’s Day. How many stickers does Jeffery have remaining?

2. During the 2011 season, a quarterback passed for 302 yards per game. He played in all 16 regular season games that year.
   a. How many total yards did the quarterback pass for?
   b. If he matches this passing total for each of the next 13 seasons, how many yards will he pass for in his career?

3. Bao saved $179 a month. He saved $145 less than Ada each month. How much would Ada save in three and a half years?
4. Mrs. Williams is knitting a blanket for her newborn granddaughter. The blanket is 2.25 meters long and 1.8 meters wide. What is the area of the blanket? Write the answer in centimeters.

5. Use the chart to solve.

**Soccer Field Dimensions**

<table>
<thead>
<tr>
<th></th>
<th>FIFA Regulation (in yards)</th>
<th>New York State High Schools (in yards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Length</td>
<td>110</td>
<td>100</td>
</tr>
<tr>
<td>Maximum Length</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Minimum Width</td>
<td>70</td>
<td>55</td>
</tr>
<tr>
<td>Maximum Width</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

a. Write an expression to find the difference in the maximum area and minimum area of a NYS high school soccer field. Then evaluate your expression.

b. Would a field with a width of 75 yards and an area of 7,500 square yards be within FIFA regulation? Why or why not?

c. It costs $26 to fertilize, water, mow, and maintain each square yard of a full size FIFA field (with maximum dimensions) before each game. How much will it cost to prepare the field for next week’s match?