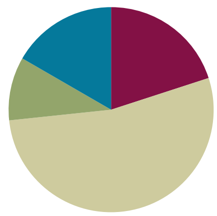
Lesson 7

Objective: Connect area models 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 exercise helps preserve skills students learned and mastered in G5–Module 1 and lays the groundwork for multiplying with three-digit factors in today's lesson.

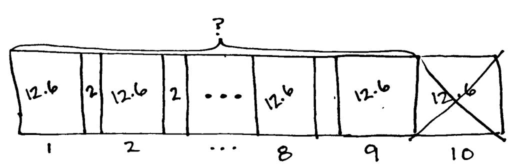
Multiply Using the Area Model (4 minutes)

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 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?



9 Buses : (12.6 × 10) − (12.6)
= 126 − 12.6
= 113.4 m

Space between:
8 × 2 = 16 m

113.4 + 16 = 129.4 m

The total length is 129.4 m.

Note: This problem is designed to bridge to the current lesson with multi-digit multiplication while also reaching back to decimal multiplication work from G5–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.

NOTES ON MULTIPLE MEANS OF REPRESENTATION:

Some students may find it difficult to align digits in the standard algorithm. Consider offering graph paper as a scaffold to support them.

Concept Development (32 minutes)

Problem 1

524 × 136

T: (Write 524 × 136.) Compare the problem on the board with the problems in the previous lesson. What do you notice?

S: In the previous lesson, 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 previous models?

S: There will be 3 columns and 3 rows. In the previous lesson, 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.

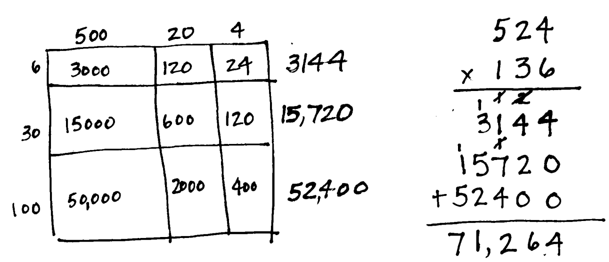
T: Partner A, draw an area model to find the product. Partner B, solve using the standard algorithm.

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?

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 use 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.)

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?"

Problem 3

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

	4000	500	9
6	24,000	3000	54
20	89000	10,000	180
300	1,200,000	150,000	2,700

```
      4509
   ×   326
   -------
     27054
     90180
 1,352,700
 ---------
 1,469,934
```

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?

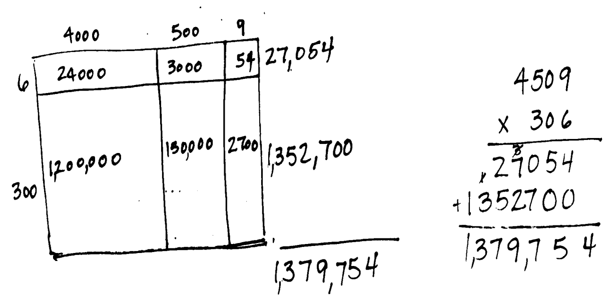
S: It's going to be 20 units less of 4,509 than last time. → There is a zero in both factors this time.

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 × 4,509 and 300 × 4,509.



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

S: (Record first partial product.)

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

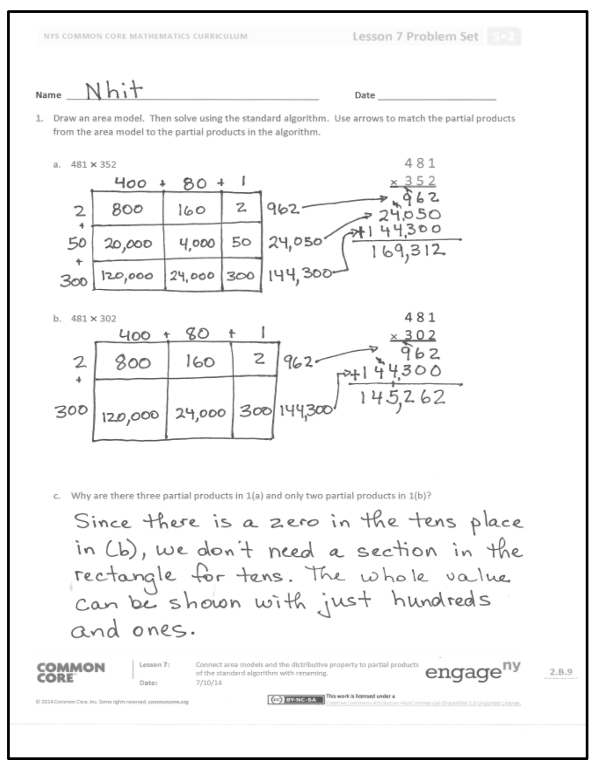
S: Each becomes 100 times as large and shifts two places to the left.

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 should solve these problems using the RDW approach used for Application Problems.



NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 7 Problem Set 5•2

Name Nhit 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. 481 × 352

	400 +	80 +	1	
2 +	800	160	2	962
50 +	20,000	4,000	50	24,050
300	120,000	24,000	300	144,300

481
× 352
962
24,050
+1 44,300
169,312

b. 481 × 302

	400 +	80 +	1	
2 +	800	160	2	962
300	120,000	24,000	300	144,300

481
× 302
962
+1 44,300
145,262

c. Why are there three partial products in 1(a) and only two partial products in 1(b)?

Since there is a zero in the tens place in (b), we don't need a section in the rectangle for tens. The whole value can be shown with just hundreds and ones.

COMMON CORE Lesson 7: Connect area models and the distributive property to partial products of the standard algorithm with renaming. Date: 7/10/14 engage^ny 2.B.9

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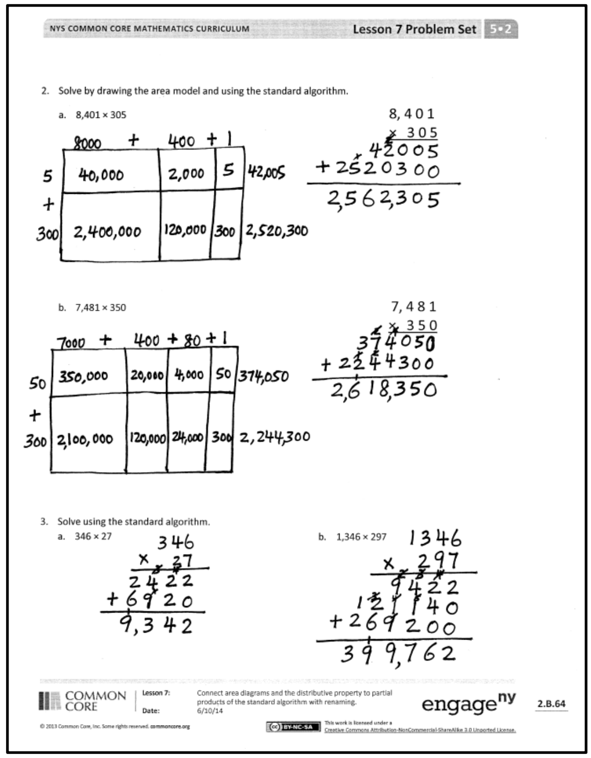
Student Debrief (10 minutes)

Lesson Objective: Connect area models 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.


NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 7 Problem Set 5•2

2. Solve by drawing the area model and using the standard algorithm.

a. 8,401 × 305

b. 7,481 × 350

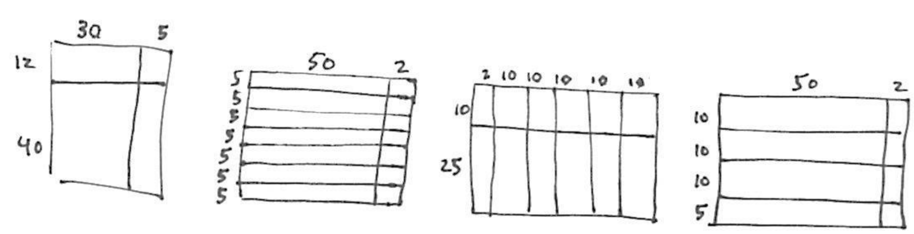
3. Solve using the standard algorithm.

a. 346 × 27

b. 1,346 × 297

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 Problems 1(a) and (b) as examples.
- How are the area models for Problems 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.

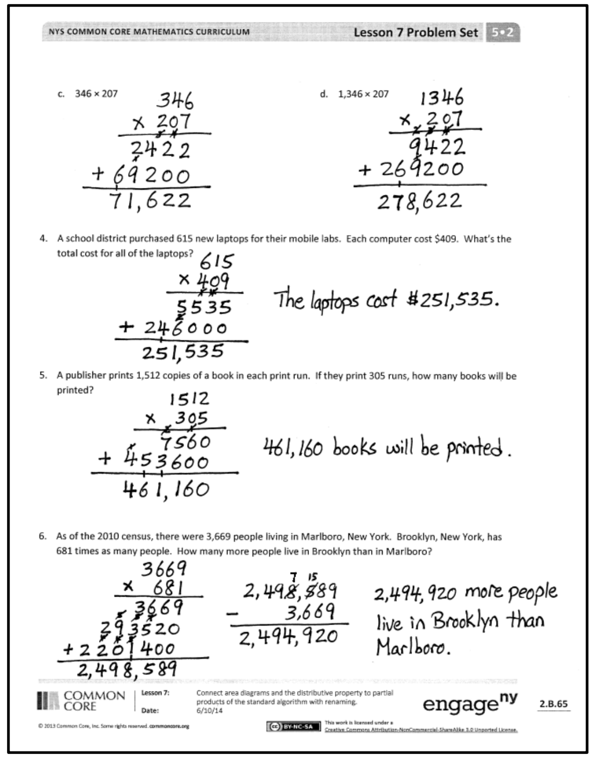


- Does it matter which factor goes on the top of the model or the algorithm? Why or why not? (The orientation of the rectangle does not change its area.)
- How many ways can you decompose the length? The width?
- What are you thinking about as you make these decisions on how to split the area into parts? (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?

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.


NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 7 Problem Set 5•2

c. 346 × 207

346
× 207
2422
+ 69200
71,622

d. 1,346 × 207

1346
× 207
9422
+ 269200
278,622

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?

615
× 409
5535
+ 246000
251,535

The laptops cost $251,535.

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?

1512
× 305
7560
+ 453600
461,160

461,160 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?

3669
× 681
3669
293520
+ 2201400
2,498,589

2,498,589
− 3,669
2,494,920

2,494,920 more people live in Brooklyn than Marlboro.

COMMON CORE Lesson 7: Connect area diagrams and the distributive property to partial products of the standard algorithm with renaming. Date: 6/10/14 engage^ny 2.B.65

A # Correct _____

Multiply.

1	2 x 10 =		23	33 x 20 =	
2	12 x 10 =		24	33 x 200 =	
3	12 x 100 =		25	24 x 10 =	
4	4 x 10 =		26	24 x 20 =	
5	34 x 10 =		27	24 x 100 =	
6	34 x 100 =		28	24 x 200 =	
7	7 x 10 =		29	23 x 30 =	
8	27 x 10 =		30	23 x 300 =	
9	27 x 100 =		31	71 x 2 =	
10	3 x 10 =		32	71 x 20 =	
11	3 x 2 =		33	14 x 2 =	
12	3 x 20 =		34	14 x 3 =	
13	13 x 10 =		35	14 x 30 =	
14	13 x 2 =		36	14 x 300 =	
15	13 x 20 =		37	82 x 20 =	
16	13 x 100 =		38	15 x 300 =	
17	13 x 200 =		39	71 x 600 =	
18	2 x 4 =		40	18 x 40 =	
19	22 x 4 =		41	75 x 30 =	
20	22 x 40 =		42	84 x 300 =	
21	22 x 400 =		43	87 x 60 =	
22	33 x 2 =		44	79 x 800 =	

multiply by multiples of 10 and 100

B Improvement _____ # Correct _____

Multiply.

1	3 x 10 =		23	44 x 20 =	
2	13 x 10 =		24	44 x 200 =	
3	13 x 100 =		25	42 x 10 =	
4	5 x 10 =		26	42 x 20 =	
5	35 x 10 =		27	42 x 100 =	
6	35 x 100 =		28	42 x 200 =	
7	8 x 10 =		29	32 x 30 =	
8	28 x 10 =		30	32 x 300 =	
9	28 x 100 =		31	81 x 2 =	
10	4 x 10 =		32	81 x 20 =	
11	4 x 2 =		33	13 x 3 =	
12	4 x 20 =		34	13 x 4 =	
13	14 x 10 =		35	13 x 40 =	
14	14 x 2 =		36	13 x 400 =	
15	14 x 20 =		37	72 x 30 =	
16	14 x 100 =		38	15 x 300 =	
17	14 x 200 =		39	81 x 600 =	
18	2 x 3 =		40	16 x 40 =	
19	22 x 3 =		41	65 x 30 =	
20	22 x 30 =		42	48 x 300 =	
21	22 x 300 =		43	89 x 60 =	
22	44 x 2 =		44	76 x 800 =	

multiply by multiples of 10 and 100

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. 481×352

$$\begin{array}{r} 4\,8\,1 \\ \times\ \underline{3\,5\,2} \end{array}$$

   b. 481×302

$$\begin{array}{r} 4\,8\,1 \\ \times\ \underline{3\,0\,2} \end{array}$$

   c. 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 × 305

$$\begin{array}{r} 8,401 \\ \times\ \underline{305} \end{array}$$

   b. 7,481 × 350

$$\begin{array}{r} 7,481 \\ \underline{\times\ \ 350} \end{array}$$

3. Solve using the standard algorithm.

   a. 346 × 27

   b. 1,346 × 297

c. 346×207

d. $1{,}346 \times 207$

4. A school district purchased 615 new laptops for their mobile labs. Each computer cost $409. What is 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?

Name ______________________________ Date ________________

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

   a. 642×257

$$\begin{array}{r} 642 \\ \times\ \underline{257} \end{array}$$

   b. 642×207

$$\begin{array}{r} 642 \\ \times\ \underline{207} \end{array}$$

Name ______________________________ Date ________________

1. Draw an area model. 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 × 346

$$\begin{array}{r} 2\ 7\ 3 \\ \times\ \underline{\ 3\ 4\ 6} \end{array}$$

   b. 273 × 306

$$\begin{array}{r} 2\ 7\ 3 \\ \times\ \underline{\ 3\ 0\ 6} \end{array}$$

   c. Both Parts (a) and (b) have three-digit multipliers. Why are there three partial products in Part (a) and only two partial products in Part (b)?

2. Solve by drawing the area model and using the standard algorithm.

   a. 7,481 × 290

   b. 7,018 × 209

3. Solve using the standard algorithm.

   a. 426 × 357

   b. 1,426 × 357

c. 426×307

d. $1{,}426 \times 307$

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

5. One Saturday at the farmer's market, each of the 94 vendors made $502 in profit. How much profit did all vendors make that Saturday?