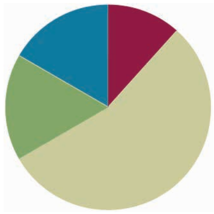
Lesson 12

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)

- Multiply Using the Area Model with a Zero in One Factor **5.3B, 5.4B** (5 minutes)

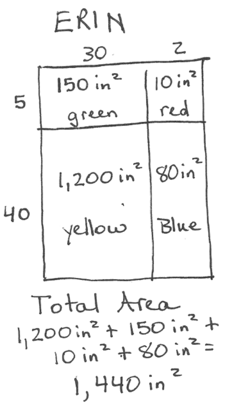
Multiply Using the Area Model with a Zero in One Factor (5 minutes)

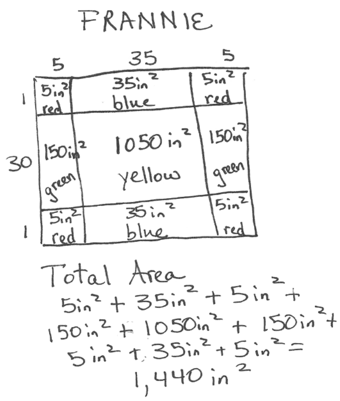
Note: Students need additional practice when there is a zero in one of the factors. If deemed appropriate, students may be asked to share their observations about what they notice in these cases and then justify their thinking.

Follow the same process and procedure as Lesson 10, juxtaposing similar problems such as 342 × 251 and 342 × 201 whereby one factor has a zero.

Application Problem (11 minutes)

Erin and Frannie entered a rug design contest. The rules stated that the rug's dimensions must be 32 inches × 45 inches and that they must be rectangular. They drew the following for their entries, showing their rug designs and the measurements of each part of their design. Show at least three other designs they could have entered in the contest. Calculate the area of each section, and the total area of the rugs.





NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Students might be encouraged to actually produce the designs that they generate for this Application Problem. This offers opportunity for students not only to reinforce the notion that area can be partitioned into multiple partial products but also allows for a cross-curricular application of math concepts.

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

Concept Development (34 minutes)

Problem 1

314 × 236

T: (Write 314 × 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.
→ 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?

314 × 236
≈ 300 × 200
= 60,000

$$\begin{array}{r} 314 \\ \times\ 236 \\ \hline 1884 \\ 9420 \\ +\ 62800 \\ \hline 74{,}104 \end{array}$$

S: Hundreds times hundreds makes ten thousands. 3 × 2 is 6. So, we'll get 6 ten thousands, or 60,000.

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.

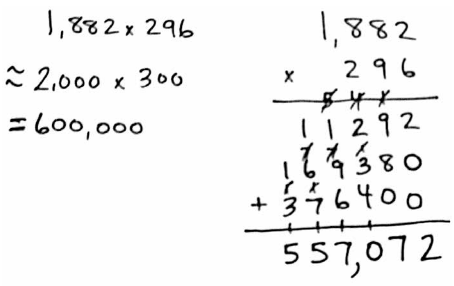
S: (Solve to find 74,104.)

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 × 296



T: (Write 1,882 × 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 × 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.

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.

Problem 3

4,902 × 408

T: (Write 4,902 × 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 × 408 is about as much as 5,000 × 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 × 400 is like (5 × 1,000) × (4 × 100). That's like (5 × 4) × 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 estimated product? How do you know? Turn and talk.

4,902 × 408

≈ 5,000 × 400

= 2,000,000

$$\begin{array}{r} 4{,}902 \\ \times\ \ \ 408 \\ \hline 39216 \\ +\ 1960800 \\ \hline 2{,}000{,}016 \end{array}$$

S: We rounded one factor up and one factor down. Our actual product could be more or less. → 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 × 408.

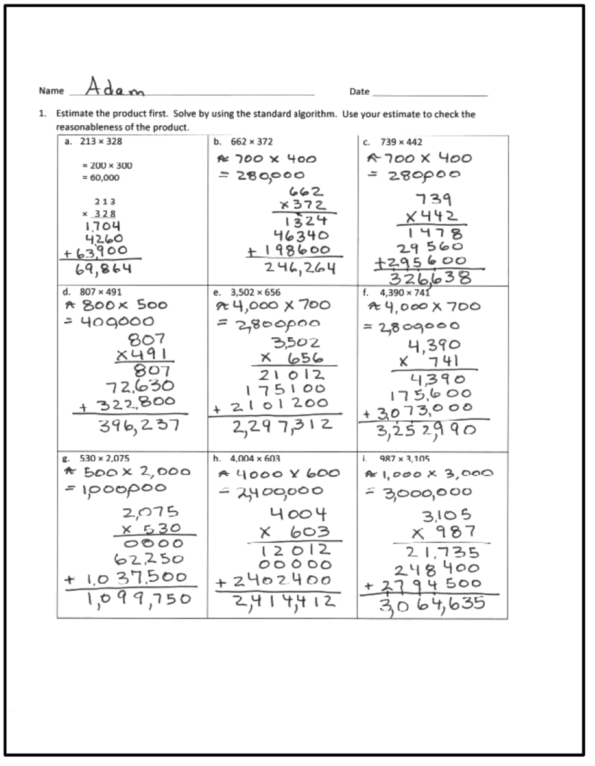
S: (Solve to find 2,000,016.)

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


Name Adam Date

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

a. 213 × 328 = 200 × 300 = 60,000 213 × 328 1,704 4260 + 63,900 69,864	b. 662 × 372 ≈ 700 × 400 = 280,000 662 × 372 1324 46340 + 198600 246,264	c. 739 × 442 ≈ 700 × 400 = 280,000 739 × 442 1478 29 560 + 295 600 326,638
d. 807 × 491 ≈ 800 × 500 = 400,000 807 × 491 807 72,630 + 322,800 396,237	e. 3,502 × 656 ≈ 4,000 × 700 = 2,800,000 3,502 × 656 21 012 175100 + 2101200 2,297,312	f. 4,390 × 741 ≈ 4,000 × 700 = 2,809000 4,390 × 741 4,390 175,600 + 3,073,000 3,252,990
g. 530 × 2,075 ≈ 500 × 2,000 = 1,000,000 2,075 × 530 0000 62,250 + 1,037,500 1,099,750	h. 4,004 × 603 ≈ 4000 × 600 = 2,400,000 4004 × 603 12012 00000 + 2402400 2,414,412	i. 987 × 3,105 ≈ 1,000 × 3,000 = 3,000,000 3,105 × 987 21,735 248400 + 2794500 3,064,635

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.

Any combination of the questions below may be used to lead the discussion.

- What is the benefit of estimating before solving?
- Look at Problems 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 Problems 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 will not 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 a real-life example 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.)

2. Each container holds 1L 275mL of water. How much water is in 609 identical containers? Find the difference between your estimated product and precise product.

Estimate:
1,200ml X600
=720,000ml
=720L

Actual:
1,275ml x609
=776,475ml
= 776L 475ml

$$\begin{array}{r} 1275 \\ \times\ 609 \\ \hline 11475 \\ +765000 \\ \hline 776{,}475 \end{array}$$

$$\begin{array}{r} 776L\ 475ml \\ -\ 720L \\ \hline 56L\ 475ml \end{array}$$

My actual product was 56L 475ml larger than the estimated 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?

1 unit = $199
355 units = 355 x $199
= $70,645

$$\begin{array}{r} 355 \\ \times\ 199 \\ \hline 3195 \\ 31950 \\ +35500 \\ \hline 70{,}645 \end{array}$$

$$\begin{array}{r} \$70{,}645 \\ +\ \$1{,}068 \\ \hline \$71{,}713 \end{array}$$

The club had $71,713 at first.

4. So far, Carmella has collected 14 boxes of baseball cards. There are 315 cards in each box 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?

She won't have enough room for all her cards in the album she bought. Carmella probably rounded both the number of cards per box and the number of boxes down. Her estimate was too low. Since she wants to make sure she has enough room for all her cards, she probably should have rounded the number of boxes up. Like, ≈300x15=4,500 would have been a better estimate in this situation.

b. How many cards does Carmella have?

315 x 14 = 4,410

$$\begin{array}{r} 315 \\ \times\ 14 \\ \hline 1260 \\ +3150 \\ \hline 4{,}410 \end{array}$$

Carmella actually has 4,410 cards.

c. How many albums will she need for all of her baseball cards?

skip counting: 500, 1,000, 1,500, 2,000, 2,500, 3,000, 3,500, 4,000, 4,500.

OR

≈ 4,500 ÷ 500
= 9

Sine the albums hold 500 cards each, she'll need 9 albums to hold all her cards.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students' understanding of the concepts that were presented in today's lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

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 × 328 ≈ 200 × 300 = 60,000 $\begin{array}{r} 2\,1\,3 \\ \times\ \ 3\,2\,8 \\ \hline \end{array}$	b. 662 × 372	c. 739 × 442
d. 807 × 491	e. 3,502 × 656	f. 4,390 × 741
g. 530 × 2,075	h. 4,004 × 603	i. 987 × 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. There are 315 cards in each box. 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 ________________

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

a. 283 × 416

$\approx$ ____________ × ____________

= ____________

$$\begin{array}{r} 283 \\ \times\ \ 416 \\ \hline \end{array}$$

b. 2,803 × 406

$\approx$ ____________ × ____________

= ____________

$$\begin{array}{r} 2,803 \\ \times\ \ \ 406 \\ \hline \end{array}$$

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Name ______________________________ Date ________________

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

a. 312 × 149 ≈ 300 × 100 = 30,000 $\begin{array}{r} 3\,1\,2 \\ \times\ 1\,4\,9 \\ \hline \end{array}$	b. 743 × 295	c. 428 × 637
d. 691 × 305	e. 4,208 × 606	f. 3,068 × 523
g. 430 × 3,064	h. 3,007 × 502	i. 254 × 6,104

2. When multiplying 1,729 times 308, Clayton got a product of 53,253. Without calculating, does his product seem reasonable? Explain your thinking.

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 is a reasonable estimate?