

Student Guide

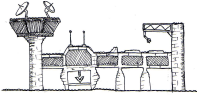
Compact Multiplication Revisited

Questions 1–20 (SG pp. 501–506)

1. **A.** Jerome rounded 96 to 100 and multiplied by 7.
B. Since he rounded one number up, his estimate will be higher than the exact answer.
2. **A.*** Jackie multiplied $7 \times 6 = 42$ and $7 \times 90 = 630$
B.* Jerome multiplied $7 \times 6 = 42$ and $7 \times 90 = 630$
- 3.* Answers will vary. They are alike because both got the same answer; both partitioned 96 into tens and ones to multiply. They are different because Jackie wrote her partial products separately and Maya did not.
- 4.* Answers will vary. They are alike because both got the same answer; both partitioned 96 into tens and ones to multiply. They are different because Jerome wrote his partial products separately and Maya did not.
5. **A.*** To remind him that he has to add 3 tens from his first step; 3 tens
B.* John multiplied 6×70 and got 420; then he added the 3 tens from his first step and got 450; 2 tens + 3 tens = 5 tens
C.* When John multiplied 6×70 , he got 420, 4 hundreds and 2 tens; after adding the 3 tens from the first step, he still had only 4 hundreds.
6. **A.** 74 **B.** 328 **C.** 3205
D. 4764 **E.** 108 **F.** 648
7. **A.** Answers will vary. A possible strategy for Question E is to think about money; 27 is two more than 25; $4 \times 25 = 100$; $4 \times 2 = 8$; $100 + 8 = 108$
B. Answers will vary. A possible estimation strategy is $9 \times 70 = 630$.

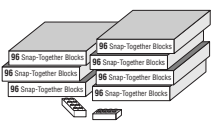
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Compact Multiplication Revisited



Jackie, Jerome, and Maya are building a model city for the moon using snap-together blocks. They ran out of blocks, so they put their money together to buy more. A new box holds 96 blocks. They have enough money to buy 7 boxes.

1. Jerome said, "That will give us almost 700 new blocks."
 - A.** What numbers did Jerome use to estimate?
 - B.** Why does he think the total will be less than 700 blocks? Why not more than 700 blocks?



Jackie, Jerome, and Maya solved the problem using the three different methods shown below. Compare their methods to each other.

Jackie's All-Partials Method	Jerome's Expanded-Form Method	Maya's Compact Method
$\begin{array}{r} 96 \\ \times 7 \\ \hline 42 \\ 630 \\ \hline 672 \end{array}$ 672 blocks	$\begin{array}{r} 96 = 90 + 6 \\ \times 7 \\ \hline 630 + 42 = 672 \end{array}$ 630 + 42 = 672 blocks	$\begin{array}{r} 96 \\ \times 7 \\ \hline 4 \\ 672 \\ \hline 672 \end{array}$ 672 blocks

2. **A.** Review Jackie's method. Tell what numbers she multiplied to find each partial product.
B. Do the same for Jerome's method.

Maya began by multiplying $7 \times 6 = 42$. She knows 42 is 4 tens and 2 ones. She wrote the 2 in the ones place and put a small 4 above the tens place as a reminder that she had 4 tens. This small 4 is sometimes called a carry. It reminds Maya to add 4 tens in the next step. Maya then multiplied 7×9 tens = 63 tens = 63 tens and added the 4 tens from her reminder to get 67 tens. She knows this is the same as 670, or 6 hundreds and 7 tens, so she put the 7 in the tens place. She then put the 6 in the hundreds place because she had no more partial products to multiply.

3. How are Jackie's and Maya's methods alike? How are they different?
4. How are Jerome's and Maya's methods alike? How are they different?

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✓ Check-In: Question 5

5. John and Roberto built 6 houses with blocks. Each one was made of exactly 76 blocks. John used the compact method to find out how many blocks they used in all.

76	3
$\times 6$	18
456	blocks

 - A.** Why did John place a 3 above the problem? What does the 3 mean?
 - B.** How did John get the 5 in the tens place of the answer?
 - C.** How did John get the 4 in the hundreds place of the answer?
6. Find the following products. Try to use the compact method or mental math. Estimate to make sure your answers are reasonable.

$\begin{array}{r} 37 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 41 \\ \times 8 \\ \hline \end{array}$	$\begin{array}{r} 641 \\ \times 5 \\ \hline \end{array}$
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 - D.** $794 \times 6 =$
 - E.** $4 \times 27 =$
 - F.** $72 \times 9 =$
7. **A.** Choose one problem from Question 6 and show or tell how you can use mental math to solve it.
B. Show or tell how you estimated for Question 6F.

Multiplying Two-Digit Numbers

Mr. Todd owns the TIMSville Toy Store. He sells the same blocks that the students are using to build their cities. He sells packets of blocks with 42 blocks in each packet. There are 37 packets in the bin. Frank and Tanya figure out how many total blocks are in the bin.

8. Frank thinks about the problem this way:
 - A.** The students call Frank's method the "combination" method. Why do you think they chose that name?
 - B.** Explain how Frank divided the problem into two smaller problems.
 - C.** What method do you think Frank used to solve 42×30 ?
 - D.** What does the 1 mean above the tens column in 42×7 ?
9. Solve these problems using Frank's "combination" method.

$\begin{array}{r} 13 \\ \times 49 \\ \hline \end{array}$	$\begin{array}{r} 58 \\ \times 68 \\ \hline \end{array}$	$\begin{array}{r} 32 \\ \times 74 \\ \hline \end{array}$
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*Answers and/or discussion are included in the lesson.

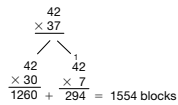
Check-In: Question 5

5. John and Roberto built 6 houses with blocks. Each one was made of exactly 76 blocks. John used the compact method to find out how many blocks they used in all.
- $$\begin{array}{r} 3 \\ 76 \\ \times 6 \\ \hline 456 \end{array}$$
- A. Why did John place a 3 above the problem? What does the 3 mean?
 B. How did John get the 5 in the tens place of the answer?
 C. How did John get the 4 in the hundreds place of the answer?
6. Find the following products. Try to use the compact method or mental math. Estimate to make sure your answers are reasonable.
- A. $\begin{array}{r} 37 \\ \times 2 \\ \hline \end{array}$ B. $\begin{array}{r} 41 \\ \times 8 \\ \hline \end{array}$ C. $\begin{array}{r} 641 \\ \times 5 \\ \hline \end{array}$
- D. $794 \times 6 =$ E. $4 \times 27 =$ F. $72 \times 9 =$
7. A. Choose one problem from Question 6 and show or tell how you can use mental math to solve it.
 B. Show or tell how you estimated for Question 6F.

Multiplying Two-Digit Numbers

Mr. Todd owns the TIMSville Toy Store. He sells the same blocks that the students are using to build their cities. He sells packets of blocks with 42 blocks in each packet. There are 37 packets in the bin. Frank and Tanya figure out how many total blocks are in the bin.

8. Frank thinks about the problem this way:
- A. The students call Frank's method the "combination" method. Why do you think they chose that name?
 B. Explain how Frank divided the problem into two smaller problems.
 C. What method do you think Frank used to solve 42×30 ?
 D. What does the 1 mean above the tens column in 42×7 ?
9. Solve these problems using Frank's "combination" method.
- A. $\begin{array}{r} 13 \\ \times 49 \\ \hline \end{array}$ B. $\begin{array}{r} 58 \\ \times 68 \\ \hline \end{array}$ C. $\begin{array}{r} 32 \\ \times 74 \\ \hline \end{array}$

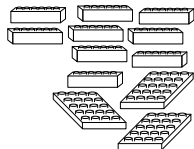


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The Compact Method with Two-Digit Numbers

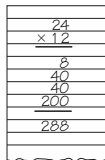
Mr. Todd also sells boxes of larger blocks. He has 24 boxes of the larger blocks. Each box has 12 blocks.

10. A. Estimate the total number of larger blocks.
 B. Will your estimate be higher or lower than the exact answer? Why do you think so?

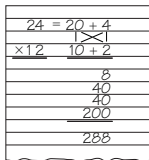


Jacob, Lee Yah, and Nicholas solved the problem using paper-and-pencil methods.

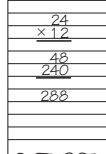
Jacob's All-Partials Method



LeeYah's Expanded-Form Method



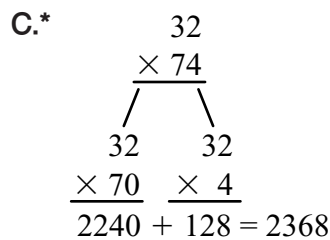
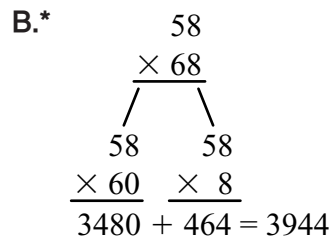
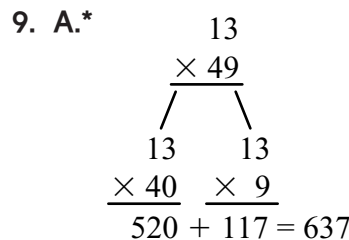
Nicholas's Compact Method



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8. A.* Answers will vary. A possible answer is that the strategy is a combination of the expanded-form method and the compact method.
 B.* Frank partitioned 37 into tens and ones to make two problems: 42×30 and 42×7 .
 C.* Answers will vary. Frank could have used the compact method to multiply 42×3 and then added a zero at the end because he used the mental math strategy of multiplying by tens.

D.* 1 ten



10. A. Estimates will vary. One possible estimate is $10 \times 25 = 250$ blocks.
 B. Answers will vary. One possible response with the estimate above: It is hard to tell because one number was rounded up and the other rounded down.

*Answers and/or discussion are included in the lesson.

11.

$$\begin{array}{r}
 24 \\
 \times 12 \\
 \hline
 24 \quad 24 \\
 \times 10 \quad \times 2 \\
 \hline
 240 + 48 = 288
 \end{array}$$

The partial products are the same.

12. $2 \times 24 = 48$; $10 \times 24 = 240$; Nicholas multiplied the same numbers.

13. Using all-partials:

$$\begin{array}{r}
 23 \\
 \times 74 \\
 \hline
 1400 \\
 80 \\
 210 \\
 12 \\
 \hline
 1702
 \end{array}$$

Nicholas showed how to solve 12×24 using the compact method. He first multiplied 2×24 . To do this, he multiplied 2×4 to get 8 and wrote the 8 in the ones column. He then multiplied 2×20 to get 40 and wrote 4 in the tens column.

$$\begin{array}{r}
 24 \\
 \times 12 \\
 \hline
 48
 \end{array}$$

For the next part of the problem, Nicholas multiplied 10×24 . He first multiplied 10×4 to get 40.



He put a 4 in the tens column. He put the 0 in the ones column. He made sure his columns stayed lined up.

$$\begin{array}{r}
 24 \\
 \times 12 \\
 \hline
 48 \\
 40 \\
 \hline
 288
 \end{array}$$

Then he multiplied 10×20 to get 200.



He put a 2 in the hundreds column.

$$\begin{array}{r}
 24 \\
 \times 12 \\
 \hline
 48 \\
 240 \\
 \hline
 288
 \end{array}$$

Nicholas then added to get 288.

$$\begin{array}{r}
 24 \\
 \times 12 \\
 + 240 \\
 \hline
 288
 \end{array}$$

The products that are added together in the compact method are called partial products. The final product is the sum of all the partial products.

- Solve 12×24 using Frank's "combination" method. How do your partial products compare with Nicholas's partial products?
- What did you multiply to get each of your partial products using the "combination" method? What did Nicholas multiply to get each of his partial products using his compact method?

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13. Compute 74×23 using the all-partials method or the expanded-form method.

Step 1. To compute 74×23 using the compact method, Nicholas first multiplied $4 \times 3 = 12$. He put a 2 in the ones column and a 1 above the problem as a reminder of the 1 ten. He then multiplied $4 \times 20 = 80$. He now has 8 tens and the extra 1 ten, so he has 9 tens altogether. Nicholas wrote a 9 in the tens column.

Step 1:

$$\begin{array}{r}
 1 \\
 23 \\
 \times 74 \\
 \hline
 92
 \end{array}$$

Step 2. Nicholas then multiplied $70 \times 3 = 210$. He put a 0 in the ones column and a 1 in the tens column. He crossed out the 1 above the problem since he had taken care of the 1 ten. He put a 2 to the left of the 1 as a reminder that he has 2 hundreds.

Step 2:



$$\begin{array}{r}
 2 \\
 23 \\
 \times 74 \\
 \hline
 92 \\
 10
 \end{array}$$

Step 3. Nicholas then multiplied $70 \times 20 = 1400$. He added the 200 from his remainder to the 1400 and got 1600. Nicholas put a 6 in the hundreds column and a 1 in the thousands column. He didn't have to carry the 1 thousand because he had no more partial products to compute.

Step 3:

$$\begin{array}{r}
 2 \\
 23 \\
 \times 74 \\
 \hline
 92 \\
 1610
 \end{array}$$

Step 4. Nicholas added the numbers from each row and found the product $74 \times 23 = 1702$.

Step 4:

$$\begin{array}{r}
 2 \\
 23 \\
 \times 74 \\
 \hline
 92 \\
 1610 \\
 \hline
 1702
 \end{array}$$

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Answer Key • Lesson 4: Compact Multiplication Revisited

14. A. Solve 74×23 using Frank's "combination" method.
 B. How is Frank's method like Nicholas's? How are the methods different?
15. Here is another problem where Nicholas used the compact method.

$$\begin{array}{r} 49 \\ \times 64 \\ \hline 196 \\ 2940 \\ \hline 3136 \end{array}$$

— First partial product 4×49
 — Second partial product 60×49

- A. Why did Nicholas put a 3 above the problem?
 B. How did Nicholas get a 9 in the tens column of the first partial product?
 C. How did Nicholas get the 4 in the tens column and the 0 in the ones column of the second partial product?
 D. Why did Nicholas put a 5 above the problem?
 E. How did Nicholas get a 9 in the hundreds column in the second partial product?
 F. Solve Nicholas's problem using either the all-partials method or the expanded-form method.
 G. How do the partial products in Nicholas's compact method compare to the partial products in your solution?

Compute the problems below using the compact method. Solve each problem a second way using either a rectangle model, the all-partials method, or the expanded-form method. If you get two different answers, look for your mistake and correct it.

16. 34×79 17. 27×82 18. 42×28

Check-In: Questions 19-20

19. A. Estimate the product of 49×33 .
 B. Will your estimate be higher or lower than the exact answer?
 C. Solve the problem using the compact method.
 D. Check your work by solving the same problem a different way.
20. Jerome visited a children's museum that had a city made of snap-together blocks. The fire station was made of 53 packets of small blocks and 49 boxes of large blocks. There are 42 blocks in a packet of small blocks and 12 blocks in a box of large blocks. How many blocks did it take to build the fire station? Show or tell how you solved the problem.

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15. A. To remind himself of the three tens he got from the 36 when he multiplied 4×9 .
 B. He multiplied 4×4 tens and got 16 tens; then he added the 3 tens from the first step and got 19 tens.
 C. He multiplied 60×9 and got 540. 540 has 4 tens and 0 ones.
 D. To remind himself of the 5 hundreds from the previous step.
 E. He multiplied 60×40 and got 2400. Then he added the 5 hundreds from the previous step; 24 hundreds + 5 hundreds = 29 hundreds, or 2 thousands and 9 hundreds.
 F. Using expanded form:

$$\begin{array}{r} 49 = 40 + 9 \\ \times 64 \quad 60 + 4 \\ \hline 36 \\ 160 \\ 540 \\ \hline 2400 \\ \hline 3136 \end{array}$$

- G. They are not the same but they add up to the same. The 2 partial products in 15F add up to one of Nicholas's: $36 + 160 = 196$ and $540 + 2400 = 2940$.

16. Compact All-partials

$\begin{array}{r} 79 \\ \times 34 \\ \hline 316 \\ 2370 \\ \hline 2686 \end{array}$	$\begin{array}{r} 79 \\ \times 34 \\ \hline 36 \\ 280 \\ 270 \\ \hline 2100 \\ \hline 2686 \end{array}$
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17. Compact Expanded-Form

$\begin{array}{r} 82 \\ \times 27 \\ \hline 574 \\ 1640 \\ \hline 2214 \end{array}$	$\begin{array}{r} 80 + 2 \\ 20 + 7 \\ \hline 14 \\ 560 \\ 40 \\ \hline 1600 \\ \hline 2214 \end{array}$
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14. A.

$$\begin{array}{r} 23 \\ \times 74 \\ \hline 23 \quad 23 \\ \times 70 \quad \times 4 \\ \hline 1610 + 92 = 1702 \end{array}$$

B. Possible response:

The methods are alike because they both multiply 23×4 and 23×70 . They both get the same answer.

They are different because Frank's method shows both problems. Nicholas doesn't write as much.

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18. Compact:

$$\begin{array}{r} \overset{31}{28} \\ \times 42 \\ \hline 56 \\ 1120 \\ \hline 1176 \end{array}$$

Rectangle model:

	20	8	
40	40 × 20 = 800	40 × 8 = 320	800
			320
			40
2	2 × 20 = 40	2 × 8 = 16	+ 16
			1176

19. A. Possible response: $50 \times 30 = 1500$

B. Answers will vary; it's hard to tell when one number is rounded up and one is rounded down.

C.

$$\begin{array}{r} 49 \\ \times 33 \\ \hline 147 \\ 1470 \\ \hline 1617 \end{array}$$

D. Using expanded form:

$$\begin{array}{r} 49 = 40 + 9 \\ \times 33 = 30 + 3 \\ \hline 27 \\ 120 \\ 270 \\ \hline 1200 \\ \hline 1617 \end{array}$$

20. Possible response:

$$\begin{array}{r} \overset{1}{53} \\ \times 42 \\ \hline 106 \\ 2120 \\ \hline 2226 \end{array} \text{ small blocks}$$

$$49 \times 12 = 50 \times 12 - 12 = 600 - 12 = 588 \text{ large blocks}$$

$$2226 + 588 = 2814 \text{ blocks}$$

Homework

1. Jackie solved the problem 47×52 using the all-partials method. Then she tried using the compact method.

$$\begin{array}{r} 54 \\ \times 47 \\ \hline 350 \\ 160 \\ \hline 2000 \\ 2538 \end{array}$$

- A. How did Jackie get 160 in the third partial product of the all-partials method?
 B. How did Jackie get 2000 in the last partial product of the all-partials method?
 C. Why did Jackie place a 1 above the problem in the compact method?
 D. How did Jackie get a 6 in the tens place in the second partial product in the compact method?
 E. Where is Jackie's record of multiplying 7×50 in the compact method?
 F. How did Jackie get 2160 when using the compact method?
2. Look at the partial products below. If you use the all-partials method for 27×69 , which four partial products will you multiply?

$$\begin{array}{cccc} 6 \times 20 & 60 \times 7 & 2 \times 90 & 9 \times 7 \\ 60 \times 20 & 90 \times 20 & 20 \times 7 & 9 \times 20 \end{array}$$

3. If you use expanded form to multiply 71×38 , which of the four partial products below will you multiply?

$$\begin{array}{cccc} 3 \times 10 & 8 \times 70 & 30 \times 70 & 80 \times 7 \\ 30 \times 7 & 30 \times 1 & 1 \times 30 & 8 \times 1 \end{array}$$

Find the following products using mental math or any paper-and-pencil method. Estimate to be sure your answers are reasonable.

4. $25 \times 15 =$ 5. $46 \times 34 =$ 6. $58 \times 76 =$ 7. $95 \times 64 =$
 8. $70 \times 23 =$ 9. $68 \times 90 =$ 10. $52 \times 55 =$ 11. $76 \times 33 =$

Compact Multiplication Revisited

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Homework

Questions 1–11 (SG p. 507)

1. A. She multiplied 40×4 .
 B. She multiplied 40×50 .
 C. To remind her of the 1 hundred she got when she multiplied 40×4 .
 D. She multiplied 40×4 and got 160. She wrote the zero in the ones place and the 6 in the tens place and put the 1 above the problem as a reminder of the 1 hundred.
 E. In the first partial product; she multiplied 7×50 and got 350, then she added the two tens from the previous step;
 $5 \text{ tens} + 2 \text{ tens} = 7 \text{ tens}$.
 F. She multiplied 40×54 .
2. 60×7 9×7 60×20 9×20
 3. 8×70 30×70 30×1 8×1
 4. 375; Use mental math. Think $25 \times 10 = 250$ and $25 \times 5 = 125$. Then $250 + 125 = 375$.

5. 1564; Use compact method:

$$\begin{array}{r} 12 \\ 34 \\ \times 46 \\ \hline 204 \\ 1360 \\ \hline 1564 \end{array}$$

6. 4408; Use all-partials method:

$$\begin{array}{r} 76 \\ \times 58 \\ \hline 48 \\ 560 \\ 300 \\ \hline 3500 \\ 4408 \end{array}$$

7. 6080; Use “combination” method:

$$\begin{array}{r} 64 \\ \times 95 \\ \hline 64 \quad 64 \\ \times 90 \quad \times 5 \\ \hline 5760 \quad 320 \\ 5760 + 320 = 6080 \end{array}$$

8. 1610; Use mental math:

$$\begin{array}{l} 70 \times 20 = 1400 \text{ and} \\ 70 \times 3 = 210 \\ 1400 + 210 = 1610. \end{array}$$

9. 6120; Use mental math.

$$\begin{array}{l} 68 \times 100 = 6800 \\ 68 \times 90 = 6800 - 68 \times 10 \\ 68 \times 90 = 6800 - 680 \\ 68 \times 90 = 6120 \end{array}$$

10. 2860; Use expanded form:

$$\begin{array}{r} 55 \quad 50 + 5 \\ \times 52 \quad \times 50 + 2 \\ \hline 10 \\ 100 \\ 250 \\ \hline 2500 \\ 2860 \end{array}$$

11. 2508; Use compact method:

$$\begin{array}{r} 1 \\ 76 \\ \times 33 \\ \hline 228 \\ 2280 \\ \hline 2508 \end{array}$$

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