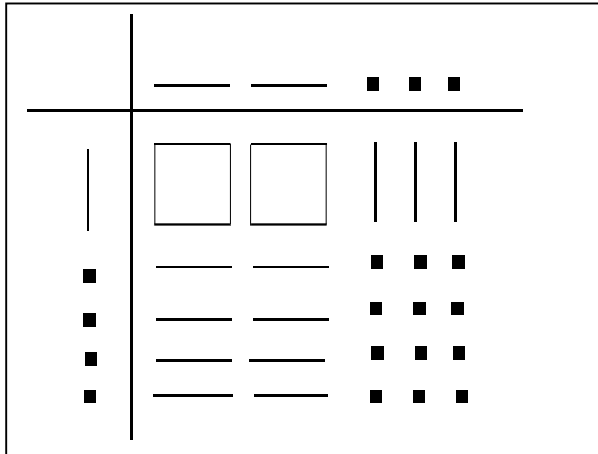


Multiplying with Multi-digit Numbers

Warm Up

We have looked at multiplication using an area model for 2 digit by 2 digit numbers.

For example we know that 23×14 would look like this:



There is a short hand way of doing an area model that is called a “Generic Rectangle.”

Let’s look at that same problem using a generic rectangle

How would I write 23 in expanded form? $(20 + 3)$ *Choral Response*

How would I write 14 in expanded form? $(10 + 4)$

Each place value needs its own row or column. So 23×14 would look like this:

Draw:

	20	+	3
10			
+			
4			

Now we find the product for each set of factors. (Choral response for products) Write partial products into appropriate box.

$$20 \times 10 = (200) \quad 20 \times 4 = (80) \quad 3 \times 10 = (30) \quad 3 \times 4 = (12)$$

Now we need to add the partial products together.

$$200 + 80 + 30 + 12$$

I am going to use decomposition to help me add these numbers:

Think aloud: I know that $80 + 20 = 100$ so I am going to break apart the 30 to $20 + 10$, and I am going to break apart the 12 by place value to see if that helps me combine the numbers in a friendly way.

$$\begin{aligned} & 200 + 80 + 20 + 10 + 10 + 2 \\ = & 200 + 100 + 20 + 2 \\ = & 322 \end{aligned}$$

Is this the only way I could have decomposed these addends? (*Consider having students share other ways to decompose*)

So the product of $23 \times 14 = 322$

Why might I choose to use a generic rectangle instead of an area model? (Possible answers - more efficient, takes up less room)

Guided You try: 17×35

Ask same questions as on the example problem. Students do the thinking – teacher records.

	10	+	7
30	300		210
+			
5	50		35

$$\begin{aligned} & 300 + 210 + 50 + 35 \\ = & 300 + 200 + 10 + 50 + 30 + 5 \\ = & 500 + 90 + 5 \\ = & 595 \end{aligned}$$

“Would it matter if I put $30 + 5$ across the top of my rectangle and $10 + 7$ down the side? (No)

Why wouldn't it matter? (The commutative property of multiplication allows me to multiply the factors in any order) (Can model switching the factors and seeing that you arrive at the same products.)

What do you think I would do if I was finding the product of a 3 digit and a 2 digit number and I wanted to use the generic rectangle? (I would need to add another row or column to my rectangle)

Let's do a problem from your warm up in a generic in pairs.

$$215 \times 57$$

How do I write 215 in expanded form? ($200 + 10 + 5$) How many rows or columns will I need for this factor? (3) Why? (Because there are 3 place values.) How do I write 57 in expanded form? ($50 + 7$) How many rows or columns for this factor? Why? (Because there are 2 place values.) So my generic rectangle will be 3 by 2. Draw it and write in the expanded form of the products.

	200	+	10	+	5
50					
+					
7					

What do we do next? (Find the partial products)

Work with your partner and find the partial products. (*lower affective filter*)

Have students share out the partial products and complete the generic rectangle.

$$50 \times 200 = 10,000 \quad 50 \times 10 = 500 \quad 50 \times 5 = 250$$

$$7 \times 200 = 1,400 \quad 7 \times 10 = 70 \quad 7 \times 5 = 35$$

What do we do next? (add the partial products together)

$$\begin{aligned} &10,000 + 500 + 250 + 1,400 + 70 + 35 \\ &= 10,000 + 1,400 + 500 + 250 + 70 + 35 \\ &= 10,000 + 1,900 + 300 + 20 + 35 \\ &= 10,000 + 2,200 + 55 \\ &= 12,255 \end{aligned}$$

During debrief ask "Does it matter which box we start in? (No)

Could we start somewhere else? (Yes) Would the product be the same? (Yes) Do "You Try" again going in a different order.

You Try: 318×24 (Independently)

	300	+	10	+	8	
20	6,000		200		160	
+						
4	1,200		40		32	

Or

	20	+	4	
300	6,000		1,200	
+				
10	300		40	
+				
8	160		32	

$$\begin{aligned}
 &6,000 + 1,200 + 200 + 160 + 40 + 32 \\
 &= 7,400 + 200 + 32 \\
 &= 7,632
 \end{aligned}$$

Now we are going to look at these same problems with another way to solve them called

Partial Products

Our first problem was 23×14 . We solved that with an area model and the generic rectangle. Now we will solve using partial products:

Have you heard of partial sums? (*Connect to prior knowledge*) Turn to your partner and tell them what partial sums are. Who can share with the class the definition of partial sums?

Partial products are similar to partial sums except that you will be multiplying instead of adding.

23	OR	23
$\begin{array}{r} 23 \\ \times 14 \\ \hline 12 \text{ (4 x 3)} \\ 80 \text{ (4 x 20)} \\ 30 \text{ (10 x 3)} \\ + 200 \text{ (10 x 20)} \\ \hline 322 \end{array}$		$\begin{array}{r} 23 \\ \times 14 \\ \hline 30 \text{ (10 x 3)} \\ 200 \text{ (10 x 20)} \\ 80 \text{ (4 x 20)} \\ + 12 \text{ (4 x 3)} \\ \hline 322 \end{array}$

Just like the generic rectangle, when doing partial products, you can multiply the digits in any order – but, you must pay careful attention to the place value of each digit.

Do: Work the example out as you are explaining

If I start with the 4 in 14, I first multiply 4 times the 3 in 23. What is the place value of the 4? (Ones)

What is the place value of the 3? (ones.) What is 4×3 ? (12) I will write this partial product down. Now I am going to multiply the 4 and the 2. What is the place value of the 2? (tens.) What is the value? (20) Yes, 20. So I multiply 4 ones by 2 tens or 20. What is 4×20 ? (80) Yes, 80. I write the 80 below the 12.

Now I am going to multiply the 1 in 14. What is the place value of the one? (tens) Yes so what is the value? (10) Yes 10. $10 \times 3 = 30$. Have I multiplied all the digits? (no.) What else do I need to multiply? (The one times the 2 or 10 times 20) I need to multiply the one in the tens place by the 2 in the tens place, so what is 10×20 ? (200)

Now I have the 4 partial products and to find the final product I need to add the partial products together.

When doing partial products, I can start with any digit.

Show other example using the same questioning.

You try in Pairs: 17×35

$$\begin{array}{r} 17 \\ \times 35 \\ \hline 300 \text{ (30 x 10)} \\ 210 \text{ (30 x 7)} \\ 50 \text{ (5 x 10)} \\ + 35 \text{ (7 x 5)} \\ \hline 595 \end{array}$$

So do you think partial products will work when we are multiplying with a 3-digit number?

Let's do one together 215×57

Does it matter if I start in the ones place or the tens place? (no)

$$\begin{array}{r} 215 \\ \times \quad 57 \\ \hline 10,000 \quad (50 \times 200) \\ 500 \quad (50 \times 10) \\ 250 \quad (50 \times 5) \\ 1,400 \quad (7 \times 200) \\ 70 \quad (7 \times 10) \\ + \quad 35 \quad (7 \times 5) \\ \hline 12,255 \end{array}$$

I am going to multiply the 5 x 2 but is it really 5 x 2? (No, it is 50 x 200) The 2 is in the hundreds place and the 5 is in the 10's place so it is 50 x 200. *Continue talking through each step pointing out the place value and the value.*

You Try Independently:

$$\begin{array}{r} 318 \times 24 \\ 318 \\ \times \quad 24 \\ \hline 32 \quad (4 \times 8) \\ 40 \quad (4 \times 10) \\ 1200 \quad (4 \times 300) \\ 160 \quad (20 \times 8) \\ 200 \quad (20 \times 10) \\ +6000 \quad (20 \times 300) \\ \hline 7,632 \end{array}$$

You try 3ways:

$$217 \times 43$$

Partial Products

$$\begin{array}{r} 217 \\ \times 43 \\ \hline 21 \quad (3 \times 7) \\ 30 \quad (3 \times 10) \\ 600 \quad (3 \times 200) \\ 280 \quad (40 \times 7) \\ 400 \quad (40 \times 10) \\ + 8000 \quad (40 \times 200) \\ \hline 9,331 \end{array}$$

Generic Rectangle

	40	+	3
200	8,000		600
+			
10	400		30
+			
7	280		21

$$8,000 + 600 + 400 + 30 + 280 + 21 = 9,331$$

Traditional

$$\begin{array}{r} 217 \\ \times 43 \\ \hline 651 \\ 8680 \\ \hline 9331 \end{array}$$