Partial Products Multiplication:

Partial-Products Multiplication with Multidigit Factors

When you use partial-products multiplication with multidigit factors, it is important that all of the partial products are included. Use an estimate to check whether your answer is reasonable.

Example

34 * 26 = **?**

Estimate the product: 34 rounds down to 30, and 26 rounds up to 30. 30 * 30 = 900

Think of 34 as 30 + 4.				3	4
Think of 26 as 20 + 6.		*		2	6
Multiply each part of 34 by each part of 26.	20 * 30 →		6	0	0
	20 * 4 →			8	0
	6 * 30 →		1	8	0
	6 * 4 →	+		2	4
Add the four partial products.			8	8	4

34 * 26 = **884**

The answer makes sense because 884 is close to the estimate of 900.

Lattice Multiplication:

Lattice Multiplication

Lattice multiplication has been used for hundreds of years. It is based on placing answers to basic multiplication facts in boxes, and then adding along diagonals. The box with cells and diagonals is called a **lattice.**

Lattice multiplication works because each diagonal is the same as a place-value column. The lattice is like a place-value chart. The far right-hand diagonal is the ones place, the next diagonal to the left is the tens place, the third diagonal is the hundreds place, and so on.

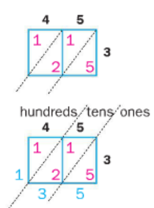
Example

3 * 45 = **?**

Estimate the product: 45 is between 40 and 50, so the product should be between 3 * 40 and 3 * 50, or between 120 and 150.

Write 45 above the lattice.
Write 3 on the right side of the lattice.
Multiply 3 * 5. Then multiply 3 * 4.
Write the answers in the lattice as shown.

Add the numbers along each diagonal, starting at the right.
Read the answer. 3 * 45 = **135**



135 is reasonable since it falls between 120 and 150.

Everyday Math Algorithms

An algorithm is a procedure for solving a problem based on conducting a series of specified actions. In *Everyday Mathematics* students use invented, alternative, and traditional algorithms to fully understand math at a greater depth and compute in an effective, efficient, and successful manner. After multiple hands-on activities strategically placed in the program, students work with visual representations (picture models) and then algorithms. Inside you will find several, but not all, of the alternative algorithms your children will use.

Your student's math reference book explains and illustrates each algorithm. Additionally your student's launch pad from Everyday Math's technology platform, ConnectEd, has digital explanations. Lastly, Everyday Math's parent website, http://everydaymath.uchicago.edu/parents/algorithms-tutorials/, shares many algorithm procedures as well as the background for various algorithms.

Coatesville Area School District

Algorithms

Partial Sums Addition:

Here is the partial-sums method for adding 2-digit or 3-digit numbers:

1. Add the 100s.
2. Add the 10s.
3. Add the 1s.
4. Add the sums you just found (the partial sums).

Did You Know?

Another word for *method* is *algorithm.* A method is a clear set of rules used to solve a problem. So is an algorithm.

Example Add 248 + 187 using the partial-sums method.

		100s	10s	1s
		2	**4**	**8**
		+ **1**	**8**	**7**
Add the 100s.	200 + 100 →	3	0	0
Add the 10s.	40 + 80 →	1	2	0
Add the 1s.	8 + 7 →		1	5
Add the partial sums.	300 + 120 + 15 →	**4**	**3**	**5**

248 + 187 = 435

Column Addition:

You can use **column addition** to find sums with paper and pencil.

To use column addition:

- Draw lines to separate the 1s, 10s, and 100s places.
- Add each place-value column. Write each sum in its column.
- If the sum of any column is a 2-digit number, make a trade with the column to the left.

You can use an estimate to check whether your answer is reasonable.

Example

248 + 187 = **?**

Estimate: 248 is close to 250, and 187 is close to 200.

250 + 200 = 450

The exact sum should be close to 450.

	100s	10s	1s
	2	4	8
	+ 1	8	7
Add the numbers in each column.	3	12	15
Trade 10 ones for 1 ten. Move 1 ten to the tens column.	3	13	5
Trade 10 tens for 1 hundred. Move the 1 hundred to the hundreds column.	4	3	5

248 + 187 = **435**

435 is a reasonable answer because it is close to the estimate of 450.

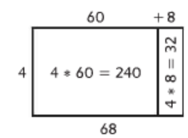
Partitioning Rectangles for Multiplication:

Partitioning rectangles is especially helpful when either of the factors are larger numbers.

Example

4 ∗ 68 = **?**

Estimate: 4 ∗ 70 = 280



	2	4	0
+		3	2
	2	7	2

4 ∗ 68 = **272**

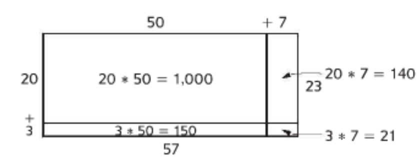
This answer is reasonable since it is close to the estimate of 280.

You can use area models to solve multiplication problems when both factors are multidigit numbers.

Example

23 ∗ 57 = **?**

Estimate: 20 ∗ 60 = 1,200



	1,	0	0	0
		1	5	0
		1	4	0
+		+	2	1
	1,	3	1	1

23 ∗ 57 = **1,311**

This is reasonable since it is close to the estimate of 1,200.

Trade First Subtraction:

To use **trade-first subtraction,** compare each digit in the top number with each digit below it and make any needed trades before subtracting. To subtract numbers using trade-first subtraction:

- Look at the digits in each place and make all necessary trades.

Example

352 – 164 = **?**

Estimate the difference: 352 is close to 350, and 164 is close to 150.

350 – 150 = 200

	100s	10s	1s
	3	5	2
–	1	6	4

Look at the 1s place.

2 < 4, so you need to make a trade.

	100s	10s	1s
		4	12
	3	~~5~~	~~2~~
–	1	6	4

So trade 1 ten for 10 ones.

Mark the problem to show the trade.

Now look at the 10s place. 4 < 6, so you need to make a trade.

	100s	10s	1s
		14	
	2	~~4~~	12
	~~3~~	~~5~~	~~2~~
–	1	6	4
	1	8	8

So trade 1 hundred for 10 tens.

Mark the problem to show the trade.

Now subtract in each column.

352 – 164 = **188**

The answer makes sense because 188 is close to the estimate of 200.

Open Number Line for Subtraction:

You can use a number line to show subtraction by counting up. There are many different ways to use this method to solve subtraction problems. Here is one way:

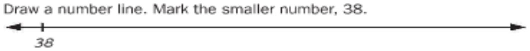
Example

325 – 38 = **?**

Estimate the difference: You can round 325 to 330 and round 38 to 40.

330 – 40 = 290

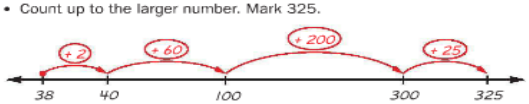
Draw a number line. Mark the smaller number, 38.



Think: How can I get from 38 to 325?

Start at 38. As you count from 38 up to 325, circle each amount that you count up.

- Count up to the nearest 10. Mark 40 on the number line.
- Count up to the nearest 100. Mark 100.
- Count up to the largest possible hundred. Mark 300.
- Count up to the larger number. Mark 325.



Add the amounts you circled: 2 + 60 + 200 + 25 = 287

You counted up by 287.

325 – 38 = **287**

The answer makes sense because 287 is close to the estimate of 290.

Partial Quotients Division:

Partial-Quotients Division

Partial-quotients division is similar to partitioning rectangles in the area model, without having to draw a rectangle. At each step in partial-quotients division, you find a partial answer (called a **partial quotient**). You add the partial answers to find the quotient.

Study this example. To find the number of [5s] in 70, first find partial quotients, then add them. Record the partial quotients in a column to the right of the original problem.

Example

70 / 5 = **?**

Estimate: 50 / 5 = 10 and 100 / 5 = 20, so the quotient will be between 10 and 20.

Write the partial quotients in this column.

5) 70		
– 50	10	*Think:* How many [5s] are in 70? At least 10. The first partial quotient is 10. 10 * 5 = 50 Subtract 50 from 70.
20		
– 20	4	*Think:* How many [5s] are in 20? There are 4. The second partial quotient is 4. 4 * 5 = 20 Subtract 20 from 20.
0	14	Add the partial quotients.

Quotient

The answer is **14.** Record the answer as $5\overline{)70}$ with 14 on top, or rewrite 70 / 5 = 14.

The answer makes sense because 14 is between 10 and 20, which matches the estimate.

There are different ways to find partial quotients when you use partial-quotients division.

Example

228 / 6 = **?**

Estimate: 228 is close to 240. 240 / 6 = 40

One way:

6)228	
– 180	30
48	
– 30	5
18	
– 18	3
0	38

Another way:

6)228	
– 120	20
108	
– 60	10
48	
– 48	8
0	38

Still another way:

6)228	
– 180	30
48	
– 48	8
	38

The quotient, **38,** is the same for each way.

The answer is reasonable since it is close to the estimate of 40.