MA.5.NSO.2.1

Overarching Standard: MA.5.NSO.2 *Add, subtract, multiply and divide multi-digit numbers.*

Benchmark of Focus

MA.5.NSO.2.1 Multiply multi-digit whole numbers including using a standard algorithm with procedural fluency.

Related Benchmark/Horizontal Alignment

- MA.5.FR.2.2
- MA.5.AR.1.1
- MA.5.M.1.1
- MA.5.GR.3.1/3.2/3.3

Vertical Alignment

Previous Benchmarks
- MA.4.NSO.2.1/2.2

Next Benchmarks
- MA.6.NSO.2.1

Terms from the K-12 Glossary
- Equation
- Expression
- Whole Number

Purpose and Instructional Strategies

The purpose of this benchmark is for students to demonstrate procedural fluency while multiplying multi-digit whole numbers. To demonstrate procedural fluency, students may choosethe standard algorithm that works best for them and demonstrates their procedural fluency. A standard algorithm is a method that is efficient and accurate (MTR.3.1). In Grade 4, students had experience multiplying two-digit by three-digit numbers using a method of their choice with procedural reliability (MA.4.NSO.2.2) and multiplying two-digit by two-digit numbers using a standard algorithm (MA.4.NSO.2.3). In Grade 6, students will multiply and divide multi-digit numbers including decimals with fluency (MA.6.NSO.2.1).

- There is no limit on the number of digits for multiplication in Grade 5.
- When students use a standard algorithm, they should be able to justify why it works conceptually. Teachers can expect students to demonstrate how their algorithm works, for example, by comparing it to another method for multiplication. (MTR.6.1)
- Along with using a standard algorithm, students should estimate reasonable solutions before solving. Estimation helps students anticipate possible answers and evaluate whether their solutions make sense after solving.

- This benchmark supports students as they solve multi-step real-world problems involving combinations of operations with whole numbers (MA.5.AR.1.1).

Common Misconceptions or Errors

- Students can make computational errors while using standard algorithms when they cannot reason why their algorithms work. In addition, they can struggle to determine where or why that computational mistake occurred because they did not estimate reasonable values for intermediate outcomes as well as for the final outcome. During instruction, teachers should expect students to justify their work while using their chosenalgorithms and engage in error analysis activities to connect their understanding to the algorithm.

Strategies to Support Tiered Instruction

- Instruction includes estimating reasonable values for partial products as well as final products.
    - For example, students make reasonable estimates for the partial products and final product for 513 × 32. Before using an algorithm, students can make estimates for partial products and final product to make sure that they are using the algorithm correctly and the answer is reasonable. First, students will estimate the first partial product by rounding 513 to the nearest hundred, 500, and multiplying by 2. When using an algorithm to solve the first partial product, the answer should be approximately 1,000. Next, students can estimate the second partial product by rounding 513 to 500 and multiplying by 30. When using an algorithm to solve the second partial product, it should be approximately 15,000. Finally, students can add the estimates for the partial products to find an estimate for the final product.

			5	0	0		513 rounded to the nearest hundred
×				3	2		
		1	0	0	0	$= 2 \times 500$	first partial product estimate
+	1	5	0	0	0	$= 30 \times 500$	second partial product estimate
	1	6	0	0	0		final product estimate

    - For example, students make reasonable estimates for the partial products and final product for 41 × 23. Before using an algorithm, students can make estimates for our partial products and final product to make sure that they are using the algorithm correctly and the answer is reasonable. First, students will estimate the first partial product by rounding 41 to 40 and multiplying by 3. When using an algorithm to determine the first partial product, it should be approximately 120. Next, students will estimate the second partial product by rounding 41 to 40 and multiplying by 20. When using an algorithm to determine the second partial product, it should be approximately 800. Finally, students can add the estimates for the partial products to find an estimate for the final product.

		4	0		41 rounded to the nearest ten
×		2	3		
	1	2	0	$= 3 \times 40$	first partial product estimate
+	8	2	0	$= 20 \times 40$	second partial product estimate
	9	4	0		final product estimate

- Instruction includes explaining and justifying mathematical reasoning while using a multiplication algorithm. Instruction includes determining if an algorithm was used correctly by analyzing any errors made and reviewing the reasonableness of solutions.
  - For example, students use an algorithm to determine 513 × 32 and explain their thinking using place value understanding. Begin by multiplying 2 ones times 3 ones; students should recognize this equals 6 ones. Students can write the 6 ones under the line, in the ones place. Next, multiply 2 ones times 1 ten, which students should recognize this equals 2 tens. They can write the 2 tens under the line in the tens place. Then, multiply 2 ones times 5 hundreds, which equals 10 hundreds. Write the 10 hundreds under the line in the thousands and hundreds place because 10 hundred is the same as 1 thousand. Students should see that this gives the first partial product of 1,026. Now multiply the 3 ones by the 3 tens from 32; this equals 9 tens or 90. Record 90 below the first partial product of 1,026. Next, multiply the 1 ten by 3 tens, which equal 3 hundreds, and write the 3 in the hundreds place of the second partial product. Then, multiply the 5 hundreds times 3 tens, which equals 15 thousands. Students can write the 15 in the ten thousands and thousands place of our second partial product, noticing that the second partial product is 15,390. Finally, add the partial products to find the product of 16,416.

			5	1	3		
×				3	2		
		1	0	2	6	$= 2 \times 513$	
+	1	5	3	9	0	$= 30 \times 513$	This is the same as $(3 \times 513) \times 10$
	1	6	4	1	6		

  - For example, have students use an algorithm to determine 41 × 23 and explain their thinking using place value understanding. Explicit instruction could include "Begin by multiplying 3 ones times 1 one. This equals 3 ones. We will write the 3 ones under the line, in the ones place. Next, we will multiply 3 ones times 4 tens. This equals 12 tens. We will write the 12 tens under the line in the hundreds and tens place because 12 tens is the same as 1 hundred 2 tens. This gives us our first partial product of 123. Now we will multiply the 1 one by the 2 tens from 23. This equals 2 tens or 20. We will record 20 below our first partial product of 123. Next, we will multiply 2 tens times 4 tens, which equal 8 hundreds. We will write the 8 in the hundreds place of our second partial product. Our second partial product is 820. Finally, we add our partial products to get 943."

$$
\begin{array}{rrrrl}
 & & 4 & 1 & \\
\times & & 2 & 3 & \\
\hline
 & 1 & 2 & 3 & = 3 \times 41 \\
+ & 8 & 2 & 0 & = 20 \times 41 \quad \Rightarrow \quad \text{This is the same as } (2 \times 41) \times 10 \\
\hline
 & 9 & 4 & 3 &
\end{array}
$$

- For example, students solve 41 × 23 using an area model and place value understanding and explain how each partial product is calculated and what it represents as they multiply using the area model. Then, students explain how the final product is calculated using the partial products from the area model

	20	3
40	40 x 20 = 800	40 x 3 =120
1	1 x 20 = 20	1 x 3 = 3

$$
\begin{array}{rrrr}
 & 8 & 0 & 0 \\
 & 1 & 2 & 0 \\
 & & 2 & 0 \\
+ & & & 3 \\
\hline
 & 9 & 4 & 3
\end{array}
$$

Questions to ask students:

- Ask a student who estimated and then solved if their solution is reasonable and how they know if it is reasonable or not.

- Ask students why they wrote a zero before multiplying the second partial product (Example: 372 x 46)
    - Sample answer that indicates understanding: Before multiplying the second partial product I write a zero because I'm not multiplying 372 x 4, I'm multiply 372 x 40. The zero is needed to reflect the actual value of the 4.
    - Sample answer that indicates an incomplete understanding or misconception: Before you multiply the second partial product you must write a zero to get the correct answer.

- Ask students why the second partial product in the standard algorithm is always greater than the first when multiplying by a 2-digit number.
    - Sample answer that indicates understanding: The second partial product is always greater because now we are multiplying a number with a value in the tens place, when before we were multiplying a number with only a value in the ones place.

Instructional Tasks

Instructional Task 1

Maggie has three dogs. She buys a box containing 175 bags of dog food. Each bag weighs 64 ounces.

Part A. What is the total weight of the bags of dog food in ounces?
Part B. Maggie has a storage cart to transport the box that holds up to 750 pounds. Will the storage cart be able to hold the box? Explain.

Instructional Items

Instructional Item 1

What is the product of 1,834 × 23?

Benchmark	Context	Assessment Limits
MA.5.NSO.2.1 Multiply multi-digit whole numbers including using a standard algorithm with procedural fluency.	Mathematical	Items should have factors greater than two digits and a product that has six digits.

ALD 2	ALD 3	ALD 4	ALD 5
N/A	multiplies multi-digit whole numbers, four digits by two digits or five digits by two digits, using a standard algorithm.	multiplies multi-digit whole numbers including using a standard algorithm with procedural fluency.	identifies an error and multiplies multi-digit whole numbers including using a standard algorithm with procedural fluency.

Additional Resources:

CPALMS

Khan Academy

Resources/Tasks to Support Your Child at Home:

Multiplying whole numbers game