Cluster 4: Develop multi-digit multiplication and division strategies through meaningful contexts and models
Duration: 5-6 weeks
Content Standards **This list includes standards that will be addressed in this cluster, but not necessarily mastered, since all standards are benchmarks for the end of the year. Please note strikethroughs and recommendations in the Important Considerations section for more information.** **Use place value understanding and the properties of operations to perform multi-digit arithmetic.** **NC.4.NBT.5** Multiply a whole number of up to three digits by a one-digit whole number, and multiply up to two two-digit numbers with place value understanding using area models, partial products, and the properties of operations. Use models to make connections and to develop the algorithm. **NC.4.NBT.6** Find whole-number quotients and remainders with up to three-digit dividends and one-digit divisors with place value understanding using rectangular arrays, area models, repeated subtraction, partial quotients, properties of operations, and/or the relationship between multiplication and division. **Solve problems involving area and perimeter.** **NC.4.MD.3** Solve problems with area and perimeter. ● Find areas of rectilinear figures with known side lengths. ● Solve problems involving a fixed area and varying perimeters with a fixed perimeter and varying areas. ● Apply the area and perimeter formulas for rectangles in real world and mathematical problems. **Use the four operations with whole numbers to solve problems.** **NC.4.OA.3** Solve two-step word problems involving the four operations with whole numbers. ● Use estimation strategies to assess reasonableness of answers. ● Interpret remainders in word problems. ● Represent problems using equations with a letter standing for unknown quantity. **Supporting Standards** Represent and solve problems involving multiplication and division. **NC.4.OA.1** Interpret a multiplication equation as a comparison. Multiply or divide to solve word problems involving multiplicative comparisons using models and equations with a symbol for the unknown number. ~~Distinguish multiplicative comparison from additive comparison.~~ **NC.4.NBT.1** Explain that a multi-digit whole number, a digit in one place represents 10 times as much as it represents in the place to its right, up to 100,000.

Mathematical Practices:
1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning.

What is the mathematics?

During this cluster, students will apply their understanding of place value, the models for multiplication (array/area model, tape diagram, partial products, etc.), and the properties of operations (distributive, associative, commutative properties) to explore, develop, discuss and solve multiplication and division problems involving multi-digit numbers. A variety of contexts should be used to provide opportunities for students to select and make sense of different strategies to compute numbers. Investigation of area and perimeter should be incorporated throughout this cluster. Students will use their understanding of rectangles and reason about multiplication and division related to the dimensions of a rectangle. Through the investigations, the area and perimeter formulas will emerge in connection to the area model. Students will also explore division using the area model and the relationship between multiplication and division to solve problems with missing side measures. Students will expand on their work of representing and solving problems using the area model and partial products solving two-digit by two-digit multiplication problems. As the numbers get larger, students will see the need for more efficient strategies. Students will compare and connect the standard algorithm to the area model and partial products method.

- Students will explore multiplication and division patterns when multiplying/dividing by 10, 100, and 1,000 through various models (ex: place value blocks and disks, array model, tape diagram, numerically- 4 x 3, 4 tens x 3, 4 hundreds x 3).
- Students will use the properties of operations to decompose numbers (3 x 20 = 3 x 2 x 10).
- Students will use estimation and mental math strategies as an ongoing practice to calculate and reason about products and quotients.
- Students will use the area model, partial products, and other appropriate strategies to represent and solve multiplication problems.
- Students will use the area model and partial quotients to represent and solve division problems (both partitive and quotative division situations).
- Interpret division problems as either number of groups unknown or group size unknown.
- Students will understand the inverse relationship between multiplication and division.
- Students will explore multiple ways to divide multi-digit numbers and be able to explain chosen strategy.
- Students will describe the role of place value in multiplication and division strategies.
- Students will compare the area model, partial products, and the standard algorithm and understand the connection through use of the distributive property.
- Students will choose efficient and appropriate strategies to solve multiplication or division problems.

Important Considerations:

- Contexts that are familiar and relevant to students are a meaningful way to engage **all** students, in meaningful development of multiplication/division concepts, models, and relationships. Contexts can be developed using common classroom experiences, through read alouds, from a story and/or pictures, and written in a story problem format. Rich tasks with multiple entry and exit points allow for natural differentiation of instruction and are accessible for all students.

- This cluster has many opportunities to make relevant mathematical connections between topics. (ex: Exploring multiplication and division patterns when multiplying/dividing by 10, 100, and 1,000 is an opportunity to further develop understanding of the base ten system; students make comparison, place value, and multiplication connections as the value of digits change when they are multiplied by 10, 100, and 1,000. (ex: 500 is 10 times greater than 50); Building on work with multiples, students break apart factor(s) into multiples of 10 and 100 before multiplying (3 x 20 = 3 x 2 x 10). Solve missing factor problems given a comparison situation and use multiplicative thinking or division to find the missing factor.)
- Allow students to model and solve problems in ways that make sense to them. Teachers may create a context to lead students toward a specific model, but honor divergent ideas and strategies as students engage in the math. Comparing different ideas and strategies to solving problems can lead students to deeper mathematical understanding.
- Students should solve division problems with/without remainders. Discussion about how to interpret remainders based on the context of the problem being solved is important as students decide whether they need to round up (ex. We have 20 students going on the field trip. Each car can carry 3 students. How many cars are needed?) or down (ex. I have $20 to buy packs of stickers. Each pack costs $3. How many packs can I buy?) or use the exact amount (ex. We have 20 brownies to share with 3 table groups. How many brownies will each table group get?)
- As the strategies for solving multiplication and division problems become more efficient, the math becomes more abstract (ex: going from the area model of 4 partial products → area model with 2 partial products → partial products without the area model → standard algorithm). Some students (specifically students with disabilities) may not be ready to use the standard algorithm *with understanding*. All students should continue to be exposed and work towards efficient, accurate strategies, but should not use procedural strategies without understanding.
- Students are not expected to be fluent with standard algorithm until 5th grade.
- Students work in multiple contexts with one and two-step word problems throughout the cluster. They use variables to represent unknown quantities in number sentences. They use estimation to anticipate and assess the reasonableness of their solutions.