

Cluster 4: Making Sense of Multiplication and Division

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 the recommendations in the Important Considerations section of this cluster for more information.

NC.3.OA.1

For products of whole numbers with two factors up to and including 10:

- Interpret the factors as representing the number of equal groups and the number of objects in each group.
- Illustrate and explain strategies including arrays, repeated addition, decomposing a factor, and applying the commutative and associative properties.

NC.3.OA.2

For whole-number quotients of whole numbers with a one-digit divisor and a one-digit quotient:

- Interpret the divisor and quotient in a division equation as representing the number of equal groups and the number of objects in each group.
- Illustrate and explain strategies including arrays, repeated addition or subtraction, and decomposing a factor.

NC.3.OA.3

Represent, interpret, and solve one-step problems involving multiplication and division.

- Solve multiplication word problems with factors up to and including 10. Represent the problem using arrays, pictures, and/or equations with a symbol for the unknown number to represent the problem.
- Solve division word problems with a divisor and quotient up to and including 10. Represent the problem using arrays, pictures, repeated subtraction and/or equations with a symbol for the unknown number to represent the problem.

NC.3.OA.6

Solve an unknown-factor problem, by using division strategies and/or changing it to a multiplication problem.

NC.3.OA.7

Demonstrate fluency with multiplication and division with factors, quotients and divisors up to and including 10.

- Know from memory all products with factors up to and including 10.
- Illustrate and explain using the relationship between multiplication and division.
- Determine the unknown whole number in a multiplication or division equation relating three whole numbers.

NC.3.OA.8

Solve two-step word problems using addition, subtraction, and multiplication, representing problems using equations with a symbol for the unknown number.

NC.3.OA.9

Interpret patterns of multiplication on a hundreds board and/or multiplication table.

NC.3.NBT.3

Use concrete and pictorial models, based on place value and the properties of operations, to find the product of a one-digit whole number by a multiple of 10 in the range 10–90.

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?

This cluster represents the major work of third grade focused on multiplication and division. The cluster builds on the work of Cluster 1 where students began their development of understanding the meaning of multiplication as equal groups through their work with story problems. Clusters 2 and 3 both included some supporting work on multiplication in the context of data displays (scaled picture graphs and bar graphs) and two-step story problems that involve equal-groups situations. The work in this cluster expands their previous work with multiplication to include division and the representation of division with symbolic notation. Their learning in this cluster also prepares them for the work of Cluster 6 focused on applying multiplication to area. Multiple clusters of work around multiplication (Clusters 1, 2, 4, and 6) allow students to gain conceptual understanding and build towards procedural fluency over the course of the year, giving them time to deeply learn the content.

Students will:

- Represent story problems that involve multiplication and division (equal groups) with a variety of models including arrays, pictures, repeated addition/subtraction, and equations.
- Interpret factors as the number of equal groups and the number of objects in each group.
- Understand that division can be used to find the number of objects in each group (partitive division, size of the groups unknown) or to find the number of groups (measurement division, number of groups unknown).
- Explore and apply properties of multiplication (commutative, associative, distributive) to solve multiplication and division problems involving single-digit factors. (See notes in the “Important Considerations” section about the properties).
- Describe patterns of multiplication on a hundreds board or a multiplication table.
- Solve two-step story problems involving addition, subtraction, and multiplication.
- Share their thinking by communicating their reasoning and sharing their solutions.

Important Considerations

- As in Cluster 1, the content of this cluster should be developed through the use of story problems. Building an understanding of the “equal groups” interpretation of multiplication and division means giving students many experiences with real problems that are situated in their own context and community.
- Multiplication and division are taught simultaneously to help students understand the relationship between them.
- While the use of representations will continue to support students’ solutions, writing an equation using a variable for the unknown number is included in this cluster.
- Arrays should be a central part of this unit including story problems that lend themselves to arrays (i.e., things arranged in rows).
- To develop the concept of the commutative property, focus on real situations. While 2 bags with 6 apples each looks different than 6 bags with 2 apples each, both situations have a total of 12 apples. It is important to acknowledge that 2×6 and 6×2 look different when we draw a

picture using the “groups of” interpretation, but what remains the same is the value of the two expressions.

- To develop the concept of the associative property, consider its natural use by your students to make numbers friendlier. For example, for 8×6 , a student might think of the problem as $8 \times 3 \times 2$, multiply 8×3 first, and then multiply by 2. By making 8×6 friendlier, the student has essentially changed the grouping of the factors: $8 \times (3 \times 2) = (8 \times 3) \times 2$. When students use strategies like this one, these are opportunities to discuss the associative property in the context of its use rather than separately.
- Similar to the associative property, the distributive property can be discussed as it is used by students to solve problems. For example, for solving 7×8 , a student might use 5 groups of 8 and 2 groups of 8 to figure out 7 groups of 8. By decomposing 7 and then multiplying by 8, the student is using the distributive property: $(5 + 2) \times 8 = (5 \times 8) + (2 \times 8)$. Array models on grid paper are useful for demonstrating the distributive property.
- Number talks can be an effective approach for trying to build computational fluency with multiplication facts. That is, number talks encourage students to use facts they know to help them with facts they don't know (similar to the examples provided in the three previous bullets).
- Students work two-step story problems with addition, subtraction, and multiplication. Since multiplication understanding is still developing, students could represent the situation with objects or pictures, and then write an equation to match their picture. Here are two possible story problems that serve as examples of stories that would be appropriate at this point in the year:
 - Katie and Valerie are giving one apple to each person in their class. Katie has three bags of apples with 4 apples in each bag, and Valerie has two bags of apples with 7 apples in each bag. How many apples do they have? If there are 25 total people in their class, do they have enough apples?
 - Raymond and Timothy each store their toy cars in a case. Raymond's case has two trays of cars with 8 cars in each tray. Timothy's case has four trays of cars with 6 cars in each tray. Who has more cars? How many more?
- Building fluency with multiplication facts started with facts with a factor of 2, 5, and 10 in Cluster 1 due to past experiences with skip counting. Building fluency with other facts should begin in this cluster as students use the facts they already know to learn new facts (ex. Students multiply by 4 by doubling twice, $7 \times 4 = 7 \times 2 \times 2$, or multiply by 8 by doubling three times, $7 \times 8 = 7 \times 2 \times 2 \times 2$). Students will continue to apply these strategies in later grades (ex. $21 \times 4 = 21 \times 2 \times 2$).
- The goal to know facts from memory is an end-of-year target. Therefore, using number talks, games, and encouraging students to use facts they know to help them with facts they don't know should be ongoing with a focus on students' flexibility in mathematical thinking. Timed drill is not recommended for trying to build fluency.

