Cluster 7: Understanding operations of fractions and decimals

Duration: 4-5 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.

Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

NC.4.NF.3

Understand and justify decompositions of fractions with denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100.

- Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
- Decompose a fraction into a sum of unit fractions and a sum of fractions with the same denominator in more than one way using area models, length models, and equations.
- Add and subtract fractions, including mixed numbers with like denominators, by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction.
- Solve word problems involving addition and subtraction of fractions, including mixed numbers by writing equations from a visual representation of the problem.

Use unit fractions to understand operations of fractions.

NC.4.NF.4

Apply and extend previous understandings of multiplication to:

- Model and explain how fractions can be represented by multiplying a whole number by a unit fraction, using this understanding to multiply a whole number by any fraction less than one.
- Solve word problems involving multiplication of a fraction by a whole number.

Understand decimal notation for fractions, and compare decimal fractions.

NC.4.NF.6

Use decimal notation to represent fractions.

- Express, model and explain the equivalence between fractions with denominators of 10 and 100.
- Use equivalent fractions to add two fractions with denominators of 10 or 100.
- Represent tenths and hundredths with models, making connections between fractions and decimals

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?

In this cluster, students build and on their understanding of unit fractions, relative size of fractions, and fraction equivalence to reason and compute with numbers. Students compose fractions from unit fractions and decompose fractions into unit fractions (including mixed numbers) representing their understanding with visual models and number sentences. Using fraction knowledge and prior understanding of whole-number operations, students explore and develop fraction computation strategies.

- Students will represent decompositions of fractions (including mixed numbers) using visual models (e.g. area model, number line, tape diagrams).
- Students will write a number sentence to match visual representations. (e.g. show ¾ using a model and write an appropriate number sentence matching the model, ¾ = ¼ + ¼ + ¼)
- Students will use repeated addition to describe decomposed fractions and connect that to their understanding of multiplication. (e.g. Show 3 skips of ¼ on a number line and connect that understanding to multiplication.)
- Students will describe decomposed fractions as a whole number times a unit fraction (¾ = ¼ + ¼ + ¼ = 3 x ¼).
- Students will build on meaning of whole number multiplication and decomposition of fractions to multiply a fraction less than one by a whole number (ex. ½ x 8 can be thought of as half a group of 8 or 8 groups of ½).
- Students will solve situations of fractions of a group by relating it to multiplication of a fraction by a whole number (e.g., 2/3 of the children are girls, 2/3 of 12 is the same as 2/3 * 12 = 8).
- Students will explore fraction operations (addition, subtraction, and multiplication) using a variety of models (ex: area model, number line, tape diagrams, set models)
- Students will use equivalent fractions and/or properties of operations to add and subtract fractions (including mixed numbers).
- Students will use visual models along with addition and multiplication to build fractions greater than 1.
- Students will understand that fractions greater than one can be described both as numerator greater than the denominator (improper fraction) and as a mixed number.
- Represent decompositions of a whole into tenths using visual models and both fraction and decimal notation (ex: area model/decimal square and number line).
- Use equivalent fractions to add two fractions with denominators 10 and 100.
- Solve addition of decimals problems using understanding of equivalence, concrete decimal models, and using decimal notation.

Important Considerations:

- In Grade 4, expectations are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.
- Use a variety of meaningful contexts to engage students in computational tasks without giving rules or procedures to solve them. Contexts do not need to be elaborate, but it is important to think about contexts that fit the operation and that is reasonable for the learning goal.
- Choose contexts that encourage different models (ex: a meter might encourage a linear model, a garden or quilt as an area model, etc.), use different types of numbers in the problems (whole, mixed, improper, fractions) and vary the operations so that students continue to make meaning first.
- Integrate previous topics such as multiplicative comparison word problems, data sets involving metric measurement, properties, time concepts, area and perimeter, etc.

- Estimation should be a part of the development of fraction computation to continue the focus of reasoning/reflecting on the expected results as well as focusing on the meaning of the operation. (ex: Over or under estimation routine: Ask students to estimate the sum or difference of two fractions. Thumbs up if over, thumbs down if under. Discuss thinking. Students should justify using a number line, area model, example, etc.)
- Students should be flexible in the ways they solve fraction computation problems. In order to be flexible, they need to understand what they are doing and why they are doing it.
- Algorithms for computing fractions do not help students think conceptually and should not be used as a way to construct understanding of the operations.
- As students are using visual models, assure they connect the models to the symbolic representation of the operations. For some students, this connection needs to be made explicit as they may see the representations as different math skills.