REAL WORLD MULTIPICATION AND DIVISION

described by Courtney Flessner and Ryan Flessner

Educators in all grade levels must provide students with real-world problems to solve. Rather than discussing strategies students might use to multiply and divide in Grades K-8, we use this series of videos to (1) describe different ways teachers can construct problems while ensuring students deeply understand multiplication and division concepts and (2) examine real-world contexts in which students apply their knowledge of multiplication and division. As we discuss the construction of contextualized problems, we also explore ways to make these problems real-world, realistic, and relevant to the lives of students. The K-2 standards in this series do not pertain to real-world problems. However, they are excellent precursors to preparing students to engage in this work in Grades 3-8.

KINDERGARTEN

Use objects, drawings, etc., to decompose numbers less than or equal to 10 into pairs in more than one way, and record each decomposition with a drawing or an equation (e.g., 5 = 2 + 3 and 5 = 4 + 1). [In Kindergarten, students should see equations and be encouraged to trace them, however, writing equations is not required.] (K.CA.3)

Unpacking the Standard

In kindergarten we want students to understand that numbers can be composed of many combinations that can be represented with manipulatives and pictures. Students should be able to explain what their representations mean (e.g. “I have a group of 4 and a group of 6. Together, they make 10”).

Considerations for Lessons and Assessment

Teachers provide a variety of manipulatives and opportunities for students to explore all combinations of all numbers within 10. As it pertains to this strand, this standard is an excellent time for students to explore the concept of doubles and how they connect to multiplication as an operation. For example, 2 + 2 is the same as 2 groups of 2, 3 + 3 is the same as 2 groups of 3, etc. Teachers should use this language interchangeably as they work to decompose numbers and solve real-world problems in the classroom. Assessment is done on an ongoing basis through observation, student work samples, conversation, and conferring.

GRADE 1

Solve real-world problems that call for addition of three whole numbers whose sum is within 20 (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem). (1.CA.4)

Unpacking the Standard

First graders should spend a significant amount of time solving real-world problems. Problems presented to first graders should move beyond two addends so students see scenarios where three addends can be joined.

Considerations for Lessons and Assessment

In first grade the emphasis is put on the operations of addition and subtraction. However, when considering interchangeable language (see the examples of doubling provided in the kindergarten explanation above), we begin to help children see that repeated addition can also be represented multiplicatively (e.g., 4 + 4 + 4 is the same as 3 groups of 4). In first grade the equations to represent the problem won't include the multiplication sign; however, capitalizing on the language "groups of" is an important concept to emphasize in first grade. Assessment is done on an ongoing basis through observation, student work samples, conversation, and conferring.

GRADE 2

Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal groups. (2.CA.5)

Unpacking the Standard

Rectangular arrays are physical representations of repeated addition, can facilitate skip counting, and allow students to visualize the move from addition to multiplication. The standard also encourages students to express these visual representations in equation form. For example, an array of 5 rows of 5 dots is written as 5 + 5 + 5 + 5 + 5 = 25. This representation foreshadows the transition, in third grade, from "groups of" objects to the concept of multiplication (e.g., 5 "groups of" 5 becomes 5 x 5).

Considerations for Lessons and Assessment

Second grade provides the concrete foundation upon which later grades build. Utilizing physical objects arranged in rectangular arrays, students move beyond counting one-by-one as they use this visual representation to repeatedly add a number or skip count. As students master basic addition facts and skip counting schemes, lessons and assessments should ask them to translate these patterns into written equations that show the total number of objects as the sum of equal groups.

GRADE 3

Solve real-world problems involving whole number multiplication and division within 100 in situations involving equal groups, arrays, and measurement quantities (e.g., by using drawings and equations with a symbol for the unknown number to represent the problem). (3.AT.2)

Unpacking the Standard

Building off of the introduction to arrays in second grade, the third-grade standard expands students' understanding of multiplication and division to grouping and sorting into equal groups. By contextualizing these ideas with measurement quantities (intervals of time, amounts of money, and various distance measurements), educators provide students with avenues for exploring the application of strategies garnered through the computation standards.

Considerations for Lessons and Assessment

Real-world problems should offer students opportunities to group and sort in multiple ways. A variety of multiplication problems (e.g., grouping problems, rate problems) and division problems (e.g., partitioning problems, and measurement problems) are explored. Assessments are presented including those in both written and oral form.

GRADE 4

Solve real-world problems with whole numbers involving multiplicative comparison (e.g., by using drawings and equations with a symbol for the unknown number to represent the problem), distinguishing multiplicative comparison from additive comparison. [In grade 4, division problems should not include a remainder.] (4.AT.4)

Unpacking the Standard

Students in fourth grade should continue to work on a variety of multiplication and division problems. Specifically related to the verbiage of this standard, multiplicative comparisons require students to consider ideas that can be solved using both multiplication and division (e.g., The problem, "A tree is 3 times as tall as Anthony. If the tree is 15 feet tall, how tall is Anthony" could be solved using either operation: 15/3 = □ or 3 x □ = 15).

Considerations for Lessons and Assessment

Rather than framing problems as "multiplication" or "division" problems, educators might consider simply calling them "problems of the day." Otherwise, students will simply find the two numbers in the problem and use the operation they've been told to use. This would be problematic in the following problem: Ms. Spencer split the fourth-grade students into 6 groups. If each group had 16 students, how many fourth graders are there? In fact, either operation could be used to achieve the answer (e.g., 6 x 16 = □; or □/6=16). Assessments should ensure that students can solve problems in multiple ways and are efficient in doing so.

GRADE 5

Solve real-world problems involving multiplication and division of whole numbers (e.g., by using equations to represent the problem). In division problems that involve a remainder, explain how the remainder affects the solution to the problem. (5.AT.1)

Unpacking the Standard

Fifth grade is the first time students are asked to solve division problems with remainders. Additionally, students are expected to make sense of a remainder in real-world contexts. In these situations, a remainder may require the child to round up or down, to turn the remainder into a decimal or a fraction, or to ignore the remainder altogether (e.g., In the problem, "There are 480 students at Baldwin Elementary. The school's buses seat 52 students each. How many buses would be needed to take all of the students to the Indianapolis Children's Museum," an answer of 9 R12 would require a student to round up to 10 buses).

Considerations for Lessons and Assessment

Lessons and assessments in fifth grade should build on work done in prior grades while increasing number sizes and attending to remainders in real-world problems. Providing students with contextualized situations that require a variety of ways to make sense of remainders is essential.

GRADE 6

Compute quotients of positive fractions and solve real-world problems involving division of fractions by fractions. Use a visual fraction model and/or equation to represent these calculations. (6.C.4)

Solve real-world problems with positive fractions and decimals by using one or two operations. (6.C.3)

Unpacking the Standards

The sixth-grade standards move beyond whole number computation into fractions and decimals. In Grade 6, an emphasis should be placed on the division of fractions and multi-step problems that utilize more than one operation. Educators should note the importance of visual fraction models (e.g., fraction bars/circles, pattern blocks) in relation to standard 6.C.4.

It is important to note that this strand focuses on multiplication and division. For ideas related to addition and subtraction, please see the "Real World Addition and Subtraction" series.

Considerations for Lessons and Assessments

Students in sixth grade should be offered opportunities to see fractions and decimals at work in the world around them. Real-world problems should also address ideas that are realistic and relevant to students as they explore experiences in their lives and in their communities. Assessments could range from simple problem solving situations to inquiry-based studies in and outside of school.

GRADES 7-8

Solve real-world problems with rational numbers by using one or two operations. (7.C.8)

Solve real-world problems with rational numbers by using multiple operations. (8.C.1)

Unpacking the Standards

Seventh and eighth graders continue to make sense of the world around them using what they know about mathematics. Students in these grades solve problems with rational numbers as well as multi-step problems that require more than one operation to solve.

It is important to note that this strand focuses on multiplication and division. For ideas related to addition and subtraction, please see the "Real World Addition and Subtraction" series.

Considerations for Lessons and Assessments

Lessons in seventh and eighth grade should encourage students to examine the world around them by employing an array of mathematical understandings. Rational numbers (e.g., fractions, terminating and repeating decimals, and positive and negative integers) should comprise the numerical aspects of the real-world problems offered to students in Grades 7 and 8. Real-world investigations and inquiry-based projects can be used to supplement daily problem solving.

ADDITIONAL RESOURCES

Carpenter, T. P., Fennema, E., Franke, M. L., Levi, L., & Empson, S. B. (2014). *Children's mathematics: Cognitively guided instruction* (2nd ed.). Heinemann.

Empson, S. B., & Levi, L. (2011). *Extending children's mathematics: Fractions and decimals.* Heinemann.

Partnership for Inquiry Learning (n.d.). http://partnershipforinquirylearning.org.