Warm-Up Math Routines for Multilingual Learners

March 2022

A critical part of the daily math block for MLLs is a warm-up instructional routine such as a Number Talk or Problem String. Number Talks were created by Ruth Parker and Kathy Richardson in the early 1990s to build students' conceptual understanding and computational fluency by asking them to use what they know or notice about structure, patterns, and properties of operations to solve a series of carefully sequenced problems. The routines also expose students to multiple ways to represent and solve a problem and challenge them to make connections between problems to identify more efficient solution methods.

Warm-Up Routine Structure

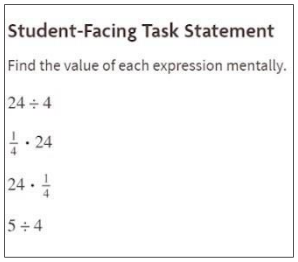
There are some differences between Number Talks and Problem Strings, but they are both 10-20 minute activities involving solving and discussing a series of related problems. Problems are carefully sequenced to build in complexity and highlight connections between solution strategies, with an emphasis on reasoning and discussion so that students have frequent ongoing opportunities to engage in critical mathematical practices such as using precise language to explain their thinking and critiquing varying strategies. A typical structure for these activities might look like this:

- The teacher displays one problem at a time.
- Students independently solve the problem and give a signal when they have an answer and one or more solution strategies.
- The teacher selects or asks for students to volunteer to share their answers and solution strategies with the whole class. Ideally, at least 2-3 different solution strategies per problem are shared.
- As students share, the teacher may model their strategy on the board, ask clarifying questions to prompt the student to be more precise or explain their rationale, and/or ask other students questions about the solution strategy to highlight the most important math concepts and efficient strategies.

Warm-Up Routine Examples

Number Talks

Example Number Talk – IM 6-8 Math, 6th Grade Unit 2, Lesson 2, Activity 2.1: Dividing by 4 and Multiplying by ¼



Key mathematical concepts:

- Dividing by a number is the same as multiplying by its reciprocal.
- You can multiply numbers in any order if it makes it easier to find the answer.

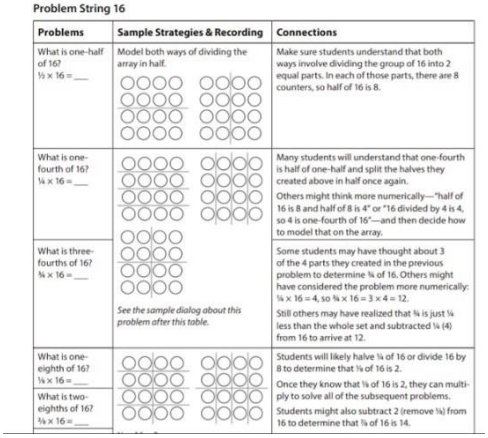
Number Talk Videos:

- YouTube video about Number Talks
- Inside Mathematics

Problem Strings

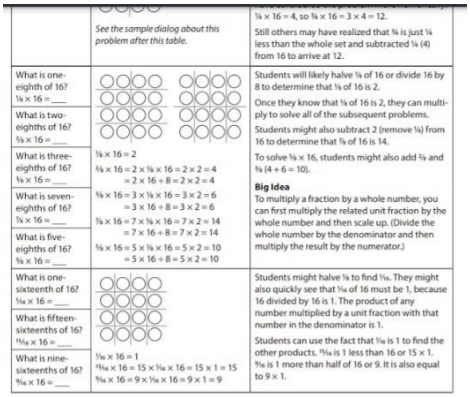
Example Problem String – Bridges 5th Grade February Number Corner (Multiplying Whole Numbers by Fractions), Problem String #16

From Teacher Guide: "All four problem strings this month focus on the multiplication of whole numbers by fractions. Arrays of counters are used as a model in the first two problem strings, and then students are encouraged to use more abstract thinking later in the month. Discussion centers around the connection between fractions and multiplication and division, the associative and distributive properties, and generalizations about (and general strategies for) multiplying fractions by whole numbers."



Problem String 16

Problems	Sample Strategies & Recording	Connections
What is one-half of 16? ½ × 16 = ___	Model both ways of dividing the array in half.	Make sure students understand that both ways involve dividing the group of 16 into 2 equal parts. In each of those parts, there are 8 counters, so half of 16 is 8.
What is one-fourth of 16? ¼ × 16 = ___	See the sample dialog about this problem after this table.	Many students will understand that one-fourth is half of one-half and split the halves they created above in half once again. Others might think more numerically—"half of 16 is 8 and half of 8 is 4" or "16 divided by 4 is 4, so 4 is one-fourth of 16"—and then decide how to model that on the array.
What is three-fourths of 16? ¾ × 16 = ___		Some students may have thought about 3 of the 4 parts they created in the previous problem to determine ¾ of 16. Others might have considered the problem more numerically: ¼ × 16 = 4, so ¾ × 16 = 3 × 4 = 12. Still others may have realized that ¾ is just ¼ less than the whole set and subtracted ¼ (4) from 16 to arrive at 12.
What is one-eighth of 16? ⅛ × 16 = ___		Students will likely halve ¼ of 16 or divide 16 by 8 to determine that ⅛ of 16 is 2. Once they know that ⅛ of 16 is 2, they can multiply to solve all of the subsequent problems. Students might also subtract 2 (remove ⅛) from 16 to determine that ⅞ of 16 is 14.
What is two-eighths of 16? ⅛ × 16 = ___		



	See the sample dialog about this problem after this table.	¼ × 16 = 4, so ¾ × 16 = 3 × 4 = 12. Still others may have realized that ¾ is just ¼ less than the whole set and subtracted ¼ (4) from 16 to arrive at 12.
What is one-eighth of 16? ⅛ × 16 = ___		Students will likely halve ¼ of 16 or divide 16 by 8 to determine that ⅛ of 16 is 2. Once they know that ⅛ of 16 is 2, they can multiply to solve all of the subsequent problems. Students might also subtract 2 (remove ⅛) from 16 to determine that ⅞ of 16 is 14. To solve ⅞ × 16, students might also add ¾ and ⅛ (4 + 6 = 10). **Big Idea** To multiply a fraction by a whole number, you can first multiply the related unit fraction by the whole number and then scale up. (Divide the whole number by the denominator and then multiply the result by the numerator.)
What is two-eighths of 16? ⅛ × 16 = ___	⅛ × 16 = 2 ⅛ × 16 = 2 × ⅛ × 16 = 2 × 2 = 4 = 2 × 16 ÷ 8 = 2 × 2 = 4	
What is three-eighths of 16? ⅛ × 16 = ___	⅛ × 16 = 3 × ⅛ × 16 = 3 × 2 = 6 = 3 × 16 ÷ 8 = 3 × 2 = 6	
What is seven-eighths of 16? ⅞ × 16 = ___	⅞ × 16 = 7 × ⅛ × 16 = 7 × 2 = 14 = 7 × 16 ÷ 8 = 7 × 2 = 14	
What is five-eighths of 16? ⅝ × 16 = ___	⅝ × 16 = 5 × ⅛ × 16 = 5 × 2 = 10 = 5 × 16 ÷ 8 = 5 × 2 = 10	
What is one-sixteenth of 16? 1/16 × 16 = ___		Students might halve ⅛ to find 1/16. They might also quickly see that 1/16 of 16 must be 1, because 16 divided by 16 is 1. The product of any number multiplied by a unit fraction with that number in the denominator is 1. Students can use the fact that 1/16 is 1 to find the other products. 15/16 is 1 less than 16 or 15 × 1. 9/16 is 1 more than half of 16 or 9. It is also equal to 9 × 1.
What is fifteen-sixteenths of 16? 15/16 × 16 = ___		
What is nine-sixteenths of 16? 9/16 × 16 = ___	1/16 × 16 = 1 15/16 × 16 = 15 × 1/16 × 16 = 15 × 1 = 15 9/16 × 16 = 9 × 1/16 × 16 = 9 × 1 = 9	

Problem String Videos:

- 3rd Grade Problem String Example
- High School Problem String Example

How Warm-Up Routines Support Language Development

Warm-up routines such as Number Talks or Problem Strings can be a great tool to develop students' productive language skills as they orally explain their solution strategies and their rationales for using those strategies. In the MLL G2G program, we worked with teachers to support their multilingual learner students during Number Talks and Problem Strings in the following ways:

- Provide sentence stems for orally sharing answers and explaining solution strategies.
- Give students a chance to share their answer and strategy with a partner first before asking students to share orally with the whole class.
- Ask students to repeat other students' solution strategies and/or paraphrase others' explanations.