Multiplication and Division Problem Situations

ASYMMETRICAL (NONMATCHING) FACTORS

	Product Unknown	Multiplier (Number of Groups) Unknown	Measure (Group Size) Unknown	
Equal Groups (Ratio/Rate)*	Mayim has 8 vases to decorate the tables at her party. She places 3 flowers in each vase. How many flowers does she need? $8 \times 3 = x$ $x \div 8 = 3$	Mayim has some vases to decorate the tables at her party. She places 3 flowers in each vase. If she uses 24 flowers, how many vases does she have? $x \times 3 = 24$ $x = 24 \div 3$	Mayim places 24 flowers in vases to decorate the tables at her party. If there are 8 vases, how many flowers will be in each vase? $8 \times x = 24$ $24 \div 8 = x$	
	Resulting Value Unknown	**Scale Factor (Times as Many) Unknown**	**Original Value Unknown**	
Multiplicative Comparison	Amelia's dog is 5 times older than Wanda's 3-year-old dog. How old is Amelia's dog? $5 \times 3 = x$ $x \div 5 = 3$	Sydney has $15 to spend on dog treats. Her best friend has $5. Sydney has how many times more dollars than her friend has? $x \times 5 = 15$ $5 = 15 \div x$	Devonte has 15 dog toys on the floor in his living room. That is 3 times the number of toys in the dog's toy basket. How many toys are in the toy basket? $3 \times x = 15$ $15 \div 3 = x$	

SYMMETRICAL MATCHING FACTORS

	Product Unknown	One Dimension Unknown	Both Dimensions Unknown
Area/Array	Mrs. Bradley bought a rubber mat to cover the floor under the balance beam. One side of the mat measured 5 feet and the other side measured 8 feet. How many square feet does the mat measure? $5 \times 8 = x$ $x \div 8 = 5$	The 40 members of the student council lined up on the stage in the gym to take yearbook pictures. The first row started with 8 students and the rest of the rows did the same. How many rows were there? $8 \times x = 40$ $x = 40 \div 8$	Mr. Donato is arranging student work on the wall for the art show. He started with 40 square entries and arranged them into a rectangular arrangement. How many entries long and wide could the arrangement be? $x \times y = 40$ $40 \div x = y$
	Sample Space (Total Outcomes) Unknown	**One Factor Unknown**	**Both Factors Unknown**
Combinations** (Fundamental Counting Principle)	Karen makes sandwiches at the diner. She offers 3 kinds of bread and 7 different lunch meats. How many unique sandwiches can she make? $3 \times 7 = x$ $3 = x \div 7$	Evelyn works at the ice cream counter. She says that she can make 21 unique and different ice cream sundaes using just ice cream flavors and toppings. If she has 3 flavors of ice cream, how many kinds of toppings does Evelyn offer? $3 \times x = 21$ $21 \div 3 = x$	Audrey can make 21 different fruit sodas using the machine at the diner. How many different flavorings and sodas could there be? $x \times y = 21$ $x = 21 \div y$

*Equal Groups problems, in many cases, are special cases of a category that includes all ratio and rate problem situations. Distinguishing between the two categories is often a matter of interpretation. The Ratio and Rates category, however, becomes a critically important piece of the middle school curriculum and beyond, so the category is referenced here. It will be developed more extensively in the grades 6–8 volume of this series.

**Combinations are a category addressed in middle school mathematics standards. They are introduced briefly in chapter 8 for illustration purposes only and will be developed more extensively in the grades 6–8 volume of this series.

Note: These representations for the problem situations reflect our understanding based on a number of resources. These include the tables in the Common Core State Standards for mathematics (Common Core Standards Initiative, 2010), the problem situations as described in the Cognitively Guided Instruction research (Carpenter, Hiebert, & Moser, 1981), in Heller and Greeno (1979) and Riley, Greeno, & Heller (1984), and other tools. See below for a more detailed summary of the documents that informed our development of this table.

References

Carpenter, T. P., Hiebert, J., & Moser, J. M. (1981). Problem structure and first-grade children's initial solution processes for simple addition and subtraction problems. *Journal for Research in Mathematics Education*, 27–39.

Heller, J. I., & Greeno, J. G. (1979). Information processing analyses of mathematical problem solving. In R. Lesh, M. Mierkiewicz, & M. Kantowski (Eds.), *Applied mathematical problem solving* (pp. 181–206). Columbus, OH: The Ohio State University. Retrieved from ERIC database (ED 180 816).

National Governors Association Center for Best Practices and Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics*. Washington, DC: Author.

Riley, M. S., Greeno, J. G., & Heller, J. I. (1984). Development of children's ability in arithmetic. In *Development of Children's Problem-Solving Ability in Arithmetic. No. LRDC-1984/37*. (pp. 153–196). Pittsburgh University, PA: Learning Research and Development Center, National Institute of Education.