

# Operations and Algebraic Thinking

## Domain Overview

### GRADE 3

The major work of this domain in Grade 3 is to develop students' conceptual understanding of multiplication and division by using concrete materials to model multiplication and then relate their understanding of multiplication to division. Multiplication problem situations provide a context for understanding multiplication as finding the total number of items given a number of equal groups and the number of items in each group. Division problem situations develop the meaning of division and how it is related to multiplication. When you know the total number of items and the number of groups, you can determine how many items in a group, or, when you know the total number of items and the number of items in a group, you can find the number of groups. All of these activities culminate in the expectation that students will demonstrate fluency with multiplication and division within 100 using single-digit factors.

### GRADE 4

Students in Grade 4 continue to solve problems using the four operations with whole numbers. New to this grade level are problem situations that involve multiplicative comparisons. Students become familiar with factors and multiples and how they relate to prime and composite numbers. They work in a variety of contexts to generate and analyze patterns.

### GRADE 5




In preparation for the Expressions and Equations domain in grades 6–8, fifth graders begin to explore, interpret, and evaluate numerical expressions. Work with patterns that began in Grade 4 extends to generating patterns, forming ordered pairs, graphing on a coordinate plane, and then analyzing the graphical representations.



## SUGGESTED MATERIALS FOR THIS DOMAIN

3	4	5	
✓	✓	✓	Hundreds chart (Reproducible 1)
✓	✓	✓	Chips, counters
✓	✓	✓	Cups, containers, other objects to represent "groups"
✓	✓	✓	Place value chart to hundreds (Reproducible 2)
✓	✓	✓	Square tiles
✓	✓	✓	Grid paper (Reproducible 3)
✓	✓	✓	Pattern blocks
✓	✓	✓	Number cards (such as a deck of playing cards)

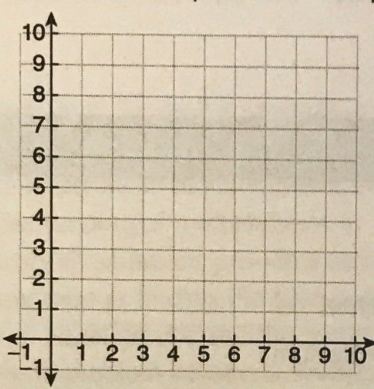
## KEY VOCABULARY

3	4	5	
✓	✓	✓	<b>add</b> to combine or join together related words: <i>add, and, plus, join, put together, (+)</i>
✓	✓	✓	<b>addend</b> any of the numbers added to find a sum
✓	✓	✓	<b>area model</b> a concrete model for multiplication or division made up of a rectangle. The length and width represent the factors and the area represents the product.  <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p><math>3 \times 5</math></p> </div> <div style="text-align: center;">  <p><math>5 \times 3</math></p> </div> </div>
✓	✓	✓	<b>array model</b> a concrete model for multiplication in which items are arranged in rows and columns. Each row (or column) represents the number of groups and each column (or row) represents the number of items in a group.  <div style="display: flex; align-items: center;">  <div style="margin-left: 20px;"> <math>5 \times 4 = 20</math>     5 rows of 4 = 20         </div> </div>
✓	✓	✓	<b>* associative property of multiplication</b> an extension of the commutative property; to change the order and group two factors to find convenient products (such as 10) in order to make the multiplication easier. Students may begin to use parentheses at this level. $7 \times 8 \times 5 = 7 \times (8 \times 5) = 7 \times 40 = 280$
✓	✓	✓	<b>* commutative property of multiplication</b> reversing the order of the factors does not change the product $8 \times 5 = 40$ and $5 \times 8 = 40$ therefore the product of $8 \times 5 = 5 \times 8$

(Continued)



# KEY VOCABULARY

3	4	5	
✓	✓		<b>comparison model</b> a multiplication or division situation in which one number is a multiple of the other <i>Example:</i> Maya has 5 marbles. Alexa has 3 times as many. How many marbles does Alexa have?
✓	✓		<b>compose</b> put a number together using other numbers 1 + 9, 2 + 8, 3 + 7, 4 + 6, 5 + 5, 1 + 2 + 3 + 4 are ways to compose 10
✓	✓		<b>composite number</b> a number that has more than two factors
	✓		<b>coordinate plane</b> a plane determined by a horizontal number line, called the x-axis, and a vertical number line, called the y-axis, intersecting at a point called the origin. Each point in the coordinate plane can be specified by an ordered pair of numbers.
			
✓	✓	✓	<b>decompose</b> separate a number into parts using other numbers 8 can be decomposed into 4 + 4, 3 + 5, 2 + 2 + 2 + 2
✓	✓	✓	<b>* distributive property</b> multiplying a sum by a given number is the same as multiplying each addend by the number and then adding the products $6 \times 9 = 54$ $6 \times (5 + 4) = (6 \times 5) + (6 \times 4) = 30 + 24 = 54$ The distributive property says that if a, b, and c are real numbers, then: $a \times (b + c) = (a \times b) + (a \times c)$
✓	✓	✓	<b>division</b> sharing a number into equal groups and finding the number of groups or the number of items in each group
✓	✓	✓	<b>equal groups model (measurement division)</b> a division model in which the total number of items and the number of items in each group is known and the number of groups that can be made is the unknown. <i>Example:</i> I have 48 peanuts. I want to put 8 peanuts in a cup. How many cups will I need?
✓	✓	✓	<b>equation</b> a mathematical sentence in which one part is the same or equal to the other part $3 + 5 = 8$ $12 - 7 = 5$ $11 = 8 + 3$ $6 = 9 - 3$
✓	✓	✓	<b>estimate</b> to make an approximation or calculate using closer or easier numbers
	✓	✓	<b>evaluate</b> find the numerical value of mathematical expression
✓	✓	✓	<b>expression</b> one or more mathematical symbols that represent a number or quantity examples of expressions $3 \times 6$ $4 + 7 \times 3$ 8
✓	✓	✓	<b>fact family</b> a set of related mathematics facts, such as $3 \times 5 = 15$ $15 = 5 \times 3$ $15 \div 3 = 5$ $3 = 15 \div 5$
✓	✓	✓	<b>factor</b> one of the numbers multiplied to find a product



## KEY VOCABULARY

3	4	5	
	✓	✓	<b>factor pair</b> a pair of numbers that when multiplied give a product; for example, 1 and 15, 3 and 5 are factor pairs for 15
✓	✓	✓	<b>fair share model (partitive division)</b> a division model in which the total number and the number of groups is known and the number of items in each group is unknown <i>Example:</i> I have 48 peanuts and want to put them into 6 cups. If I put the same number of peanuts into each cup, how many peanuts will be in each cup?
✓	✓	✓	<b>* identity property of multiplication</b> any number multiplied by 1 equals the number $3 \times 1 = 3$ $1 \times 3 = 3$
✓	✓	✓	<b>measurement division (equal groups model)</b> a division model in which the total number of items and the number of items in each group is known and the number of groups that can be made is the unknown <i>Example:</i> I have 48 peanuts. I want to put 8 peanuts in a cup. How many cups will I need?
✓	✓	✓	<b>missing factor</b> the unknown factor when a product and one factor are known $4 \times \square = 32$ The missing factor is 8.
	✓	✓	<b>multiple</b> the result of multiplying a whole number by other whole numbers multiples of 5 are 0, 5, 10, 15, 20, 25, 30
✓	✓	✓	<b>multiplication</b> a mathematical operation in which a number is added to itself a specific number of times; one factor tells the number of groups or sets, the other factor tells the number of items in a group or set and the result, or product, tells the total number of items $3 \times 5 = 15$ 3 groups with 5 in each group would give a total of 15
✓	✓	✓	<b>number line</b> a line used to show the position of a number in relation to zero and other numbers
		✓	<b>ordered pair</b> a pair of numbers that gives a location on a coordinate plane. The first number is the x coordinate and the second number is the y coordinate.
✓	✓	✓	<b>partitive division (fair share model)</b> a division model in which the total number and the number of groups is known and the number of items in each group is unknown <i>Example:</i> I have 48 peanuts and want to put them into 6 cups. If I put the same number of peanuts into each cup, how many peanuts will be in each cup?
✓	✓	✓	<b>pattern</b> set of numbers or objects that can be described by a specific rule
	✓	✓	<b>prime number</b> a number that has exactly two factors
✓	✓	✓	<b>product</b> the result when two numbers are multiplied
✓	✓	✓	<b>quotient</b> the result when two numbers are divided; the missing factor
✓	✓	✓	<b>remainder</b> amount left when two numbers are divided
✓	✓	✓	<b>round</b> to change a number to a less exact number that is more convenient for computation
✓	✓	✓	<b>strategy</b> a plan to find an answer or solve a problem that makes sense
✓	✓	✓	<b>sum</b> the result when two numbers are added
✓	✓	✓	<b>unknown</b> the quantity you are finding in a mathematics problem
✓	✓	✓	<b>* zero property of multiplication</b> any number multiplied by 0 equals 0 $8 \times 0 = 0$ (8 groups of 0 is 0) $0 \times 8 = 0$ (0 groups of 8 is 0)

\*Students are not responsible for these vocabulary words; however, they should understand the mathematical concept.