GRADE 5 • MODULE 2

Multi-Digit Whole Number and Decimal Fraction Operations

In Module 1, students explored the relationships of adjacent units on the place value chart to generalize whole number algorithms to decimal fraction operations. In Module 2, students apply the patterns of the base ten system to mental strategies and the multiplication and division algorithms.

Topic A: Mental Strategies for Multi-Digit Whole Number Multiplication

Topics A through D provide a sequential study of multiplication. To link to prior learning and set the foundation for understanding the standard multiplication algorithm, students begin at the concrete pictorial level in Topic A. They use number disks to model multi-digit multiplication of place value units, e.g., 42 × 10, 42 × 100, 42 × 1,000, leading to problems such as 42 × 30, 42 × 300 and 42 × 3,000. They then round factors in Lesson 2 and discuss the reasonableness of their products. Throughout Topic A, students evaluate and write simple expressions to record their calculations using the associative property and parentheses to record the relevant order of calculations.

Topic B: The Standard Algorithm for Multi-Digit Whole Number Multiplication

In Topic B, place value understanding moves toward understanding the distributive property via area diagrams which are used to generate and record the partial products of the standard algorithm.

Topic C: Decimal Multi-Digit Multiplication

Topic C moves students from whole numbers to multiplication with decimals, again using place value as a guide to reason and make estimations about products.

Topic D: Measurement Word Problems with Whole Number and Decimal Multiplication

In Topic D, students explore multiplication as a method for expressing equivalent measures. For example, they multiply to convert between meters and centimeters or ounces and cups with measurements in both whole number and decimal form..

Topic E: Mental Strategies for Multi-Digit Whole Number Division

Topics E through H provide a similar sequence for division. Topic E begins concretely with number disks as an introduction to division with multi-digit whole numbers . In the same lesson, 420 ÷ 60 is interpreted as 420 ÷ 10 ÷ 6. Next, students round dividends and two-digit divisors to nearby multiples of 10 in order to estimate single-digit quotients (e.g., 431 ÷ 58 ≈ 420 ÷ 60 = 7) and then multi-digit quotients. This work is done horizontally, outside the context of the written vertical method.

Topic F: Partial Quotients and Multi-Digit Whole Number Division

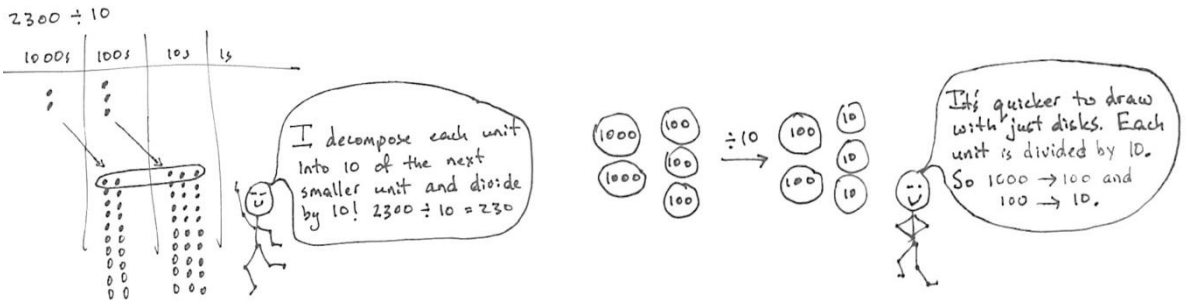
The series of lessons in Topic F leads students to divide multi-digit dividends by two-digit divisors using the written vertical method. Each lesson moves to a new level of difficulty with a sequence beginning with divisors that are multiples of 10 to non-multiples of 10. Two instructional days are devoted to single-digit quotients with and without remainders before progressing into two- and three-digit quotients.

Topic G: Partial Quotients and Decimal Multi-Digit Division

In Topic G, students use their understanding to divide decimals by two-digit divisors in a sequence similar to that of Topic F with whole numbers.

Topic H: Measurement Word Problems with Multi-Digit Division

In Topic H, students apply the work of the module to solve multi-step word problems using multi-digit division with unknowns representing either the group size or number of groups. In this topic, an emphasis on checking the reasonableness of their answers draws on skills learned throughout the module, including refining their knowledge of place value, rounding, and estimation.



Vocabulary

New or Recently Introduced Terms

Decimal Fraction (a proper fraction whose denominator is a power of 10)
Multiplier (a quantity by which a given number—a multiplicand—is to be multiplied)
Parentheses (the symbols used to relate order of operations)
≈ (This symbol means approximately)

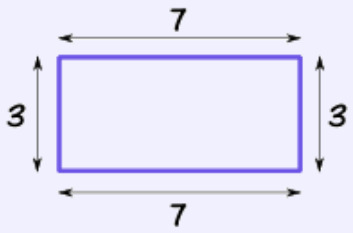
Familiar Terms and Symbols

Decimal (a fraction whose denominator is a power of ten and whose numerator is expressed by figures placed to the right of a decimal point)
Digit (a numeral between 0 and 9)
Divisor (the number by which another number is divided)
Equation (a statement that the values of two mathematical expressions are equal)
Equivalence (a state of being equal or equivalent)
Equivalent measures (e.g., 12 inches = 1 foot; 16 ounces = 1 pound)
Estimate (approximation of the value of a quantity or number)
Exponent (the number of times a number is to be used as a factor in a multiplication expression)
Multiple (a number that can be divided by another number without a remainder like 15, 20, or any multiple of 5)
Pattern (a systematically consistent and recurring trait within a sequence)
Product (the result of a multiplication)
Quotient (the answer of dividing one quantity by another)
Remainder (the number left over when one integer is divided by another)
Renaming (making a larger unit)
Rounding (approximating the value of a given number)
Unit Form (place value counting, e.g., 34 stated as 3 tens 4 ones)

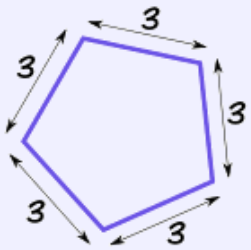
Suggested Tools and Representations

Perimeter - Perimeter is the distance around a two-dimensional shape.

Example 1: the perimeter of this rectangle is **7+3+7+3 = 20**

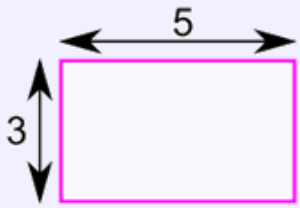


Example 2: the perimeter of this regular pentagon is **3+3+3+3+3 = 5×3 = 15**



Area - In mathematics the area of a plane figure refers to the number of square units the figure covers. The area is the inside shape or space measured in square units. In rectangles and in squares, a simple calculation of length times width **(L x W)** will give the number of square units. The square units could be inches, centimeters, yards etc. or whatever the requested unit of measure asks for. There are many formulas used to determine the area of many common shapes or polygons.

Example: What is the area of this rectangle?



The formula is:

$$\text{Area} = w \times h$$

w = width

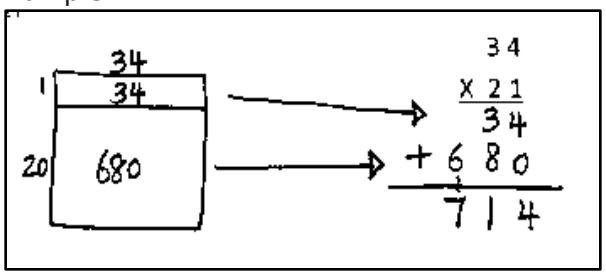
h = height

The width is 5, and the height is 3, so we know **w = 5** and **h = 3**. So:

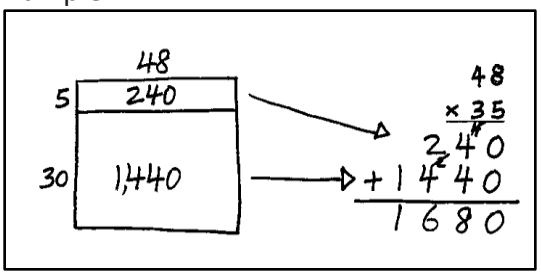
$$\text{Area} = 5 \times 3 = 15$$

Area models – The area model is a way to show multiplication or division based on place value and decomposing numbers.

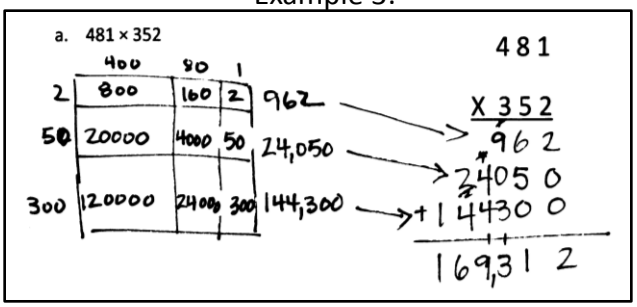
Example 1:



Example 2:



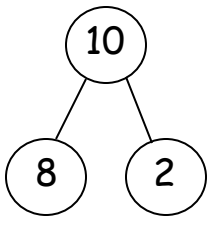
Example 3:



Videos and resources for area models:

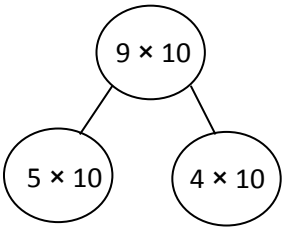
- http://www.youtube.com/watch?v=qdYV6i-kXcA
- http://www.learner.org/courses/learningmath/number/session4/video.html?pop=yes&pid=2725
- http://www.khanacademy.org/math/arithmetic/multiplication-division/area-models-multiplication/v/area-model-for-multiplication
- http://learnzillion.com/lessons/528-multiply-multidigit-numbers-using-an-area-model
- http://learnzillion.com/lessons/556-multiply-decimals-by-whole-numbers-by-using-an-area-model
- http://learnzillion.com/lessons/558-multiplying-whole-numbers-and-decimals-using-an-area-model
- http://commoncore.org/maps/math/video-gallery/array-and-area-models

Number bond - A Number bond shows part-part-whole relationship

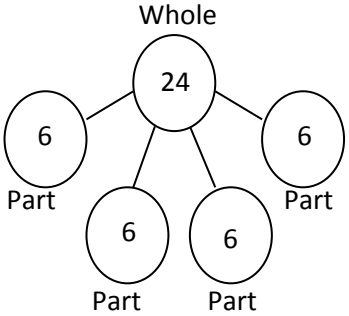


Number bond

The distributive property shown with a number bond



Sample number bond for a class of 24:



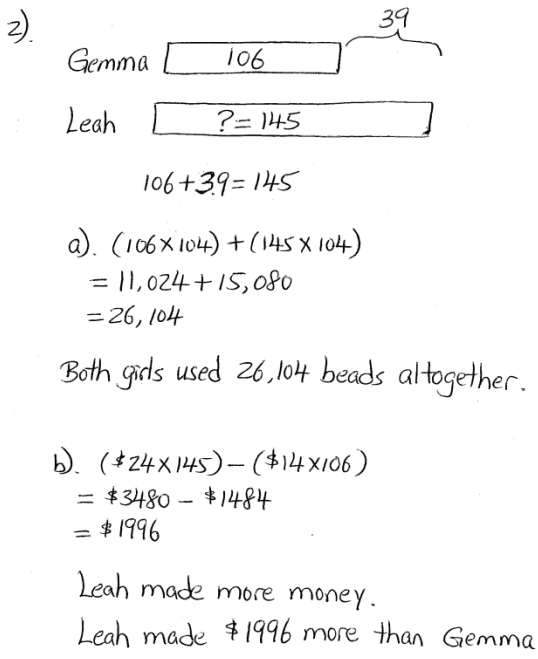
Here are some videos about number bonds and multiplication:

- http://commoncore.org/maps/math/video-gallery/number-bond-multiplication
- http://commoncore.org/maps/math/video-gallery/number-bond-decomposition-division-and-multiplication-algorithms-grades-3-5

Tape Diagram – A tape diagram is a method for modeling problems with parts and wholes. It is synonymous with bar modeling.

Example:
Gemma and Leah are both jewelry makers. Gemma made 106 beaded necklaces. Leah made 39 more necklaces than Gemma. Each necklace they make has exactly 104 beads on it. How many beads did both girls use altogether while making their necklaces?

At a recent craft fair, Gemma sold her necklaces for $14 each. Leah sold her necklaces for $10 more. Who made more money at the craft fair? How much more?? How much more?

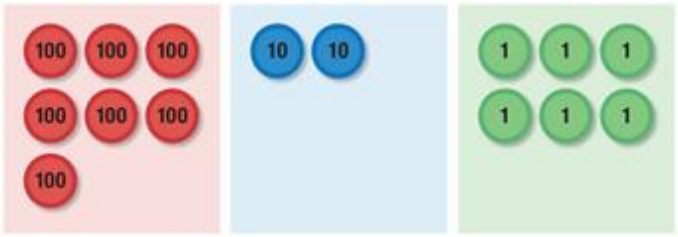


Here are some videos about Tape Diagrams:

- http://commoncore.org/maps/math/video-gallery/solving-word-problems-with-tape-diagrams
- http://learnzillion.com/lessons/2569-comparing-numbers-using-bar-models
- http://learnzillion.com/lessons/2851-solve-multiplicative-comparison-word-problems-by-using-bar-models-to-represent-division
- http://learnzillion.com/lessons/2745-solve-multiplicative-comparison-word-problems-by-using-bar-models

For an online modeling tool, interactive problems for students to try and free apps:
http://www.mathplayground.com/thinkingblocks.html

Number disks - Number disks are non-proportional units used to further develop place value understanding. Like money, the value of the disk is determined by the value printed on it, not by its size. Number disks are used by students through Grade 5 when modeling algorithms and as a support for mental math with very large whole numbers. Whole number place value relationships modeled with the disks are easily generalized to decimal numbers and operations with decimals.



Unit form modeled with number disks:
7 hundreds 2 tens 6 ones = 72 tens 6 ones

Here are some videos about Numbers Disks and Place Value:

- http://www.engageny.org/resource/place-value-number-disks-with-place-value-charts
- http://commoncore.org/maps/math/video-gallery/division-algorithms-using-number-disks

Commutative property - The Commutative property states that order does not matter. Multiplication and addition are commutative.

Examples of the Commutative Property for Addition

A. $4 + 2 = 2 + 4$
B. $5 + 3 + 2 = 5 + 2 + 3$
C. $b + a = a + b$ (Yes, algebraic expressions are also commutative for addition)

Examples of the Commutative Property for Multiplication

A. $4 \bullet 2 = 2 \bullet 4$
B. $5 \bullet 3 \bullet 2 = 5 \bullet 2 \bullet 3$
C. $a \bullet b = b \bullet a$(Yes, algebraic expressions are also commutative for multiplication)

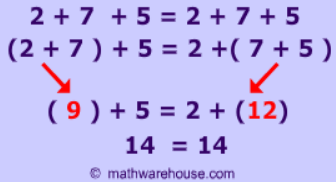
Here are resource sfor the commutative property:

- http://www.coolmath.com/prealgebra/06-properties/02-properties-commutative-multiplication-01.htm
- http://www.brainpop.com/math/numbersandoperations/commutativeproperty/preview.weml

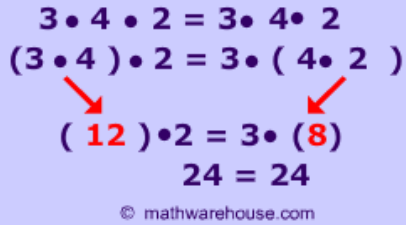
Associative property - The associative property states that you can add or multiply regardless of how the numbers are grouped. By 'grouped' we mean 'how you use parenthesis'. In other words, if you are adding or multiplying it does not matter where you put the parenthesis. Add some parenthesis any where you like!.

Examples of the Associative Property for Addition

The picture below illustrates that it does not matter whether or not we add the 1 + 7 first (like the left side) or the 7 + 5 first, like the right side.



Examples of the Associative Property for Multiplication

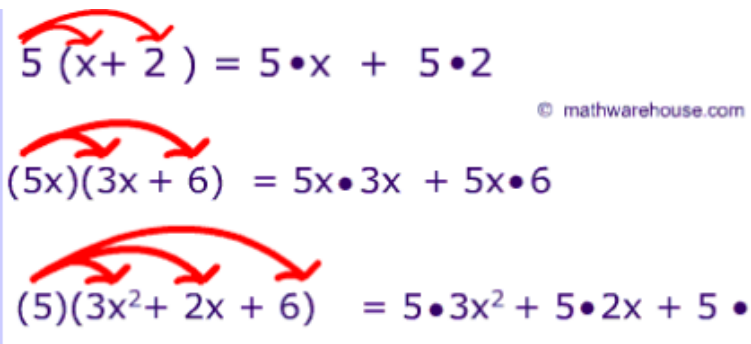


Here are resources for the Associative property:

➢http://www.coolmath.com/prealgebra/06-properties/04-properties-associative-multiplication-01.htm

➢http://www.brainpop.com/math/numbersandoperations/associativeproperty/preview.weml

Distributive property - The distributive property lets you multiply a sum by multiplying each addend separately and then add the products.



Consider the first example, the distributive property lets you "distribute" the 5 to both the 'x' and the '2'.

Here are resources for the Distributive property:

http://www.coolmath.com/prealgebra/06-properties/05-properties-distributive-01.htm

http://www.brainpop.com/math/numbersandoperations/distributiveproperty/preview.weml