

RAY'S PRIMARY ARITHMETIC — LEVEL 3

UNIT FOUR: VERTICAL MULTIPLICATION & DIVISION — Lessons 81- 115

Overview: This unit builds upon the second unit by introducing the vertical column format for multiplying and dividing, which results in the need for larger numbers.

Suggested Schedule: 7 weeks

Background:

This unit continues filling in the instructions for vertical arithmetic, introducing the new vertical column format of multiplication while reviewing the math facts so that your child only has to focus on one new skill at a time. Bit by bit we add more depth to the concept: multiplying 1-digit numbers, then 2-digits numbers, and then regrouping (carrying). We will also introduce short division with no remainders.

Helpful tips such as multiplying and dividing by 10, divisibility, and odd and even numbers will also be explored. The multiplication and division fact families will be extended to include the eevens and twelves. The latter is done because of customary measurements based on 12 inches in a foot and the concept of a dozen items. As we continue multiplying and dividing, it quickly becomes apparent that we need to learn more numbers. The child's understanding of the number system is extended from 1,000 to 100,000. These larger numbers come because we need to be able to work with larger numbers in life.



Where You Are Headed:

We are assuming that your child:

- is proficient at evaluating the digits in a numeral in terms of place value, including expanded notation.
- is proficient in the arithmetic fact families through the Tens.

Essential Skills

This unit will:

- introduce vertical multiplication (in column format) and short division with no remainders and with remainders
- introduce regrouping (carrying) for multiplication
- review multiplying by ten
- introduce multiplying and dividing money
- continue numbering from 1, 000 to 100,000 as well as ordering and comparing these numbers
- expand the concept of place value and carrying to the hundred thousands
- provide more practice in problem-solving skills and math critical thinking by using these larger numbers in story problems

Additional Skills

- introduce the concept of divisibility
- define odd and even numbers
- cover the multiplication and division facts for eleven and twelve

Supplemental Skills

- review perimeter and area of a rectangle

Note: The term *short division* is typically reserved for division problems that use the $\overline{)}$ sign with numbers based on the division facts or close to them. The term *long division* is used with larger numbers where the student must divide the divisor into the dividend across the place value columns in several steps.



Packing List (for this unit):

- ✓ optional: counters, stuffed animals/toys, or scraps of paper to act out the story problems
- ✓ optional: Hundred Chart
- ✓ collection of bundled sticks, including HUNDREDS, TENS, and ONES, as well as extra loose sticks.
- ✓ rubber bands for grouping loose sticks
- ✓ optional: copies of the 200-900 Charts if you still have them from Level 2
- ✓ optional: BASE TEN manipulatives set*
- ✓ separate paper for the child to show his work and record his answers (we recommend that the student have a separate math notebook)

* Base Ten manipulative sets vary widely, as do the corresponding costs. The ones with interlocking pieces are easier to work with, but are more expensive and usually are limited in number. The sets that are used to teach the base ten system usually have single units, a few columns of ten, a few sheets of a hundred, and one cube of a 1000. We opted to use the craft sticks instead of these sets so that the child could physically combine the sticks together to make bundles of tens, hundreds, and thousands. He could also unbundle them and rebundle them, as well as write on the sticks. You can use the sticks to match the visual in the lesson; simply stand the bundles of tens and hundreds on end. You can gather 100 bundles of tens together into a roughly cubed shape. We opted for showing the standard base ten units in the lesson in case students come across them in state-mandated tests.



CEMENT MIXERS

(check when done at least one time; these exercises can be used more than once)

For use with Lessons 81-95

Goal: To review multiplication facts.

These are designed to be oral exercises. The answers are in italics.

- | | | |
|--|------------------|--------------------|
| <input type="checkbox"/> How many are 8 times 2? (16) | 7 times 5? (35) | 4 times 7? (28) |
| <input type="checkbox"/> How many are 8 times 6? (48) | 6 times 9? (54) | 9 times 7? (63) |
| <input type="checkbox"/> How many are 9 times 8? (72) | 7 times 7? (49) | 7 times 8? (56) |
| <input type="checkbox"/> How many are 6 times 7? (42) | 2 times 10? (20) | 3 times 6? (18) |
| <input type="checkbox"/> How many are 10 times 5? (50) | 8 times 8 (64) | 9 times 2? (18) |
| <input type="checkbox"/> How many are 7 times 10? (70) | 8 times 5? (40) | 3 times 2? (6) |
| <input type="checkbox"/> How many are 4 times 2? (8) | 5 times 2? (10) | 4 times 3? (12) |
| <input type="checkbox"/> How many are 7 times 2? (14) | 5 times 3? (15) | 6 times 6? (36) |
| <input type="checkbox"/> How many are 5 times 4? (20) | 8 times 3? (24) | 5 times 5? (25) |
| <input type="checkbox"/> How many are 10 times 6? (60) | 10 times 3? (30) | 9 times 4? (36) |
| <input type="checkbox"/> How many are 4 times 10? (40) | 9 times 5? (45) | 9 times 9? (81) |
| <input type="checkbox"/> How many are 8 times 10? (80) | 3 times 3? (9) | 10 times 10? (100) |

- At 2 cents each, what will 7 oranges cost? (14 cents)
- At 7 cents each, what will 3 melons cost? (21 cents)
- At 6 cents a bag, what will 5 bags of carrots cost? (30 cents)
- At 8 cents each, what will 7 hot dogs cost? (56 cents)
- At \$6 a pound, what will 8 pounds of meat cost? (\$48)
- At \$3 a barrel, what will 9 barrels of cider cost? (\$27)
- At \$4 a pair, what is the cost of 7 pairs of socks? (\$28)
- At 8 cents a carton, what will 9 cartons of pens cost? (72 cents)
- What is the cost of 6 yards of cloth at \$7 a yard? (\$42)
- What do 8 barrels of flour cost at \$5 a barrel? (\$40)
- If a man travels 7 miles an hour, how far will he travel in 5 hours? (35 miles)

- On a chess board there are 8 rows of squares, with 8 squares in each row. How many squares are on the board? (64 squares)
- An orchard has 9 rows of trees with 6 trees in each row. How many trees are in the orchard? (54 trees)

For use with Lessons 103-110

Goal: To practice the numbers into the THOUSANDS.

● Use the worksheets in the back of the Instructor’s Manual. Each worksheet lists another set of HUNDREDS from 1400 to 2000. The child fills in the missing numbers.

For use with Lessons 111-115

Goal: To practice the fact families for Elevens and Twelve.

- The facts are listed in Lessons 84, 86, 95, and 96 for both multiplication and division.
- Drill these using the game formats listed in the Appendix, along with the necessary game boards.

LESSON 81 – Factor Machines

This lesson offers more practice in multiplication using another visual.

- This time we give the student a machine that helps them work the multiplication facts. It’s called a factor machine, and it works much like an addend machine and a difference machine.
- One factor is fed into the machine; it is the size of the group. The other factor comes down the pipeline; it is the number of times the group is used. The answer (the product) is “spit out” at the bottom.
- As always, your child “powers” the machine.
- You can probably guess that we are setting the stage for introducing vertical multiplication in the next lesson.

LESSON 82 – Vertical Multiplication Facts

This lesson introduces the vertical column format for multiplication.

- The lesson shows how we can remove the product machine and write the same facts in vertical form. In the process, the multiplication vocabulary words (factors, product) are reviewed.
- The lesson also explains the Commutative Property of Multiplication: the factors can be put in any order and still get the same answer. We show the property with real numbers, without showing the formal definition: $a \times b = b \times a$.
- The Identity Property of Multiplication is also explained: any number times one is that number, so one is the identity for multiplication. Again, we show the property with real numbers, without showing the formal definition: $a \times 1 = a$.
- We also highlight the difference between the Identity Property of Addition and the Identity Property of Multiplication—the concept is the same, but the number that causes a given number to keep its identity is different (zero for addition, one for multiplication). Be sure to always say which property you are referring to (multiplication or addition).
- We then remind the child what happens when we use zero in multiplication: the answer is always zero.
- The exercise gives the student practice in using the vertical form with the math facts that are already known.

LESSON 83 – Multiplying by Ten



Packing List:

- ✓ Multiplication Chart in the back of the Instructor’s Manual
- ✓ 10 bundles of TEN from your craft stick collection to show the math facts for TEN