3.OA.8 Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.[3]

[3]This standard is limited to problems posed with whole numbers and having whole-number answers; students should know how to perform operations in the conventional order when there are no parentheses to specify a particular order.

Mechanics

Teacher Notes: This standard requires that students first identify the information needed to solve each step in two-step word problems. Students will identify key words in the text to determine whether to use addition, subtraction, multiplication, or division to solve each step.

Start with the reading of a two-step word problem.

Example: Seven volunteers each baked 9 cupcakes for the 3rd graders' field day picnic. After the picnic, only 11 cupcakes remained. How many cupcakes did the 3rd graders eat at the field day picnic?

Ask students to identify what they need to know to answer the question.

How many cupcakes did the 3rd graders eat?

Students must identify the numbers and determine which operation they will use to solve the first part of the problem. How many cupcakes were there in the beginning?

(7) volunteers each baked (9) cupcakes for the 3rd graders' field day picnic.

(7 volunteers times 9 cupcakes) $7 \times 9 = n$ $n = 63$

Students must then identify the number and determine which operation they will use to solve the second part of the two-step word problem.

How many cupcakes were left?

After the picnic, only (11) cupcakes remained.

There were 63 cupcakes to begin with. $63 - 11 = d$

Students should be able to write an equation for each step of the word problem using a letter to stand for the unknown quantity and solve both equations to answer the question.

$7 \times 9 = n$ $n = 63$ $63 - 11 = d$ $d = 52$, so the 3rd graders ate 52 cupcakes

Is the answer reasonable?

Yes, because there were about 60 cupcakes to begin with and there were about 10 left over. The 3rd graders ate about 50 cupcakes.

Example: On vacation, Carmen planned to climb two monuments. One had 298 stairs, and the other had 391 stairs. Carmen climbed all the way to the top of one monument and part way to the top of the other before it started to rain. She did not climb the last 53 stairs. How many stairs did Carmen climb?

1. What will answer the question? the number of stairs Carmen climbed
2. Find the total number of stairs Carmen planned to climb by writing an equation. Use a letter for the unknown quantity. Solve the equation.

   $298 + 391 = r$ $r = 689$
3. Use the information from the first equation to write the second equation. Solve the equation to find the answer.

   $689 - 53 = s$ $s = 636$

Answer: Carmen climbed 636 stairs.

Concept Mastery

- ✓ Students will be able to understand and articulate what is being asked for in a two-step word problem, i.e. the information that will answer the question.
- ✓ Students will be able to identify factors, addends, etc. and determine which operation to use in each step.
- ✓ Students will be able to write an equation with a letter representing the unknown quantity for each step.
- ✓ Students will be able to solve the first equation, and then use the result to solve the second equation.

A link to helpful web resources can be found on page 73 of this document.

3.OA.9 Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. *For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.*

Mechanics

Teacher Notes: This standard lays the groundwork for the study of number patterns and rules at subsequent grade levels (see 4.OA.5 and 5.OA.3). The ability to see patterns increases number sense and appreciation for the logical nature of math.

Practice with students by using addition and multiplication charts to find patterns.

Examples:

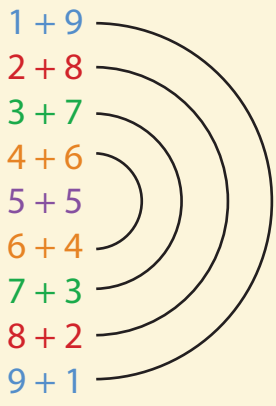
+	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
2	3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12	13
4	5	6	7	8	9	10	11	12	13	14
5	6	7	8	9	10	11	12	13	14	15
6	7	8	9	10	11	12	13	14	15	16
7	8	9	10	11	12	13	14	15	16	17
8	9	10	11	12	13	14	15	16	17	18
9	10	11	12	13	14	15	16	17	18	19
10	11	12	13	14	15	16	17	18	19	20

Look at the addition chart. Find the number 10. Color each box that has a 10 yellow. Color all the 9s green. Color the 8s pink. What pattern do you notice?
Answer: The pattern moves diagonally across the page. This is true for all sums.

+	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
2	3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12	13
4	5	6	7	8	9	10	11	12	13	14
5	6	7	8	9	10	11	12	13	14	15
6	7	8	9	10	11	12	13	14	15	16
7	8	9	10	11	12	13	14	15	16	17
8	9	10	11	12	13	14	15	16	17	18
9	10	11	12	13	14	15	16	17	18	19
10	11	12	13	14	15	16	17	18	19	20

Why do the patterns show up this way?
Possible Answer: For the tens, the sum is 9 + 1, then 8 + 2, 7 + 3, and so on, all the way up to 3 + 7, 2 + 8, and 1 + 9. If you switch the order of the addends, you get the same sum (commutative property).

Show the pattern another way for the tens.
Possible Answer: Pairs of addends are shown in the same color.



Look at the multiplication chart. Find all the factors of 6. Color them orange. What numbers do the products end in? Answer: All of the products end in 6, 2, 8, 4, or 0 in that order.

×	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

Students should discover that multiples of 2 follow a pattern of ending in 2, 4, 6, 8, and 0.

Multiples of 4 end in 4, 8, 2, 6, and 0 and then repeat.

Multiples of 5 end in 5 or 0, and multiples of 10 end in 0.

Multiples of 8 end in 8, 6, 4, 2, 0, then repeat: 8, 6, 4, 2, 0.

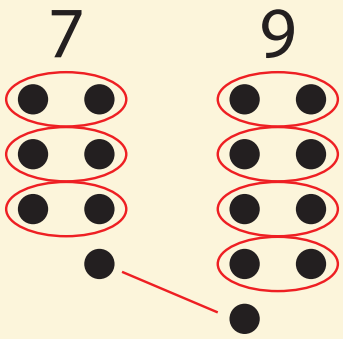
Multiples of 9 end in 9, 8, 7, 6, 5, 4, 3, 2, 1, and 0.

Multiples of even numbers are always _____. (even)

Multiples of odd numbers _____ (alternate: odd, even, odd, even, odd, and so on)

This standard also requires that students understand <u>why</u> certain rules apply in mathematics. For example, describe why two odd numbers always make an even number.

Why do two odd numbers always equal an even number? Look at the picture and use it to make pairs.
Possible Answer: When 7 and 9 are grouped into pairs, each has a remainder of one. The two remainders make another pair. This means the sum is divisible by two, and any number divisible by two is an even number.



Without actually finding the answer, tell whether the sum of 15<u>4</u> +17<u>8</u> is even or odd. Answer: Even. The sum of any two even numbers is even. (4 + 8 = 12)

Without actually finding the answer, tell whether the sum of 2,16<u>7</u> + 3,14<u>9</u> is even or odd. Answer: Even. The sum of any two odd numbers is even. (7 + 9 = 16)

Without actually finding the answer, tell whether the sum of 1,23<u>4</u> + 4,56<u>7</u> is even or odd. Answer: Odd. The sum of any odd and even number is odd. (4 + 7 = 11)

Concept Mastery

- ✓ Students are able to identify patterns in sums and products of basic facts.
- ✓ Students are able to explain (with words and/or drawings) some mathematical patterns, such as why the sum of two even or two odd numbers is always an even number.

A link to helpful web resources can be found on page 73 of the full Level 3 document.