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Lakenham Primary School Calculations Policy

To ensure consistency in teaching throughout the school this Calculations policy has been produced. It is to inform parents of the strategies used in our school to teach maths. We hope that the examples of children's work contained within this policy will enable you to support your child at home in their maths learning.

This policy gives you an overview of the calculations strategies used throughout the Primary Maths Curriculum.

As children progress at different rates, some may need to use the strategies from previous or future year groups e.g. a higher ability child in Year 2 may need to use the strategies from Year 3. In the same way a lower ability child may need to use the strategies from Year 1.

This policy contains the key pencil and paper procedures that will be taught within our school. It has been written to ensure consistency and progression throughout the school and reflects a whole school agreement.

We use a mixture of plain A4 books and squared books so that the children do not feel forced into using vertical methods only as a lot of methods can be used vertically and plain books encourage individual jottings that children need in order to answer specific questions.

The policy concentrates on the use of the empty number line as a jotting aid to mental calculation and on the introduction of paper and pencil procedures. It is important that children do not abandon jottings and mental methods once pencil and paper procedures are introduced. Therefore, children will always be encouraged to look at a calculation/problem and then decide which is the best method to choose – pictures, mental calculation with or without jottings, structured recording or a calculator. Our long-term aim is for children to be able to select an efficient method of their choice (whether this be mental, written or using a calculator) that is appropriate for a given task. They will do this by always asking themselves:

- 'Can I do this in my head?'
- 'Can I do this in my head using drawings or jottings?'
- 'Do I need to use a paper and pencil procedure?'
- 'Do I need a calculator?'

Although the focus of the policy is on pencil and paper procedures it is important to recognise that the ability to calculate mentally is a crucial part of the Numeracy curriculum. Mental methods for teaching mathematics should be taught systematically from Reception onwards and pupils should be given regular opportunities to develop the necessary skills. However mental calculation is not at the exclusion of written recording and should be seen as complementary to and not as separate from it. In every written method there is an element of mental processing. Sharing written methods with the teacher encourages children to think about the mental strategies that underpin them and to develop new ideas. Therefore written recording both helps children to clarify their thinking and supports and extends the development of more fluent and sophisticated mental strategies.

ADDITION AND SUBTRACTION

FOUNDATION STAGE

Pupils should be taught to:

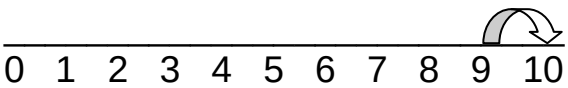
- Count reliably with numbers from 1 to 20.
- Place them in order and say which numbers is one more or one less than a given number.
- Using quantities and objects, they add and subtract two single-digit numbers and count on or back to find the answer.

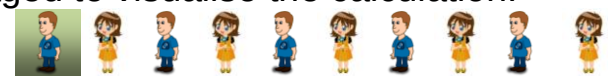
Children are taught to say numbers in familiar contexts such as number rhymes or in role play. This will develop into the counting of everyday objects. The children will be taught to say the number names in order and recognise the numerals from 1 – 9. Children will be taught to recognise, count and order numbers up to 20. Wherever possible the children will be given the opportunity to solve simple problems involving the use of the skills listed above.

The children will be taught to use the vocabulary involved in addition and subtraction through practical activities and discussion, e.g. *more, and, add, make, sum, total, altogether, take away, leave, how many left?, how many more to make?*

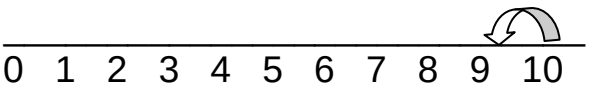
They will be taught to recognise differences in quantity of everyday objects and to find one more or one less. This will be taught in practical contexts, using objects such as toys. From the very first stages, the children will be introduced to number lines and encouraged to visualise the calculation.

9 and 1 **more** is 10
9 **add** 1 **equals** 10

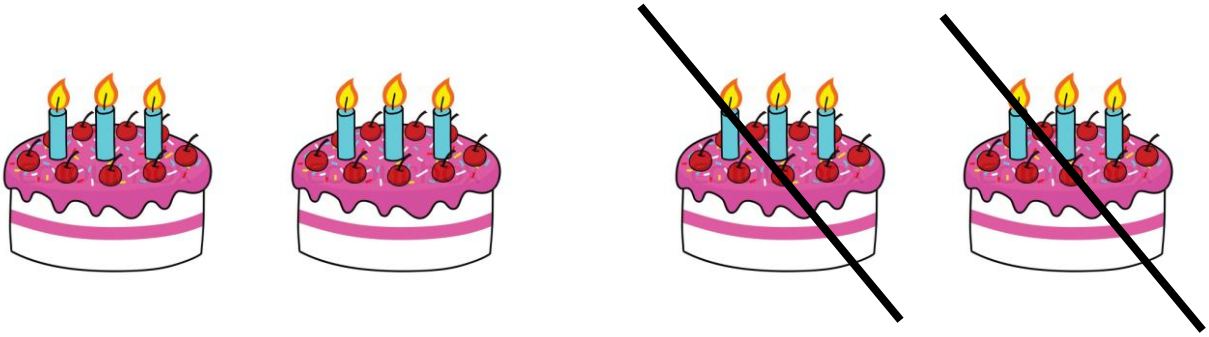




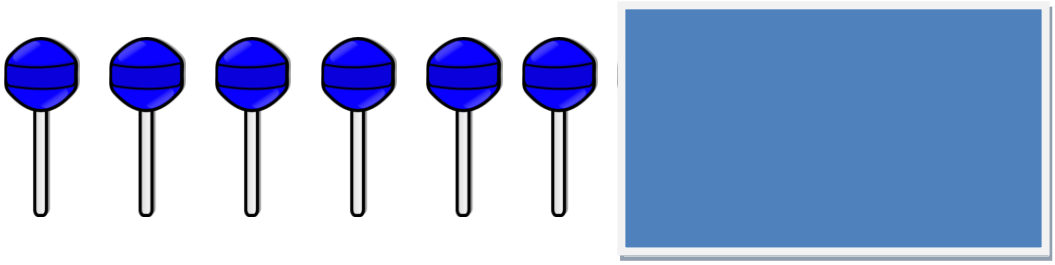
1 **less** than 10 is 9
10 **subtract** 1 **equals** 9



The children will be encouraged to relate subtraction to taking away and counting how many are left. We ate 2 of our 4 cakes. How many cakes are left?



The children will learn to find a total by counting on when one group of objects is hidden.



6 and how many **more** make 10?

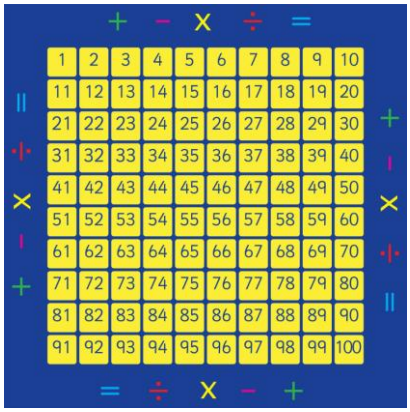
ADDITION AND SUBTRACTION

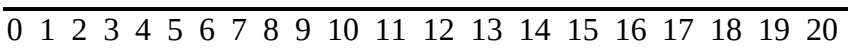
YEAR ONE

Pupil should be taught to:

- Read, write and interpret mathematical statements involving addition (+), subtraction (-) and equal (=) signs.
- Represent and use number bonds and related subtraction facts within 20.
- Add and subtract one-digit and two-digit numbers to 20, including zero.
- Solve one step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 = ◯ - 9

Children will continue to develop the practical operations of addition and subtraction. The children are taught to recognise that addition can be done in any order, putting the largest number first and combining more than two groups. The children are encouraged to move from using their fingers and practical objects towards more use of number lines and hundred squares to aid their calculations.





The children are encouraged to respond rapidly to oral questions phrased in a variety of ways, such as *3 add 1, add 2 to 4, 6 plus 3, What is the sum/total of 2 and 8? Which 2 numbers could make 9? What must I add to 4 to make 10? Take 2 from 7, 4 – 1, 7 subtract 3, How many less than 6 is 4?*

They progress to recording simple mental addition and subtraction in number sentences using the +, - and = signs.

5 + 5 = 10

4 + 16 = 20

7 + 8 = 15

10 – 6 = 4

20 – 15 = 5

16 – 7 = 9

The children learn to recognise the use of symbols, such as □ or ▲ to stand for unknown numbers.

5 - □ = 3 ▲ – 2 = 3

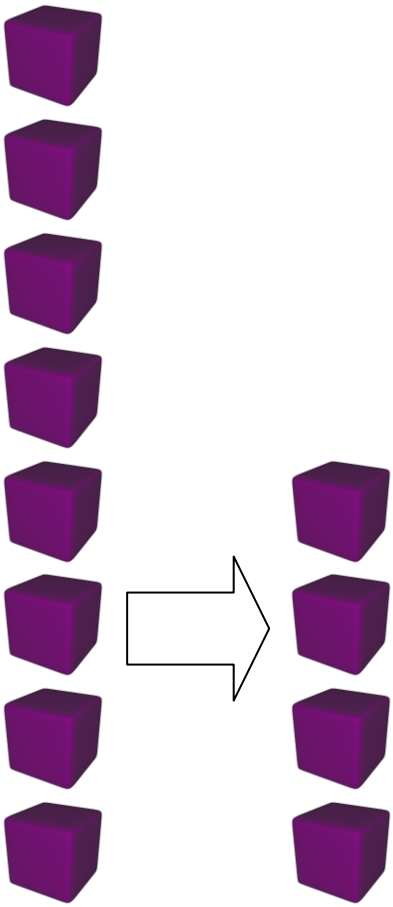
Doubles are taught through repeated addition, initially with practical activities such as, there are 4 wheels on one car, how many on two cars? The children then progress to using number lines to count on, e.g. make 2 hops, each the same, where do you land?

Once the children have instant recall of doubles, they then progress onto identifying near doubles,

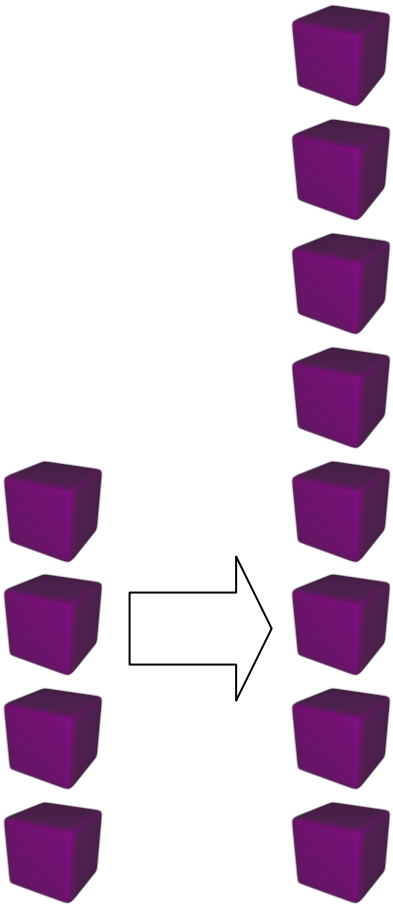
e.g. if they know 4 + 4 = 8
then 4 + 5 = 4 + 4 + 1 = 9

From their knowledge of doubles, children understand the corresponding halves.

Half of 8 is 4



Double 4 is 8



ADDITION AND SUBTRACTION

YEAR TWO

Pupils should be taught to:

- Solve problems with addition and subtraction:
  - Using concrete objects and pictorial representations, including those involving numbers, quantities and measures.
  - Applying their increasing knowledge of mental and written methods.
- Recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100.
- Add and subtract numbers using concrete objects, pictorial representations, and mentally, including:
  - A two-digit number and ones
  - A two-digit number and tens
  - Two two-digit numbers
  - Adding three one-digit numbers
- Show that addition of two numbers can be done in any order (commutative) and subtract of one number from another cannot.
- Recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

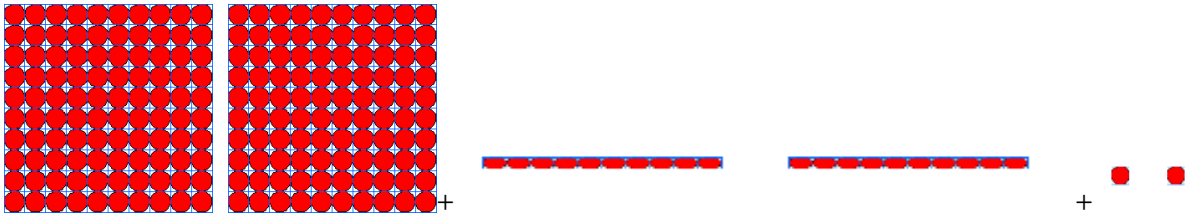
In Year Two, children learn to extend their knowledge of number facts in addition and subtraction by using larger numbers e.g.

86 + 57

25 - ☐ = 16

Partitioning and recombining will also involve using larger numbers.

222 = 200 + 20 + 2

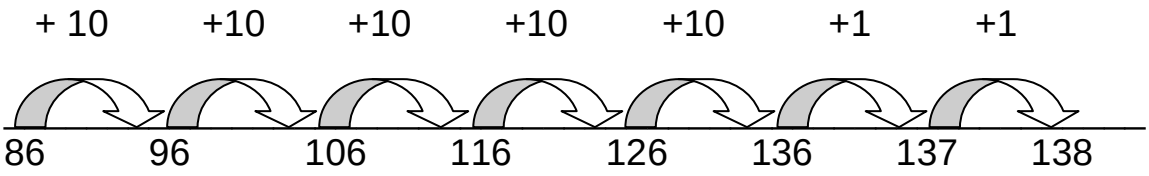


Counting on and back

The use of empty number lines is strongly encouraged in Year 2. When calculating using larger 2 digit numbers, children are encouraged to count on in multiples of 10 then add the ones.

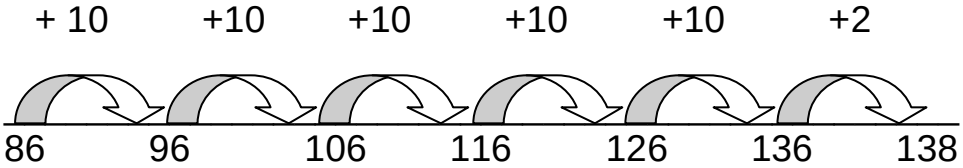
First counting on in tens and ones.

86 + 52 = 138



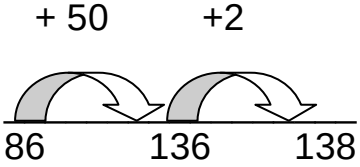
Then helping children to become more efficient by adding the ones in one jump (by using the known fact 6 + 2 = 8).

86 + 52 = 138



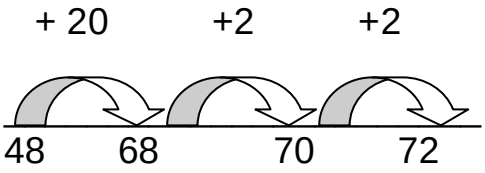
Followed by adding the tens in one jump and the ones in one jump.

86 + 52 = 138



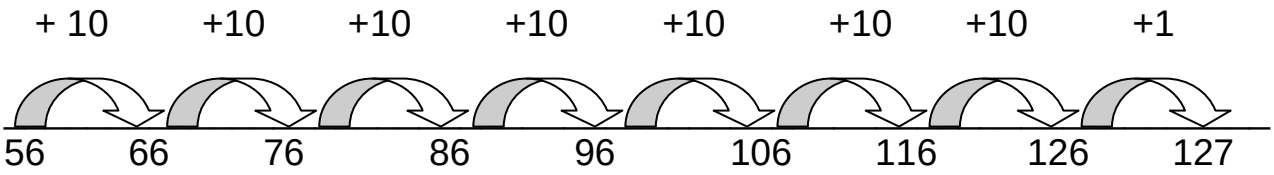
Bridging through ten can help children become more efficient.

48 + 24 = 72



For subtraction, children are encouraged to count up on the number line and solve the question through finding the difference.

127 – 56 =



Once children have completed the number line, they need to find the answer by counting the jumps.

10 + 10 + 10 + 10 + 10+ 10 + 10 + 10 + 1 = 71

<u>Understanding that addition of two numbers can be done in any order (commutative) and subtract of one number from another cannot.</u>

e.g. 25 + 24 = 49
24 + 25 = 49 Same answer

32 – 15 = 17
32 – 17 = 15 Different answer

Recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

e.g.

- 34 + 18 = 52 the inverse operation would be 52 – 34 = 18

- If 42 + 27 = 69 then from this we can work out:
  - 27 + 42 = 69
  - 69 – 42 = 27
  - 69 – 27 = 42

- Find the missing number.
  25 + □ = 56
  To find the missing number, children are taught to use the inverse operation of
  56 – 25 = 31.

ADDITION AND SUBTRACTION

In Years 3 to 6 children will be doing a daily mixture of practical, mental and oral work including counting, talking about numbers and using numbers in real life activities.

YEAR THREE

Pupils should be taught to:

- Add and subtract numbers mentally, including
  - A three-digit number and ones
  - A three-digit number and tens
  - A three-digit number and hundreds
- Add and subtract numbers with up to three digits, using formal written methods.
- Estimate the answer to a calculation and use inverse operation to check answers.
- Solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

YEAR FOUR

Pupils should be taught to:

- Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate.
- Estimate and use inverse operations to check answers to a calculation.
- Solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why.

YEAR FIVE

Pupils should be taught to:

- Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction).
- Add and subtract numbers mentally with increasingly larger numbers.
- Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy.
- Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

YEAR SIX

Pupils should be taught to:

- Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.
- Solve problems involving addition, subtraction, multiplication and division.
- Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.
- Perform mental calculations, including with mixed operations and large numbers.
- Use their knowledge of the order of operations to carry out calculations involving the four operations.

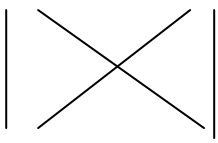
In Years 3 to 6, children will continue to develop their knowledge of number lines to solve addition and subtraction questions. Once children have mastered using number lines, they progress onto using the formal written methods, therefore as children progress at different rates, within a class there will be children using different methods e.g. you may a higher ability child in Year 3 using formal written methods. In the same way, you may have a lower ability child in Year 5 using a number line.

Starting Key Stage 2, children will continue to use the horizontal recording of addition and subtraction to support their mental calculations. The examples below show a common way of adding 74 and 98. It first splits (we refer to this as partitioning) the numbers into tens and ones, then adds the tens followed by the ones to give 172.

ADDITION

At a school there are 74 boys and 98 girls. How many children are there altogether?

74 + 98



70 + 90 4 + 8
160 12

160 + 12 = 172

OR

74 + 98

70 + 90 = 160
4 + 8 = 12

160 + 12

160 + 12= 172

Once children have become confident using the partitioning method for addition, they will then progress to using formal written methods.

The green team scored 689 points in the first half; their score increased by 456. What is the new score?

689 + 456 =

```
  6 8 9
+ 4 5 6
_______
1 1 4 5
_______
  1 1
```

Answer: 1145

Explanation

Add the **ones** first (9 + 6). This makes 15. Write the 5 in the **ones** column and carry the ten to the **tens** column.

Then add the **tens (**80 + 50 + 10). This makes 140. Write the 40 (4) in the **tens** column and carry the hundred to the **hundreds** column.

Add the **hundreds** (600 + 400 + 100). This Makes 1100. Write the 100 (1) in the **hundreds** column and then the 1000 (1) in the **thousands** column.

SUBTRACTION

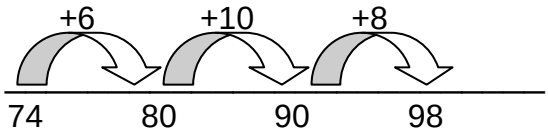
Starting Key Stage 2, children will continue to develop horizontal methods to develop their mental calculations.

If there are 74 boys and 98 girls, how many more girls are there than boys?

98 – 74

94 – 74 = 20
98 – 74 = 24

OR



6 + 10 + 8 = 24

Once children have become confident using finding the difference for subtraction, they will then progress to using formal written methods.

The blue team scored 754 points and the red team scored 386 points. By how many points did the blue team win?

754 – 386 =

```
   6  14  1
   7  5  4
 - 3  8  6
_________
   3  9  8
_________
```

Answer: 398

Explanation

First, start by exchanging a **ten** to the **ones** column.

Subtract the **ones** 14 – 6 = 8

Then exchange a **hundred** to the **tens** column.

Subtract the **tens** 14 – 5 (140 – 50) = 9

Subtract the **hundreds** 6 – 3 (600 – 300) = 3

MULTIPLICATION AND DIVISION

FOUNDATION STAGE

Pupil should be taught to:

- Solve problems including doubling, halving and sharing.

The children are taught practically to count repeated groups of the same size, e. g.

Using 3 toy animals, if the children give each animal 2 biscuits, how many biscuits altogether?

MULTIPLICATION AND DIVISION

YEAR ONE

Pupils should be taught to:

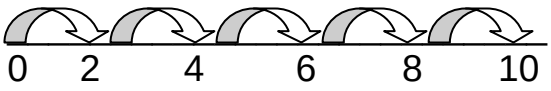
- Solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.

In Year One, the children are introduced to multiplication as repeated addition. They participate in practical sessions, e.g. counting pairs of socks and fingers on hands. This is also illustrated on a number line and a hundred square.

2 + 2 + 2 + 2 + 2 = 10

5 hops of 2

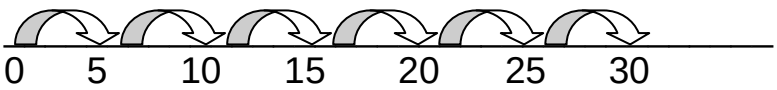
5 lots of 2



5 + 5 + 5 + 5 + 5 + 5 = 30

6 hops of 5

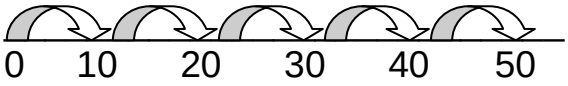
6 lots of 5



10p + 10p + 10p + 10p + 10p

5 hops of 10

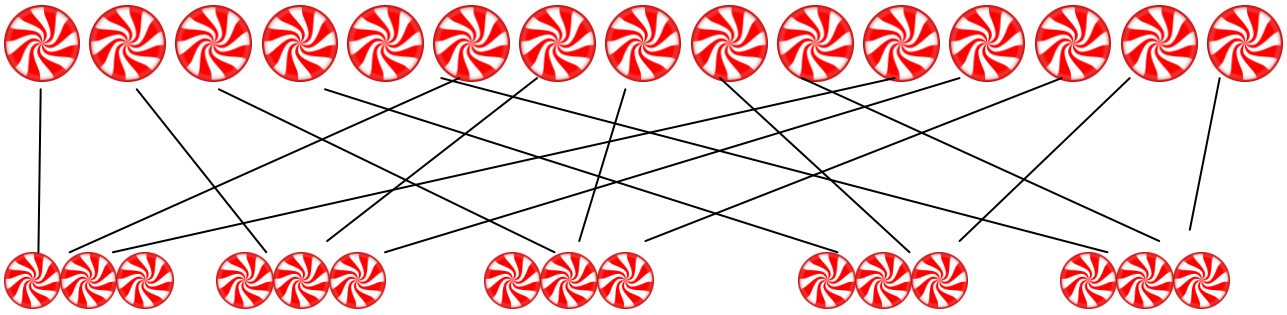
5 lots of 10



As a progression from the Foundation Stage, the children learn to share objects into equal groups when solving problems, e.g.

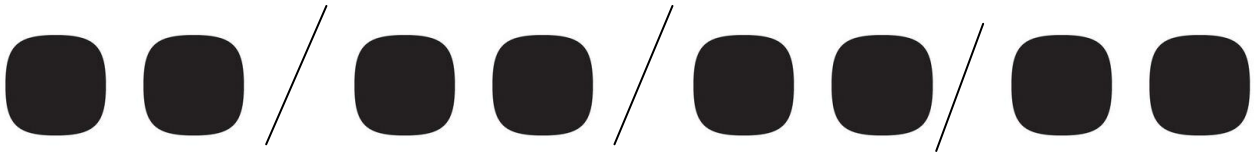
There were 5 children and 15 sweets. How many sweets would they each have?

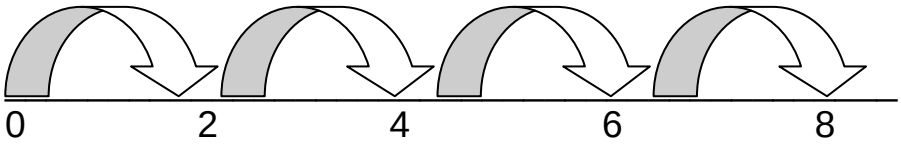
15 shared between 5.



At this stage, the children are not expected to record their work and all activities are practical.

e.g. 8 ÷ 2 = 4





Once the children are secure in their understanding of multiplication and division, they are then encouraged to use them to solve problems, e.g.

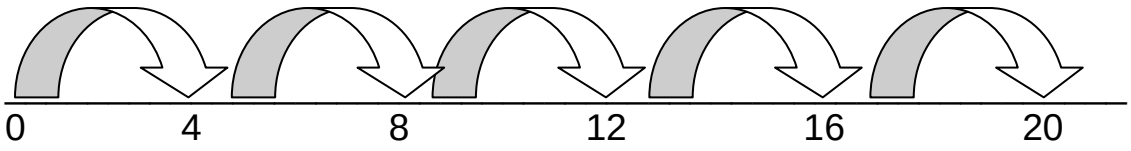
If a car has four wheels, how many wheels on 5 cars?

4 x 5 =

4 + 4 + 4 + 4 + 4 = 20

4 hops of 5

4 lots of 5

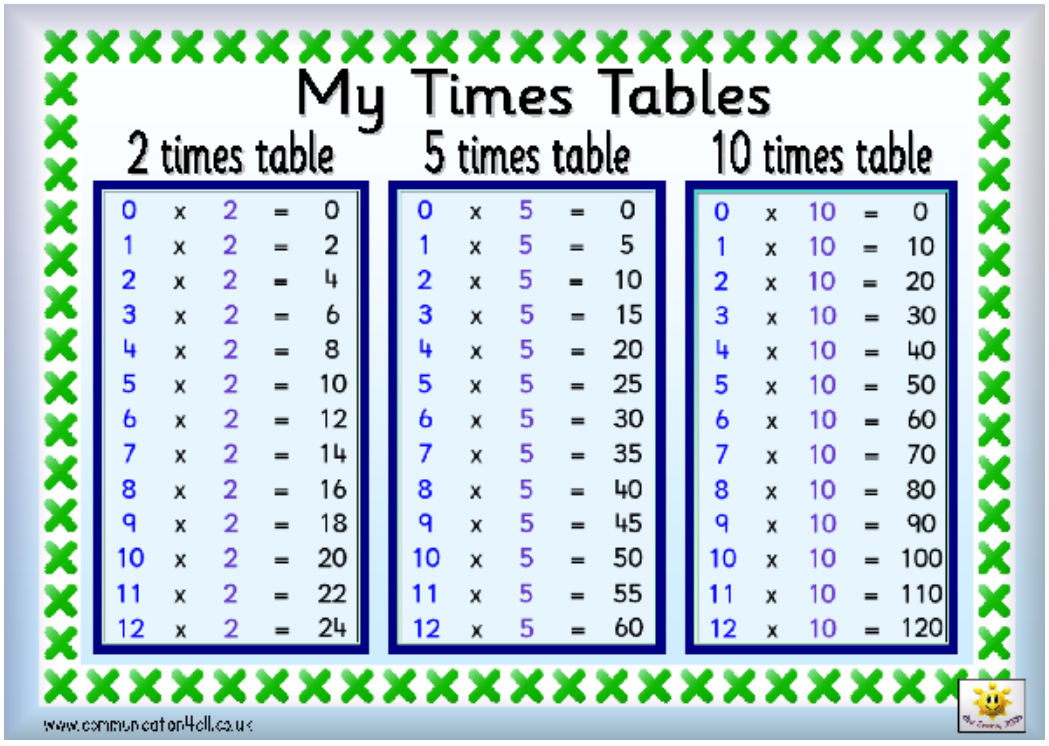


YEAR TWO

Pupils should be taught to:

- Recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers.
- Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (x), division (÷) and equals (=) signs.
- Show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot.
- Solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

In Year Two, children continue to develop their knowledge of mental calculations by beginning to learn their multiplication tables. Being able to use and apply knowledge of multiplication tables is a building block for being able to access a wide part of the numeracy curriculum. Frequently, opportunities are given for the children to practise multiplication tables in class, on laptops, playing games, at the beginning of numeracy lessons and whenever opportunities arise in other subjects.

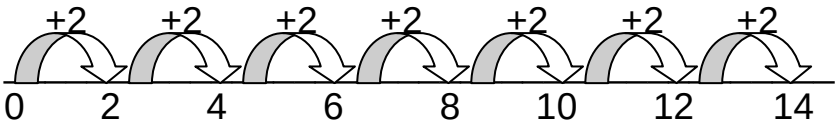


Children will start recording their multiplication and division work using the correct signs and showing their working out using a number line.

e.g.

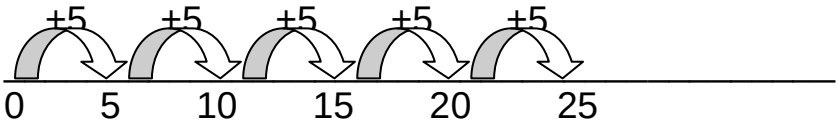
7 x 2 =

7 lots of 2



25 ÷ 5

How many 5 go into 25?



When solving problems involving multiplication and division, children will continue to develop the use of materials from Year One, progressing on to using the methods set out above.

<u>Understanding that multiplication of two numbers can be done in any order (commutative) and that division cannot.</u>

e.g. 4 x 5 = 20
5 x 4 = 20 Same answer

30 ÷ 6 = 5
30 ÷ 5 = 6 Different answer

MULTIPLICATION AND DIVISION

In Years 3 to 6 children will be doing a daily mixture of practical, mental and oral work including chanting, quick recall, and using and applying of multiplication and division facts.

YEAR THREE

Pupils should be taught to:

- Recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables.
- Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods.
- Solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems in which n objects are connected to m objects. (3 hats and 4 coats, how many different outfits?)

YEAR FOUR

Pupils should be taught to:

- Recall multiplication and division facts for multiplication tables 12 x 12
- Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers.
- Recognise and use factor pairs and commutativity in mental calculations.
- Multiply two-digit and three-digit numbers by a one-digit numbers using formal written layout.
- Solve problems involving multiplying and adding, including using the distributive law to multiply two-digit numbers by one-digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.

YEAR FIVE

Pupils should be taught to:

- Identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers.
- Know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers.
- Establish whether a number up to 100 is prime and recall prime numbers up to 19.
- Multiply numbers up to 4 digits by a one-digit or two-digit number using a formal written method, including long multiplication for two-digit numbers.
- Multiply and divide numbers mentally drawing upon known facts.
- Divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context.
- Multiply and divide whole numbers and those involving decimals by 10, 100 and 1000.
- Recognise and use square numbers and cube numbers, and the notation for squared (^{2}) and cubed (^{3}).
- Solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes.
- Solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign.
- Solve problems involving multiplication and division including scaling by simple fractions and problems involving simple rates.

YEAR SIX

Pupils should be taught to:

- Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication.
- Divide numbers up to 4 digits by a two-digit number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for content.
- Divide numbers up to 4 digits by a two-digit whole number using the formal written method of short division where appropriate, interpreting remainders according to the content.
- Perform mental calculations, including with mixed operations and large numbers.
- Identify common factors, common multiples and prime numbers.

- Use their knowledge of the order of operations to carry out calculations involving the four operations.
- Solve problems involving addition, subtraction, multiplication and division.
- Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

In Years 3 to 6, children will begin to use expanded methods to help them deal with calculations that they can't do in their heads. To start, it will mostly involve multiplying and dividing two digit numbers by a single digit (72 x 6 or 85 ÷ 4). The use of jottings to support children's calculations is encouraged.

For multiplication children begin with using the 'Grid Method', it uses knowledge of number facts and the idea of splitting a number into parts (place value) to help with understanding of the process.

In order for children to understand the process more clearly, grid can begin to be drawn in proportion to the size of the number. For example the 10 x 6 area is larger than the 3 x 6 area.

MULTIPLICATION

If I earn £13 a week doing a paper round how much will I earn in 6 weeks?

X	10	3
6	10 x 6 = 60	3 x 6 = 18

13 x 6 = 60 + 18 = 78. So the answer is £78.

Children can partition the numbers into as many parts as they like to ensure that they are only dealing with numbers that they are confident in using.

There are 5 buses each transporting 33 children. How many children are there altogether?
33 x 5

X	10	10	10	3
5	10 x 5 = **50**	10 x 5 = **50**	10 x 5 = **50**	3 x 5 = **15**

33 x 5 = 50 + 50 + 50 + 15 = 165. So the answer is 165 children.

As children become more confident with the method and with multiplying higher numbers they will go on to a more efficient way of using the method by partitioning into tens and ones.

There are 71 trays each containing 8 eggs. How many eggs are there altogether?

71 x 8

x	70	1
8	70 x 8 **560**	1 x 8 **8**

560 + 8 = 568. So the answer is 568 eggs.

There are 56 pots each containing 35 pencils. How many pencils are there altogether?

56 x 35 =

x	50	6
30	50 x 30 **1500**	6 x 30 **180**
5	50 x 5 **250**	6 x 5 **30**

1500 + 180 + 250 + 30 = 1960. So the answer is 1960 pencils.

Once children have become confident using the grid method for multiplication, they will then progress on to using expanded long multiplication.

136 x 33

H	T	O	
	1	3	6
X		3	3
		1	8
		9	0
	3	0	0
	1	8	0
	9	0	0
+3	0	0	0
4	4	8	8
1	1		

Explanation.

When using long multiplication, we multiply the top number by the bottom number.

3 x 6 = 18

3 x 30 = 90

3 x 100 = 300

30 x 6 = 180

30 x 30 = 900

30 x 100 = 3000

Then add all the numbers to reach your answer.

18 + 90 + 300 + 180 + 900 + 3000 = 4488

Long Multiplication.

128 x 34 =

H T O

$^{1}\ ^{3}$
1 2 8
x 3 4
5 1 2
3 8 4 0
^{2}
4 3 5 2
^{1}

Explanation

First multiply by 4 (**ones**).
Multiply 8 x 4 = 32. Write the 2 in the ones column and carry over the **tens** 3 to the **tens** column.
Then multiply 2 x 4 (20 x 4) = 8 (80). Add the 3 **tens.** Write 11 (110) in. Put 1 in the **tens** column and carry over 1 to the **hundreds** column.
Multiply 1 x 4 (100 x 4) = 4 (400). Add the 1 **hundred.** now multiply all the numbers by 30. We add a 0 on the right hand row of the next row. This is because we want to multiply by 30 (3 **tens),** which is the same as multiplying by 10 and by 3.
Multiply 3 x 8 (30 x 8) = 24 (240). Write the 4 in **tens** column and carry the 2 to the **hundreds** column.
Then multiply 3 x 2 (30 x 20) = 6 (600). Add the 2 in the **hundreds** column which gives 8 in the **hundreds** column.
Multiply 3 x 1 (30 x 100) = 3 (3000).
Write the 3 in the **thousands** column.
Lastly, add up the two rows using column addition.

Answer : 4352

DIVISION

In Year 3, children will begin to use multiplication facts to help them solve division questions.

There are 72 pencils sold in packs of 6. How many packs are there?

10 x 6 **2** x 6

0 60 72

Explanation

1st Jump **10** x 6 = 60
2nd Jump **2** x 6 = 12
10 + 2 = 12

Answer: 12

Once, children are confident with their multiplication tables they move onto using factors (numbers that divide **exactly** into another number).

48 ÷ 8

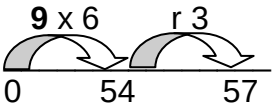
1 x 8 = **8**
2 x 8 = 16
5 x 8 = **4**
10 x 8 = 80

Explanation.
Start by writing factors using the 1, 2, 5 and 10 multiplication tables.
Then try to reach the number you are dividing into (48)
40 + 8 = 48
(1 x 8) + (5 x 8) = 48
6 x 8 = 48

Answer: 6

Children will also learn to use remainders.

57 ÷ 6 =



1 x 6 = 6
2 x 6 = **12**
5 x 6 = **30**
10 x 6 = 60

30 + 12 + 12 = 54
(**5** x 6) + (**2** x 6) + (**2** x 6) = 54

9 x 6 = 54

Answer: 9 r 3.

Once children have become confident using the factor method for division, they will then progress onto using formal written methods.

Short Division.

138 ÷ 6

$$\begin{array}{r|rrr} & 2 & 3 \\ & & {\scriptstyle 1} \\ \hline 6 & 1 & 3 & 8 \end{array}$$

Explanation
Start by dividing 6 into the first number. (1)
As this does not divide, divide 6 into first and second Number (13). 6 divides into 13 twice with a remainder of 1. Write the 2 above the line and carry one to the 8.
Then divide 6 into 18. 6 divides into 18 3 times. Write this above the line.

Answer: 23

Long Division.

Before children start long division, they need to secure in their number facts, multiplication tables and place value.

I have got 564 sweets; I share them between 15 people. How many sweets will each person get? How many will be left over?

```
        3 3 r 3
    ┌──────────
17  │ 5 6 4
  - 5 1 0        (17 x 30)
    ─────
      5 4
  -   5 1        (17 x 3)
    ─────
        3
```

Answer: 33 r 3

Explanation

Start by multiplying 17 x **30** = 510.
Write 3 in the **tens** column. (30)
Take 510 away from 564.
Multiply 17 x **3** = 51
Take away 51 from 54.
Write 3 in the **ones** column (3)
As there are 3 left over, there will be a remainder of 3.

The aim is for all children at Lakenham to feel confident with numbers and to enjoy playing with them and using them. Our target is for children to become skilled mathematicians and to use this knowledge in all areas of everyday life.