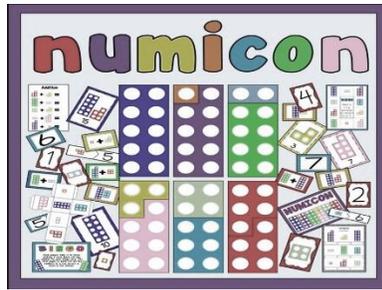


Calculation Methods Policy



Ashfield Junior School



The aim of this policy is to demonstrate the calculation methods that children are taught as they progress through Ashfield Junior School. As children move through the school, they will learn a variety of strategies to carry out the four operations of addition, subtraction, multiplication and division. These strategies are presented as a progression which children will work through when they are ready. Not all children of the same age will necessarily access the same methods of these operations at the same time. Many children will begin beyond the first step. We aim to develop confident mathematicians who can use these methods correctly and to help them to problem solve in different areas of maths.



The principal focus of mathematics teaching in lower key stage 2 is to ensure that pupils become increasingly fluent with whole numbers and the four operations, including number facts and the concept of place value. This should ensure that pupils develop efficient written and mental methods and perform calculations accurately with increasingly large whole numbers.

Year 3 Programme of Study

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 of column addition and subtraction.

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.

Year 4 Programme of Study

Add and subtract numbers with up to 4 digits using the formal written methods of column addition and subtraction where appropriate.

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.

Multiply two-digit and three-digit numbers by a one-digit number using formal written layout.

Year 5 programme of study

Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction).

Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers.

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.

Year 5 Programme of Study

Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction).

Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers.

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.

Solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes.

Year 6 Programme of Study

Carry out formal written addition and subtraction

Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

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 short division where appropriate, interpreting remainders according to the context.

Divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division.

Solve problems involving addition, subtraction, multiplication and division.

STEP 4

Adding two single digit numbers together using a hundred square, track and rods to calculate a total, then using a number line.

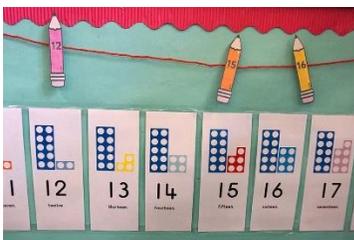
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100



E.g. $6 + 4$ start at 6 and then count on 4 more.

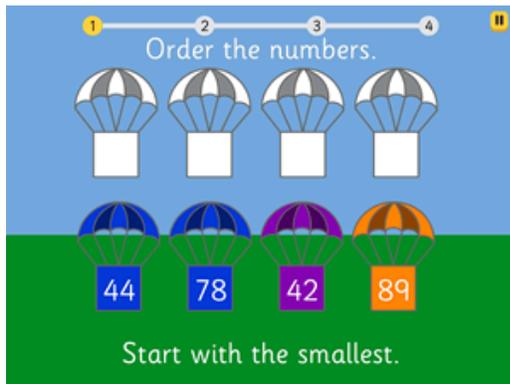
STEP 5 The process is repeated with larger numbers.

Ordering numbers to 20.



- Number bonds to 20.
- Adding a single digit number (e.g. 4) to a two-digit number (e.g. 12) with a number line and introducing the 100 hundred square.

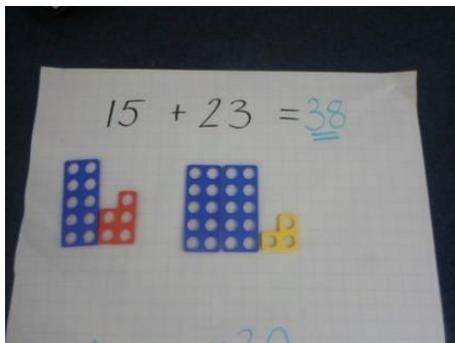
STEP 6



Counting and ordering numbers up to 50, then 100.

STEP 7

Step A = Add two 2-digit numbers.



Then carried out using rods and tracks to calculate a total.

Step 7B:

Partition and recombine.

$$64 + 35$$

$$64 = 60 + 4 \quad 35 = 30 + 5$$

$$60 + 30 = 90$$

$$4 + 5 = 9$$

$$90 + 9 = 99$$

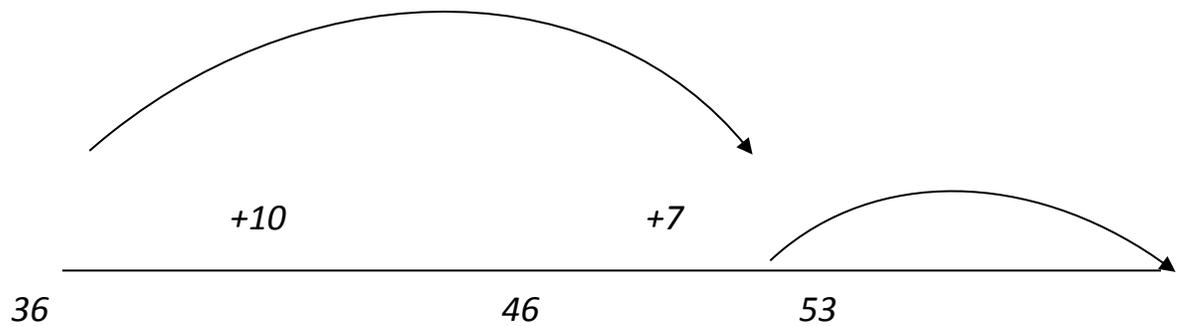
Then a number line.

SUCCESS CRITERIA

- Draw a blank number line.
- Place the largest number at the start.
- Partition the smallest number. Use rods to complete the jumps.
- Count on the tens.
- Count on the ones.
- The number you land on is the answer.

$$17 + 36 = 53$$

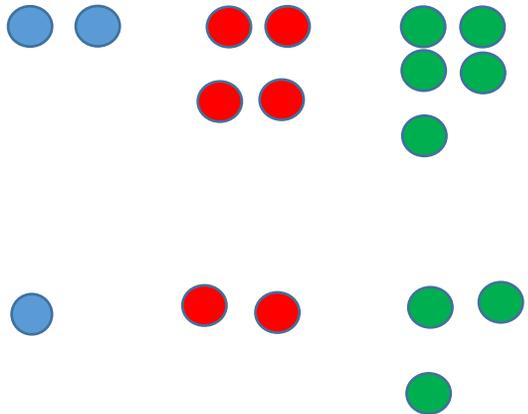
My friend has 17 books. I have 36. How many books do we have between us?



STEP 8

This step precedes column addition. It introduces the idea of columns and uses physical apparatus for adding values. Numbers are partitioned and placed into the columns.

Part 1



300 60 8

300
60
8
368

Part 2

200 40 5

100 20 3 = **368**

STEP 9

Column Addition – no carrying/bridging

SUCCESS CRITERIA:

- Align numbers correctly into place value columns, tens below tens etc.
- Begin adding from the units/ones, continue adding tens next.

First, column addition will not involve any carrying over to the next column. It will begin with 2 digit numbers, then 3 and eventually with decimal numbers. The decimal points in numbers are always aligned underneath each other. The process will extend throughout each year group. At each point, problem solving and reasoning should be used when skills are secure.

Tens Units/ones

$$\begin{array}{r|l} 4 & 4 \\ + & 12 \\ \hline & 6 \end{array}$$

$$236 + 752 = 988$$

H	T	U/O
2	3	6
7	5	2
<hr/>		
9	8	8

STEP 10

Column addition – exchanging/carrying

$$\begin{array}{r|l} & 1 \\ 2 & 3 & 7 \\ + & 1 & 1 & 6 \\ \hline & & & 3 \end{array}$$

The 7 + 6 creates a 2-digit number, so the units/one number is placed below the units/one and the 1, or 10, is carried over to the column which is immediately left.

A man bought a pack of 150 balloons. Then he bought a pack of 35 streamers and 7 banners for a party. How many decorations did he buy altogether?

$$\begin{array}{r} 150 \\ 35 \\ + \quad 7 \\ \hline 192 \end{array}$$

He bought 192 decorations.

$$3780.06 + 4927.59 = 8707.65$$

	Th	H	T	U	.	t	h
	3	7	8	0	.	0	6
+	4	9	2	7	.	5	9
	<hr/>						
	8	7	0	7	.	6	5
	<hr/>						
	1	1				1	

Subtraction

Leave Subtract
Minus  Less
Take away Difference

STEP 1

Count back from 5, then 10.



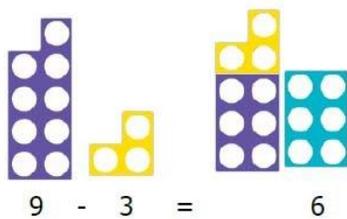
STEP 2

Subtract one from a one-digit number.



STEP 3

Subtract a one-digit number from a one-digit number. Using Numicon, place the smaller shape over the larger shape to show what remains.

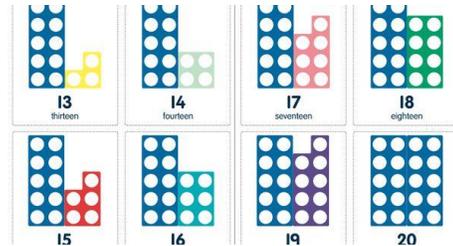


STEP 4



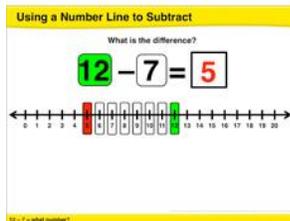
Count back from 20.

Then extend to larger numbers.



STEP 5

Subtract a one-digit number from a two-digit number.



Introduce hundred square to do this.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

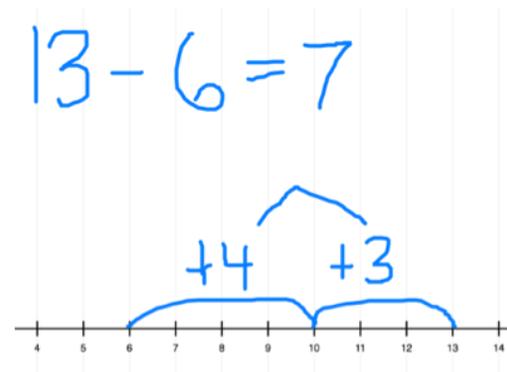
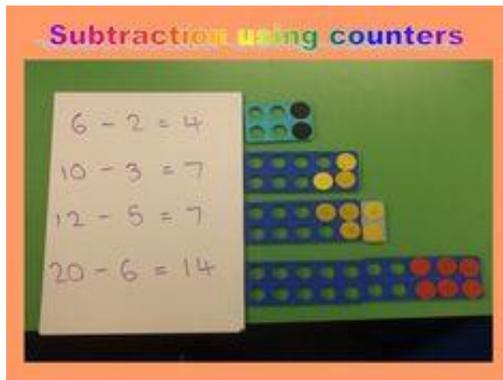
$$38 - 7 = 31$$

Begin at 38 and count back 7 places.

STEP 6

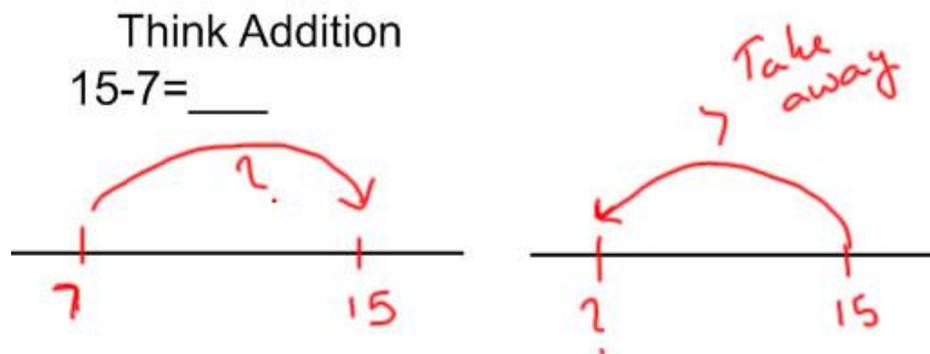
First, look at the relationship between inverse operations, ie. $1 + 6 = 7$
 $7 - 1 = 6$

Then look at bridging ten using Numicon and then using the number line.



STEP 7

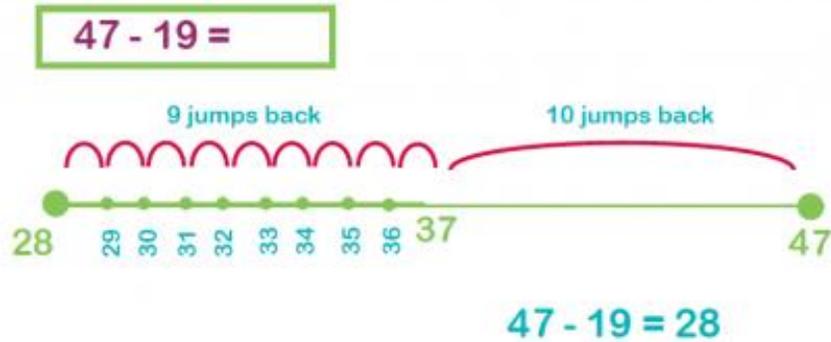
Finding the difference (no larger than 9).
Count from one to the other or back from one to the other.



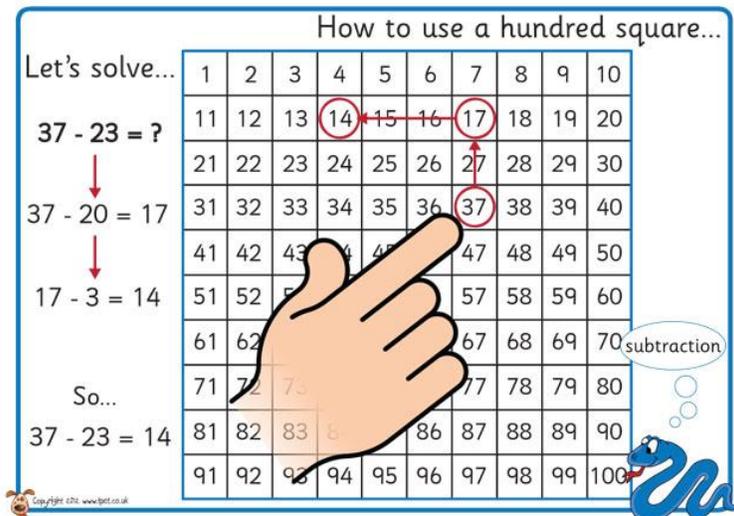
STEP 8 part 1

Subtracting a 2-digit number from a 2-digit number.

Using the number line, begin at first number in the calculation. Partition the second number and subtract in two parts.



Subtraction using the hundred square.



STEP 8 part 2

This step precedes the formal method of column subtraction. It introduces the idea of column subtraction with physical counters for subtraction.

First, a calculation is given where no exchanging is required.

E.g. $823 - 411$

$$\begin{array}{r} 800 \ 20 \ 3 \\ - 400 \ 10 \ 1 \\ \hline 400 \ 10 \ 2 \end{array} \quad 412$$

The actual sum can be shown alongside this:

$$\begin{array}{r} 823 \\ -411 \\ \hline 412 \end{array}$$

STEP 9

Column subtraction with no exchanging.

RULES:

- Align numbers correctly, tens below tens etc.
- Begin subtracting from the furthest column to the right.

First, column subtraction will not involve any exchanging from the column to the left. It will begin with 2 digit numbers, then 3 and eventually with decimal numbers. The decimal points in numbers are always aligned underneath each other. The process will extend throughout each year group. At each point, problem solving and reasoning should be used when skills are secure.

Tens Units/Ones

$$\begin{array}{r|l} 4 & 4 \\ - & 12 \\ \hline & 2 \end{array}$$

STEP 10

Column subtraction with exchanging once.

When the top digit is smaller than the digit below, it is necessary to exchange. The column to the left on the top row is exchanged.

In this example, the 5 is smaller so we go to the 3. It represents 3 tens. This amount of 30 is exchanged for a 29 and a 1. The 3 is replaced by a 2 and the 5 will gain the one as a ten. You now have 15 units/ones. It now becomes 15 – 9 and 2 – 2 in the next column.

This is then carried out using decimal numbers. Remember to align the decimal points.

Tens Units/Ones

The diagram shows the subtraction $35 - 29$ on a grid. The number 35 is written above the number 29. A horizontal line is drawn under the 9. Two blue arrows point upwards from the 5 to the 3, and a green arrow points from the 3 to the 5, indicating the exchange of one ten for ten ones. To the right of the numbers, a black box contains the text "More on the floor?" and "Go next door!".

Tens Units/Ones

The diagram shows the subtraction $32 - 17$ on a grid. The number 32 is written above the number 17. A horizontal line is drawn under the 7. A blue arrow points from the 3 to the 2, and a red arrow points from the 2 to the 3, indicating the exchange of one ten for ten ones. A red oval is drawn around the result 5.

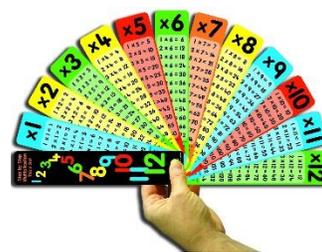
STEP 11

Exchanging from zero.

$$\begin{array}{r} \overset{1}{\cancel{2}}.\overset{9}{\cancel{0}}0 \\ - 1.62 \\ \hline 0.38 \end{array}$$

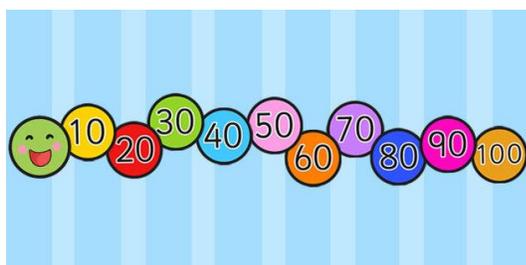
When the number on the top row is smaller than below and there are zeros in the number, repeated exchanging is necessary. If the column to the left contains a zero, the next column to the left is exchanged. This continues until a column contains a digit other than zero. It is exchanged but the one carries over to the column immediately to the right of where it is from. The process repeats until the exchanged number reaches the column which required it.

Multiplication



STEP 1

Count in multiples other than one, starting with 2, 5 and 10. Use of songs and rhymes can support this.

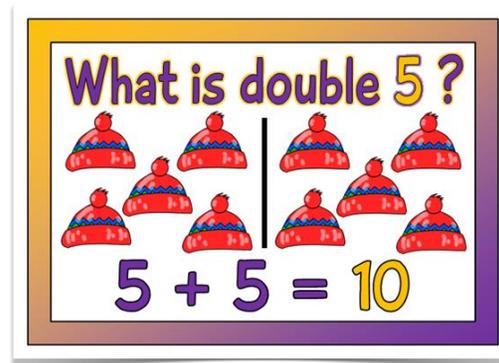


STEP 2

Doubling numbers, e.g. 3 and 3 is 6.

Can you tell me double 8?

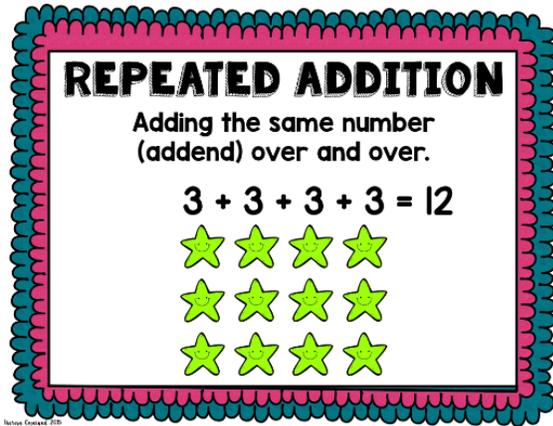
Doubling with numicon



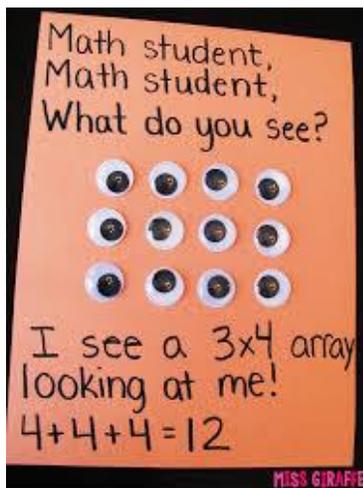
STEP 3

Repeated addition. $4 + 4 + 4 = 12$

$$3 \times 4 = 12$$

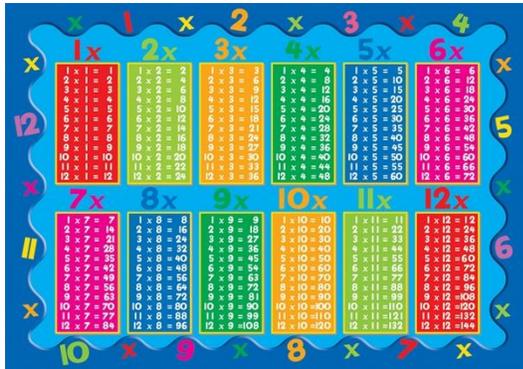


STEP 4

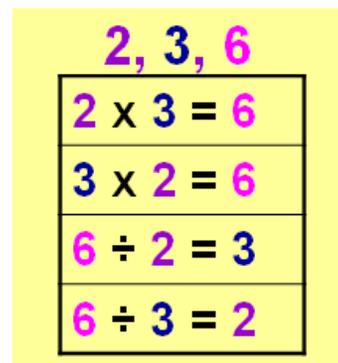


Arrays. We use these to show multiplication as a visual. We can see here that 4 groups of 3, or 3 groups of 4, total 12.

STEP 5



The extension of times tables knowledge is developed now. Other times tables facts are learnt as well as recording number stories to show the meaning of this. Times tables rockstars is used in school to promote the development and fluency of times tables knowledge. The relationship between multiplication and division is shown.



STEP 6

Short multiplication is now introduced. The first part of this is as follows:

$$237 \times 4$$

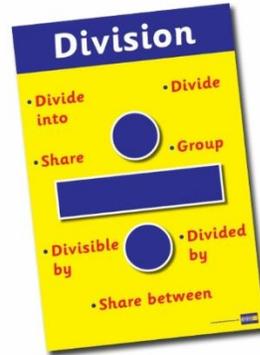
$$\begin{array}{r} 237 \\ \times 4 \\ \hline 28 \\ 120 \\ \hline 800 \\ \hline 948 \end{array}$$
$$\begin{array}{r} 7 \times 4 \\ 30 \times 4 \\ 200 \times 4 \end{array}$$

Then we move onto this:

First, a two-digit number by a one-digit number, then a three by one. All digits from the larger number are multiplied by the single digit, beginning with the units/ones. The unit/one number is recorded underneath the last column. If a tens number is carried over, it is placed beneath the tens answer. The process repeats, ensuring that the tens number carried over is added on.

$$\begin{array}{r} 237 \\ \times 4 \\ \hline 948 \\ \begin{array}{cc} 1 & 2 \end{array} \end{array}$$

Division



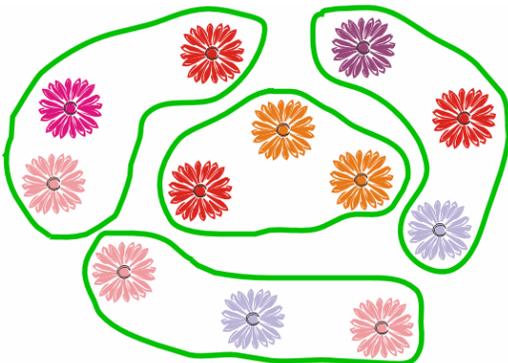
STEP 1

Halving equal numbers. First to ten, then 20.



STEP 2

Sharing or grouping items. These are either shared equally between an amount of individuals, or grouped equally. No remainder grouping and sharing are introduced first.



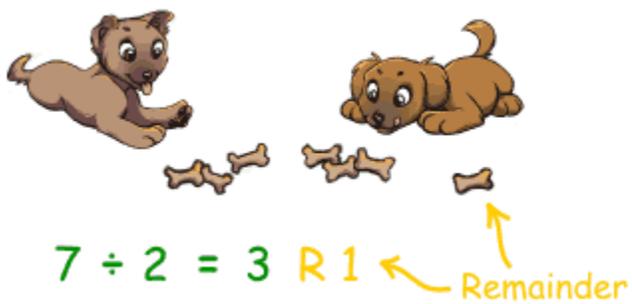
STEP 3

Use multiplication facts to derive division sums. For example,

2, 3, 6
$2 \times 3 = 6$
$3 \times 2 = 6$
$6 \div 2 = 3$
$6 \div 3 = 2$

STEP 4

Sharing or grouping items with remainders.



$20 \div 3 = 6\text{r}2$	
$20 \div 5 = 4$	
$20 \div 8 = 2\text{r}4$	
$20 \div 7 = 2\text{r}6$	

Sense Of Number *Great image for Division!*

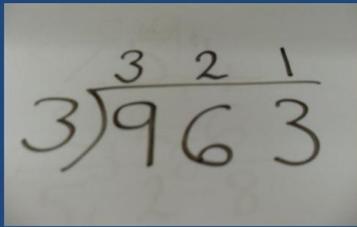
STEP 5

The bus stop method of short division is introduced to divide two, three then four digit numbers by a one-digit number. The size of the dividend is determined by the year group requirements.

PART A

Division with no remainders.

- Start by working out if 3 will go into 9. It does 3 times. This is recorded above.
- Next we repeat for 6. The 2 is recorded above, as 3 will go into 6 twice.



A photograph of a piece of paper showing the short division of 963 by 3. The divisor 3 is written on the left, followed by a vertical bar and the dividend 963. The quotient 321 is written above the dividend, with a horizontal line separating the two. The 3 is above the 9, the 2 is above the 6, and the 1 is above the 3.

Finally we solve $3 \div 3$. 3 goes into 3 once so we write 1 above the 3.

This shows us that $963 \div 3 = 321$.

PART B

Division with remainders.

$$362 \div 7 =$$

$$\begin{array}{r} 51r5 \\ 7 \overline{) 362} \end{array}$$

$$362 \div 7 = 51 r5$$

- Start by dividing 3 by 7. It doesn't, so see if 7 will go into 36. It goes 5 times to make 35. The 5 is recorded above.
- There is a remainder of 1, so this 1 goes next to the 2 to make 12.
- Now divide 12 by 7. It gives an answer of 1 and there is a remainder of 5, so write 1 over the 2 and put the remainder of 5 at the end.

PART C

$$\begin{array}{r} 137r5 \\ 7 \overline{) 964} \end{array}$$

The method is then used for carrying remainders over to the next digits which may result in the final answer having a remainder also.

- 9 divided by 7 is 1, so the 1 is recorded above and the 2 remaining carry over to the 6, creating 26.
- Now, 26 divided by 7 gives an answer of 3, which is recorded above, and the remainder this time is 5. This is carried over to the 4.
- Finally, 54 divided by 7 is 7 and there are 5 remaining.

STEP 6

PART 1

Long division.

We can use this method when dividing a number by a single digit.

The image shows a handwritten long division problem: $5 \overline{)965}$. The quotient 193 is written above the line. The first step shows 5 subtracted from 9 to get 4 . The next step shows 46 formed by bringing down the 6 , and 45 subtracted from it to get 1 . The final step shows 15 formed by bringing down the 5 , and 15 subtracted from it to get 0 . A red arrow points from the 3 in the quotient to the 15 in the multiplication $3 \times 5 = 15$ shown to the right. Another red arrow points from the 15 in the multiplication back to the 15 in the subtraction step.

5 goes into 9 once. The 1 is recorded in the answer and the 5 is subtracted vertically from the 9 to give 4.

The 6 moves down to meet the 4, creating 46. 46 is then divided by 5 to give 9.

The 9 is recorded in the answer and then 9 lots of 5 is subtracted from the 46.

This leaves 1. The 5 is then brought down to create 15. The 15 is then divided by

5. This puts a 3 at the end of our answer. 3 lots of 5 are 15, so when this is

subtracted from the 15 it leaves zero. The calculation is complete.

Long division is then used to divide by 2 digit numbers.

$$15 \overline{) 3640}$$

$$\begin{array}{r} 2 \\ 15 \overline{) 3640} \\ - 30 \\ \hline 6 \end{array}$$

15 into 3 doesn't go, so look at the next digit.

15 goes into 36 two times, so put a 2 above the 6.

$$15 \times 2 = 30$$

Take that 30 away from the 36 to get your remainder.

$$36 - 30 = 6$$

$$\begin{array}{r} 24 \\ 15 \overline{) 3640} \\ - 30 \downarrow \\ \hline 64 \\ - 60 \\ \hline 4 \end{array}$$

Next, carry the 4 down to make 64.

15 goes into 64 four times, so put a 4 above the 4.

$$15 \times 4 = 60$$

Take 60 from the 64 to get your remainder.

$$64 - 60 = 4$$

$$\begin{array}{r} 242 \\ 15 \overline{) 3640} \\ - 30 \downarrow \\ \hline 64 \downarrow \\ - 60 \downarrow \\ \hline 40 \\ - 30 \\ \hline 10 \end{array}$$

Carry the 0 down to make 40.

15 goes into 40 two times, so put a 2 above the 0.

$$15 \times 2 = 30$$

Take 30 from the 40 to get your remainder.

$$40 - 30 = 10$$