Balliol Primary School

Calculation Methods

Introduction

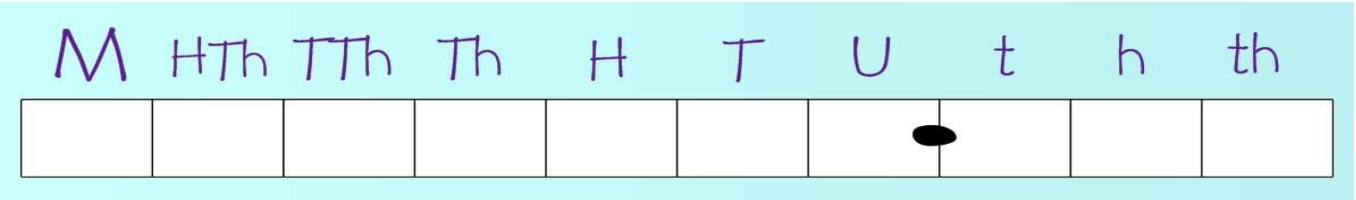
The purpose of this booklet is to outline the various calculation methods that children are taught as they progress through Balliol Primary School. As children move through the school, they will build up a bank of strategies that can be applied when appropriate. This booklet outlines the written calculation methods that children will use from the start, to the end of their time at Balliol Primary School. They are not presented by level or year group, but rather, as a progression that children can work through when they are ready. This booklet summarises the core methods that will be used when calculating, however, this will be accompanied by a range of different teaching strategies and activities.

The calculation methods taught today gradually build on the children's' understanding over time. They have been introduced after research programmes have shown them to be effective. The aim is to teach children methods that they understand, can use correctly and confidently to solve problems. Those methods used by children today are in many cases different from those used by adults when they were at school. This can cause anxiety with parents and carers who are unsure whether or not they should teach particular methods.

If you are a parent, as a general rule, if your child brings home some maths work which involves calculations:

- *Ask them to explain how they would solve this at school, and to explain to you the methods they have been taught. Use this booklet to help.*
- *If your child is unable to explain their method, or is unsure about what to do, the best advice is to contact your child's class teacher.*

Place Value is vitally important when calculating

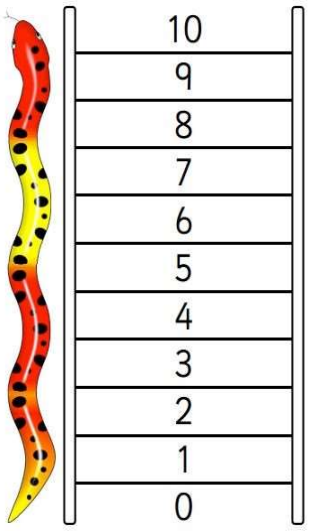


M	=	Millions
HTh	=	Hundreds of Thousands
TTh	=	Tens of Thousands
Th	=	Thousands
H	=	Hundreds
T	=	Tens
U	=	Units
.	=	Decimal Point
T	=	Tenths
H	=	Hundredths
th	=	Thousandths

Addition (+)

Step One

The basics of addition are routed in counting. The first thing a child will do is to order numbers to 5, and then 10.



Step Two

Adding one more through the use of songs

e.g. 1, 2, 3, 4, 5 once I caught a fish alive…

Step Three

Number bonds to 5 and 10 using songs, washing lines, diagrams and pictures etc.

0 + 5 = 5

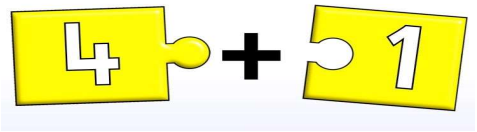
1 + 4 = 5

2 + 3 = 5

3 + 2 = 5

4 + 1 = 5

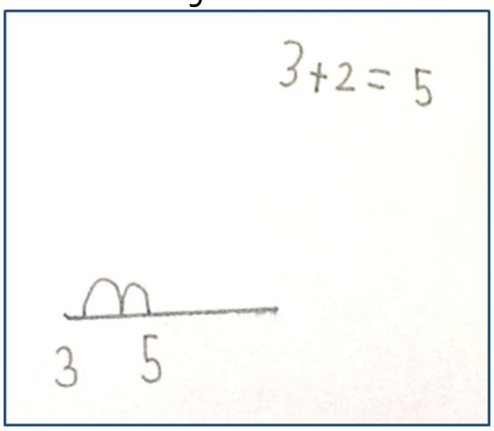
5 + 0 = 5



Step Four

Adding 2 units together using a number line, ladder or track.

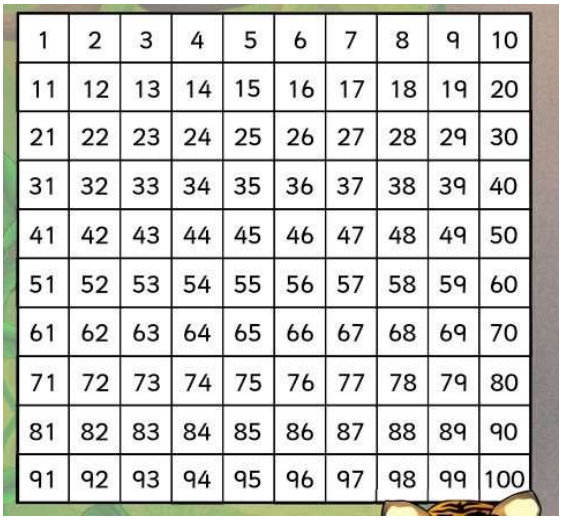
E.g. 3 + 2. Start at 3 and then count on 2 more using a number line.



Recording on a blank number line

Step Five

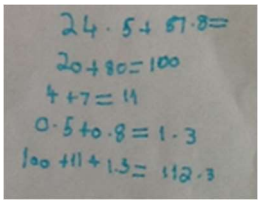
Adding a single digit number (e.g. 4) to a two-digit number (e.g. 12)



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

12 + 4 = 16

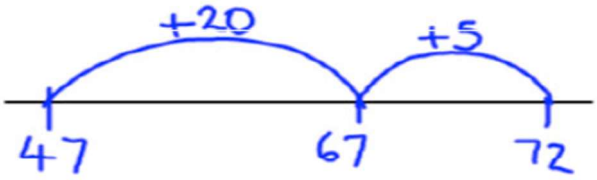
This can be done using a hundred square.
Find 12, then move across 4 more to16.



Step Six
Add two 2-digit numbers (TU and TU)

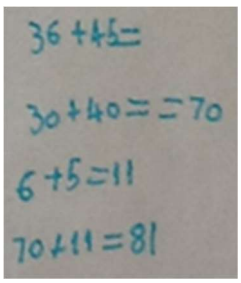
47 + 25 =

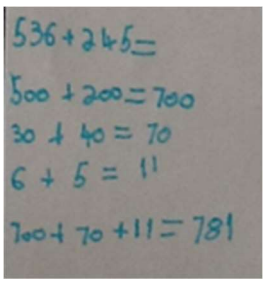
My sunflower is 47cm tall. My friend's is 25cm taller. How tall is my friend's sunflower?



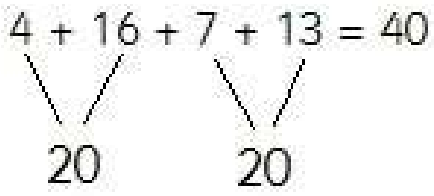
Step Seven
Partitioning would be used next to break up the number into its place value

e.g. 12 is made up of 10 and 2 i.e. 1 ten and 2 units.





Step Eight
Adding several numbers. Look for number bonds to 10 or 20 to help.
E.g.



Step Nine
Column Addition methods.

Main rules:

- Always begin adding from the furthest number to the right.
- Make sure the columns line up according to place value – tens in one column, units in another.

To being with, the children will not exchange at all.

E.g.

$$\begin{array}{r} 42 \\ +\,35 \\ \hline \\ \hline \end{array}$$

2 + 5 = 7

4 (tens) + 3 (tens) = 7 (tens) (40+30 = 70. The 7 represents 7 tens)

$$\begin{array}{r} 42 \\ +\,35 \\ \hline 77 \\ \hline \end{array}$$

This can then be used with 3 and 4-digit numbers without exchanging.

Step Ten
Use column addition and exchange

$$\begin{array}{r} 356 \\ +\,237 \\ \hline 593 \\ \hline 1 \end{array}$$

6 + 7 = 13

As this number is greater than 10, the ten is placed under the next column (exchanged) to be added later. The 3 is placed in the equals sign.

5 (tens) + 3 (tens) + 1 (ten) = 9 tens.
The 9 is recorded in the tens column

3 (hundreds) + 2 (hundreds) = 5 (hundreds) The 5 is recorded in the hundreds column to represent 5 hundred.

The children will then work on this using 3 and 4-digit numbers where they might be asked to exchange more than once.

Step Eleven
Several numbers can be added using column addition.

E.g.

$$\begin{array}{r} 463 \\ 257 \\ +\,345 \\ \hline 1065 \\ \hline 1\ 1\ 1 \end{array}$$

Step Twelve
Using column addition to add decimals.

The decimal point always remains in the same place and the digits are aligned according to their place value either side of their decimal points.

$$\begin{array}{r} 568.23 \\ +327.79 \\ \hline 896.02 \\ \hline 1\ 1\ 1 \end{array}$$

Step Thirteen
Begin to solve problems using column addition.

1. When measuring a room, Mark found that the room was a strange size! One wall was 16.02m, one wall was 20.99m, one 13.98 and one 23.55. What was the perimeter of the room?

2. Arthur decided to go to the cinema with his friend, Isla. Arthur spent £0.60 on the bus, £4.20 for entry to the cinema, £2.99 on refreshments and £0.60 on the return journey. When he came home he still had £1.61 in his wallet. How much did Arthur start out with?

Subtraction (-)

Step One

The basics of subtraction are routed in counting back from a given number. The first thing a child will do is to count back from 5, then 10.

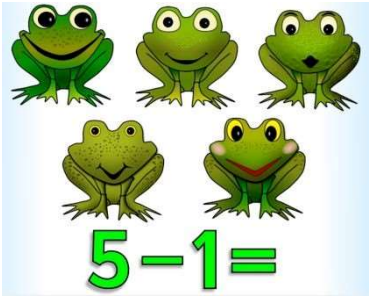
Step Two

Subtracting one more through the use of songs.

E.g.

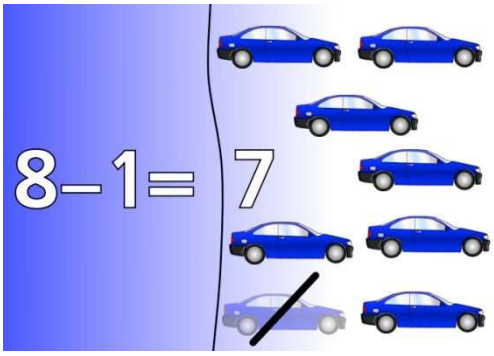
5 little speckled frogs…

5 little ducks went swimming one day.



Step Three

Using objects to subtract a 1-digit number from a 1-digit number (U – U).



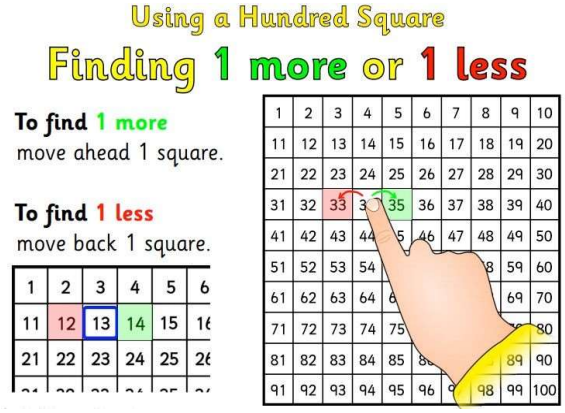
Step Four

Counting back using number lines, tracks or ladders.

Step Five

Taking a 1-digit number away from a 2-digit number (TU – U).

A hundred square can be used.



25 – 3 = 22

Start at 25 then count back 3.

This then will move onto bridging a ten.

E.g.

52 – 5 = 47

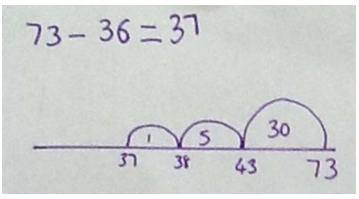
Start at 52 then count back 5.

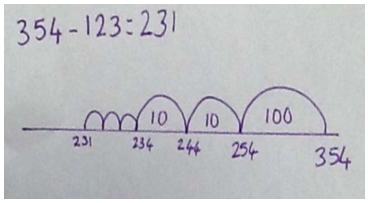
Step Six
Subtracting a 2-digit number from a 2-digit number (TU – TU)

A number line can be used to support this.

73 – 36 =

I cut 36cm off a ribbon measuring 73cm, how much is left?





Step Seven
Using number bonds to 10, 20 or 100 when subtracting.

Step Eight
Finding the difference between two numbers that are fairly close together by counting on.

45 – 42
Count on from 42 to 45 (put 42 in your head then count on).

Step Nine

Column Subtraction methods.

Main rules:

- *Always begin subtracting from the furthest number to the right.*
- *Make sure the columns line up according to place value – tens in one column, units in another.*
- *The largest number should go on the top (Key Stage 1 and 2).*
- *Always do the top number take away the bottom number.*

To begin with the children will not take from other columns at all.

$$\begin{array}{r} 35 \\ -\,12 \\ \hline 23 \end{array}$$

5 – 2 = 3
3 (tens) – 1 (ten) = 2 (tens)

Step Ten
The children will begin to 'take' from other columns.

$$\begin{array}{r} {}^{3}\not{3}\,{}^{1}6 \\ -\,228 \\ \hline 118 \end{array}$$

You cannot subtract 6 from 8 (without going into negative numbers) so you take a ten from the tens columns and place in the units column. As we have taken a ten the 4 tens now become 3 (cross out the 4 and write 3).

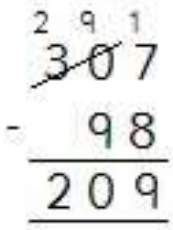
We can now subtract 8 from 16. 16 – 8 = 8. The 8 is recorded in units column.

Now move on to subtract tens. 3 (tens) – 2 (tens) = 1. The 1 is recorded in the tens column.

Finally subtract the hundreds.
3 (hundreds) – 2 (hundreds) = 1 (hundred). The 1 is recorded in the hundreds column.

Step Eleven

Taking from a 0.



You cannot do 7 – 8 or take away from 0. (without going into negative numbers). Therefore you need to take from the 30 (tens). If you subtract 1 (ten) from 30 you get 29 (tens). Place the remaining 1 ten with the 7 units. You can now do 17 – 8.

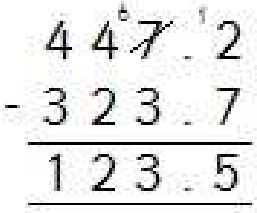
Continue with the rest of the calculation

9(tens) – 9(tens) = 0 (tens)

2 (hundreds) – 0(hundreds) = 2 (hundreds)

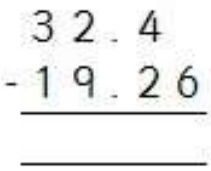
307 – 98 = 209

Step Twelve
Subtract decimals using column subtraction.

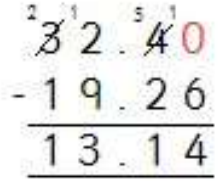


Step Thirteen

Include 0 as a place holder before completing the calculation.



In the hundredths column you need to use a place holder (0) to complete the calculation.



Step Fourteen
Begin to solve problems using column subtraction.

Multiplication (x)

Step One

After counting in ones, the children begin to count in other multiples e.g. twos, fives and tens.

Songs and rhymes can be used to support this.

Step Two

Doubling numbers e.g. 5 + 5 = 10. Say things like, "What is double 4?"

The 'X' symbol is then introduced.

5 x 2 = 10

Step Three

Repeated addition.

2 + 2 + 2 = 6

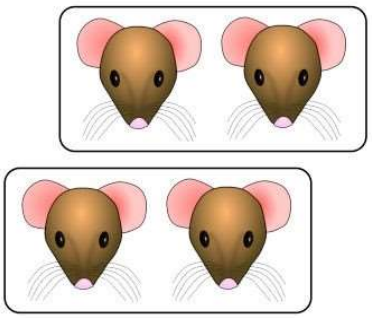
OR

3 + 3 = 6

Therefore, 3 x 2 = 6

This can be supported using pictures, diagrams and objects.

5 x 4 = 20



2 + 2 = 4
2 groups of 2 = 4
2 × 2 = 4

Step Four

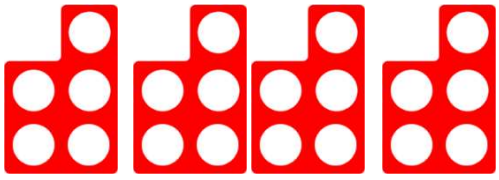
Arrays are used to show multiplication in a pictorial form.

5 x 4 = 20 or 4 x 5 = 20

This also illustrates repeated addition because
5 + 5 + 5 + 5 = 20

4 + 4 + 4 + 4 + 4 = 20

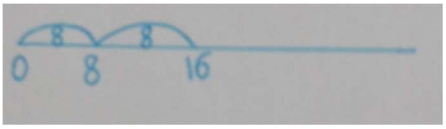
Multiplication tables are taught. Number sentences are written with missing numbers multiple and factors are used to help the children recognise numbers from different multiplication tables.



Step Five

Once children are confident and have had plenty of experience through arrays they can move onto using a numberline to solve multiplication problems.To begin with thye will sonstrucct a 'simple' number line then move onto 'chunking'.

8 x 2 = 16



8 x 2 means 8 multiplied two times

Step Six

Grid Method is introduced to multiply a 2- digit number by a 1-digit number (TU x U).

32 x 5 would be partitioned (broken up) Into 30 x 5 and 2 x 5 with the answers being added together.

	30	2
5		

The answers are then inserted into the correct box on the grid.

	30	2
5	150	10

Next you would add the 150 and 10 resulting in an answer of 160.

32 x 5 = 160

Column addition can be used to add larger numbers.

Step Seven

When calculating with larger numbers, the grids can be expanded. The example below shows TU x TU.

54 x 23 =

	50	4
20	1000	80
3	150	12

54 x 23 = 1242

The progression would continue with the children working through calculations as follows:

TU x TU

HTU x TU

HTU x HTU

U.t x U

U.t x U.t

Etc…

Step Eight

Short multiplication can then be taught to multiply using the most formal written method.

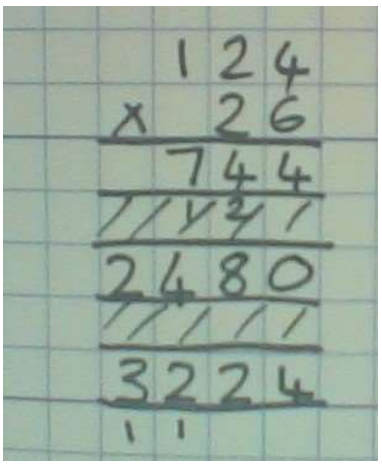
Broken down, this calculation shows: 3 x 3 = 9

2 (tens) x 3 = 6 (tens)

Step Nine

As the calculations become more complex, Long Multiplication can be used to work with numbers of a greater value.

124 x 26 =



Begin by multiplying each digit in 124 by 6:

4 x 6 = 24 The 4 goes in units column and 2 gets placed under the tens

6 x 2 (tens) = 12 (tens) + 2 extra tens = 14 (tens) The 4 goes in tens column and 1 gets placed under the hundreds column.

Next multiply each digit by 20:
4 x 20 = 80. Record 8 in the tens column and 0 in units as a place holder.

20 x 20 = 400. Place 4 (representing 4 hundreds) in the hundreds column.

20 x 100 = 2000 Place 2 (representing 2 thousands) in the thousands column.

The final step is to add the 2 totals. 744 + 2480 = Use column addition methods to complete this calculation

Step Ten

Multiplying decimals using the Grid Method.

Just follow these steps:

- Multiply normally, ignoring the decimal points.
- **Then** put the decimal point in the answer - it will have as many decimal places as the two original numbers combined.

In other words, just count up how many numbers are after the decimal point in both numbers you are multiplying, then the answer should have that many numbers after its decimal point.

Example: Multiply 0.03 by 1.1

Start with: **0.03 x 1.1**
Multiply without decimal points: **3 x 11 = 33**
0.03 has **2 decimal places**
and 1.1 has **1 decimal place,**
so the answer has **3 decimal places:**
0.033

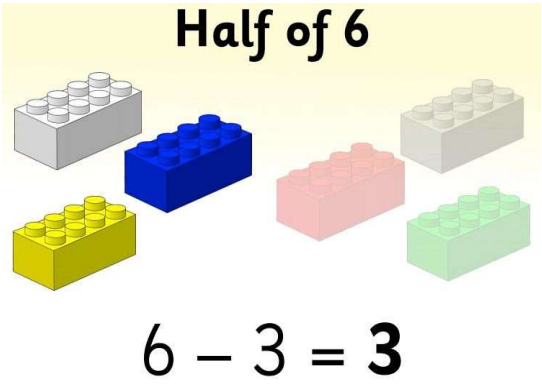
Division (÷)

Step One
Halving numbers is the first step when dividing.

"What is half of 4?"

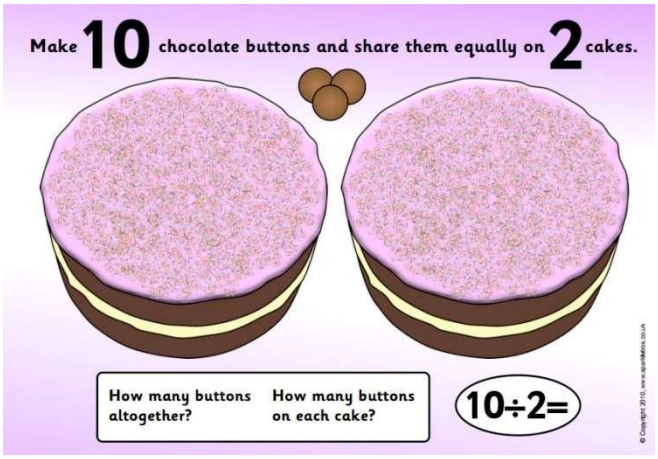
4 shared by 2 = 2

4 ÷ 2 = 2



Step Two
Sharing into sets or groups.
Hoops and boxes can be used.

Start off with a given number of objects and share them out equally.



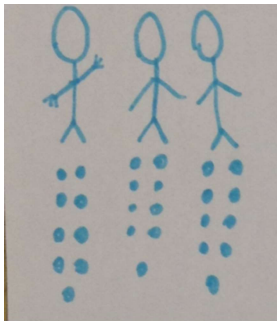
Step Three
Begin using multiplication facts to help with division number sentences.

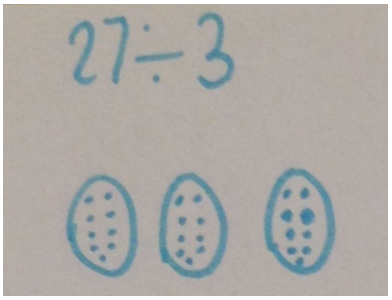
E.g.

5 x 3 = 15

Therefore, 15 ÷ 3 = 5 and 15 ÷ 5 = 3

Step Four
Drawing arrays or sets
27 ÷ 3 =

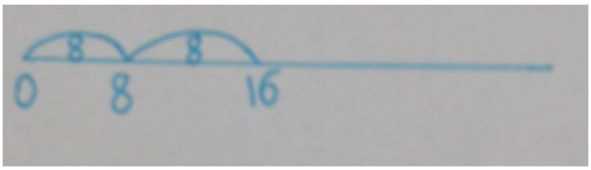




Step Five
Division on a number line

Division on a number line will start as repeated subtraction. 'How many smarties can we each have?' or 'How many of these can I afford?

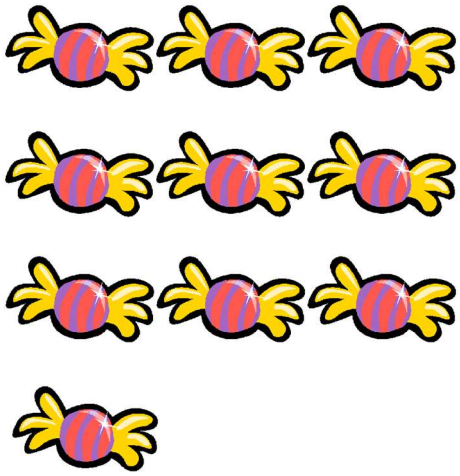
16 ÷ 8 = 2

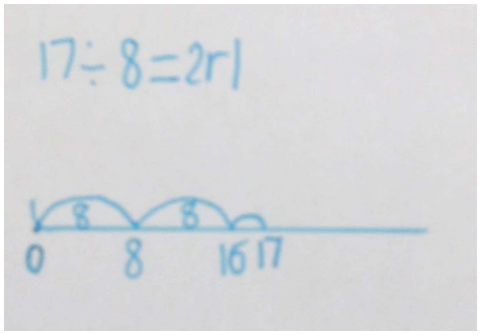


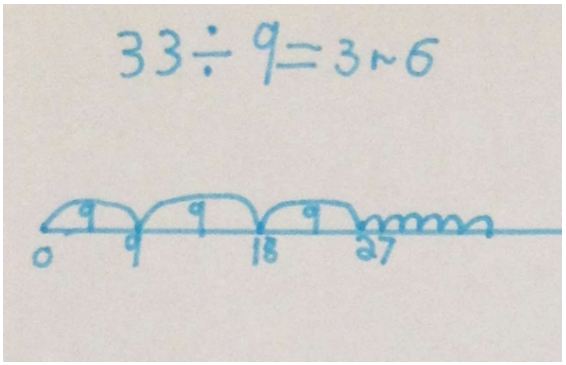
"I start at zero and count in 8s until I get to 16. That's two eights"

Step Six
Share objects with remainders (some left over).

10 ÷ 3 = 3 r 1 (r means remainder)





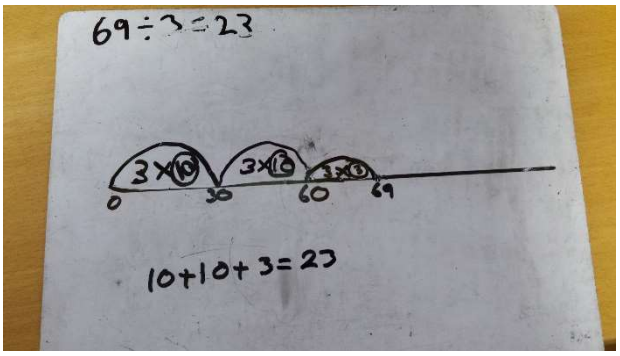


Step Seven

Chunking can be used to divide bigger numbers. For example a 1-digit number divided by a 2-digit number.

The idea behind chunking is to show children how a number can be divided, and is often the mental method a child may use when calculating a division number sentence.

A number line can be used to do this. 69 divided by 3.



We start with 69 and create our first Jump (chunk) by calculating 3 x 10. The answer is 30.

We can take another chunk of 3 x 10 which leaves us with 9.

Our last chunk us 3 x 3 which is 9.

69 has been completely shared into different chunks.

The chunks we have are 10, 10 and 3

When we add the chunks together, our answer is 23.

69 ÷ 3 = 23

This can also be taken onto exploring divisions involving remainders.

Step Eight

Bus Stop Method can be used to divide larger numbers.

98 ÷ 7 becomes

$$\begin{array}{r} 1\ 4 \\ 7\overline{)\ 9\ 8} \\ \quad\ 2 \end{array}$$

Answer: 14

98 ÷ 7 =

How many 7s are there in 9?

The answer is 1. This is placed on top of the bus stop.

A remainder of 2 is then placed above the 8. How many 7s are there in 28?

The answer is 4. This is placed on top of the bus stop.

98 ÷ 7 = 14

The children would then begin to look at what happens with a remainder.

432 ÷ 5 becomes

$$\begin{array}{r} 8\ 6\ \text{r}\,2 \\ 5\overline{)\ 4\ 3\ 2} \\ \quad\ 3 \end{array}$$

Answer: 86 remainder 2

432 ÷ 5 =

How many 5s are there in 4? This cannot be done. Therefore we move across and look at both digits as 43.

How many 5s are there in 43? The answer is 8. The remainder of 3 is then placed above the 2 to make 32.

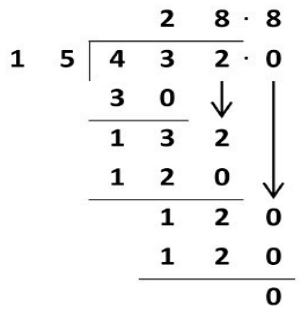
How many 5s are there is 32? The answer is
6 leaving 2 as a remainder.

432 ÷ 5 = 86 r 2

Step Nine

The final step would be to explore long division.

432 ÷ 15 becomes



Answer: 28·8

How many 15s are there in 4? This cannot be done.

How many 15s are there in 43? The answer is 2 which is placed above the bus stop.

2 x 15 = 30 which is placed directly below the bus stop.

Then 43 – 30 = 13

3 – 0 = 3

4 – 3 = 1

The 2 drops down alongside the 13.

Now, how many 15s are in 132? The answer is 8. So 8 goes above the bus stop.

8 x 15 = 120

This goes underneath the 132.

132 – 120 = 12

0 – 2 = 2

3 – 2 = 1

Bring down the 0 because 15 does not go into 12. This gives us 120. Put the decimal point in place.

How many 15s in 120? The answer is 8.

432 ÷ 15 = 28.8

Step Eight
The children would then begin to solve and create problems using different division methods.

All Calculations and Operations

The final step would be for children to choose the best calculation methods for them. Whichever method they are confident with and able to be accurate with for each operation (+ - x ÷) should be the one they stick with!

They can then use and apply their mathematics in a variety of contexts. This will be done throughout the learning process but it is particularly important as they move into Key Stage 3.

Useful Websites

www.nrich.maths.org

www.coolmath.com

www.bbc.co.uk/schools

www.funbrain.com

There are many more websites available. If you are ever in doubt, YouTube has many videos of the different methods or the teachers at Balliol Primary School are always willing to offer extra support, so please ask if you have any questions.