Calculation Methods

Introduction

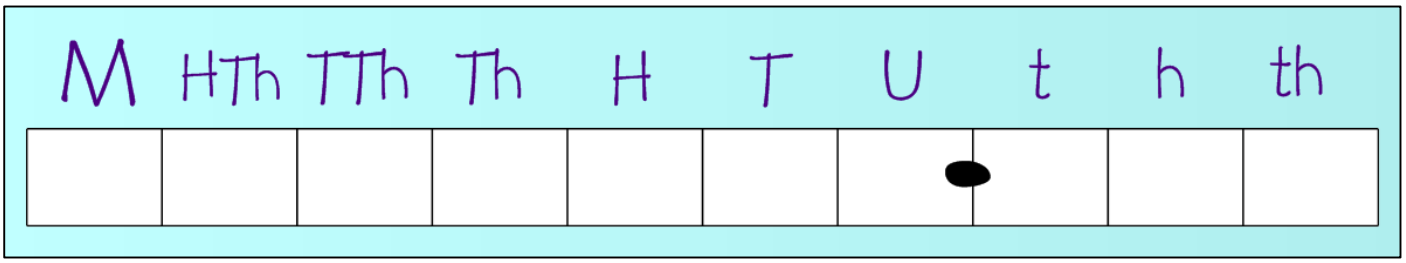
The purpose of this booklet is to outline the various calculation methods that children are taught as they progress through Stoneraise School. As children move through the school, they will build up a bank of strategies that can be applied when appropriate. This booklet outlines the written calculation methods that children will use from the start, to the end of their time at Stoneraise 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 which 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 unsure about what to do, the best advice is to contact your child's class teacher.

Place value is vitally important when calculating.

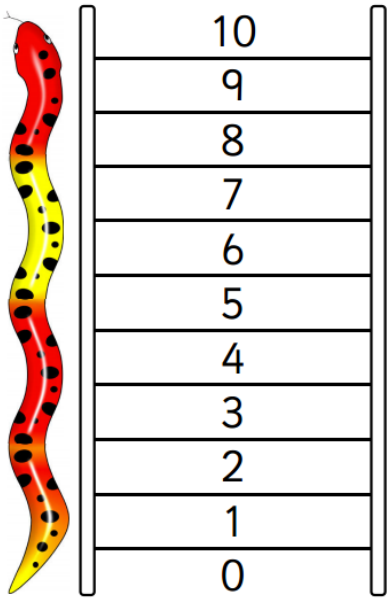


M	=	Millions
HTh	=	Hundreds of Thousands
TTh	=	Tens of Thousands
Th	=	Thousands
H	=	Hundreds
T	=	Tens
U	=	Units
.	=	decimal point
t	=	tenths
h	=	hundredths
th	=	thousandths

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…

Objects are used to demonstrate quantities before looking at digits.

When children are ready, they will begin to add two sets of objects together and record using a number sentence.

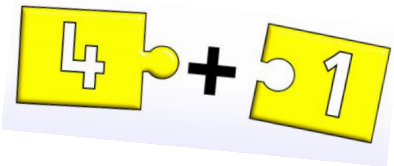
Step Three

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

0 + 5 = 5

1 + 4 = 5

2 + 3 = 5 etc.



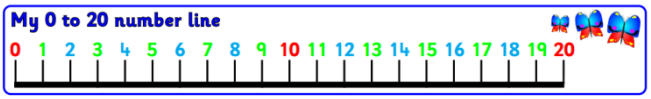
Number bonds to ten are key for later calculation work:

9 + 1 = 10

8 + 2 = 10 etc.

Step Four

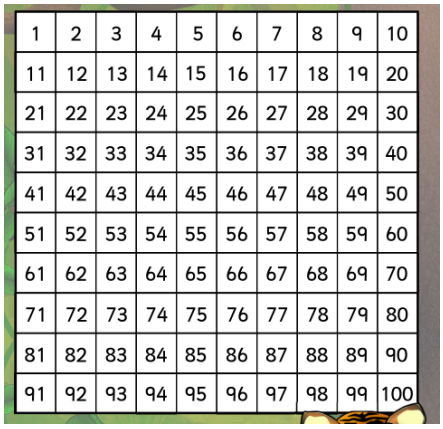
Adding 2 units together using a number line, ladder or track.



E.g. 7 + 8. Start at 7 and then count on 8 more using a 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.

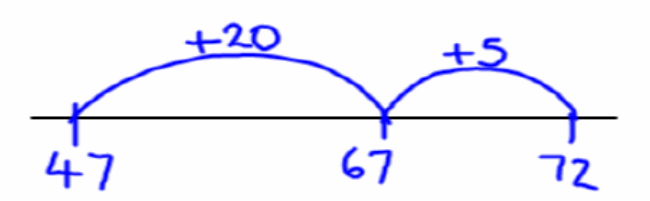
Step Six

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?

A number line can be used to show this:



Step Seven

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 carry at all.

E.g.

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

2 + 5 = 7

4 + 3 = 7

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

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

Step Eight

Use column addition and carry.

$$\begin{array}{r} 356 \\ +\,2_{1}37 \\ \hline 593 \\ \hline \end{array}$$

6 + 7 = 13

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

5 + 3 + 1 = 9

3 + 2 = 5

The children will then work on this using 3 and 4-digit numbers where they might be asked to carry several tens.

Step Nine

Several numbers can be added using column addition.

E.g.

$$\begin{array}{r} 463 \\ 257 \\ +\,{}_{1}{}_{1}3{}_{1}45 \\ \hline 1065 \\ \hline \end{array}$$

Step Ten

Children will the columnar method to add larger numbers up to 10 million.

Step Eleven

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.

$$\begin{array}{r} 568.23 \\ +\ 3_{1}2_{1}7.{}_{1}79 \\ \hline 896.02 \end{array}$$

A place holder (0) can be used when adding decimals.

Step Twelve

At all stages, children will begin to apply their methods in context to gain a greater depth of understanding. They will complete deeper learning activities, using these methods in their calculations.

Children solve word problems which require them to use the methods they have learnt.

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.

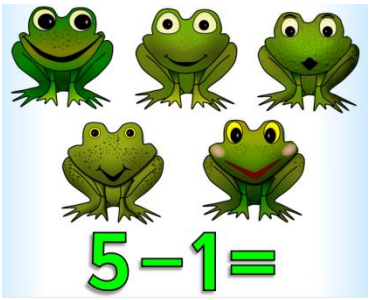
Step Two

Subtracting one more through the use of songs.

E.g.

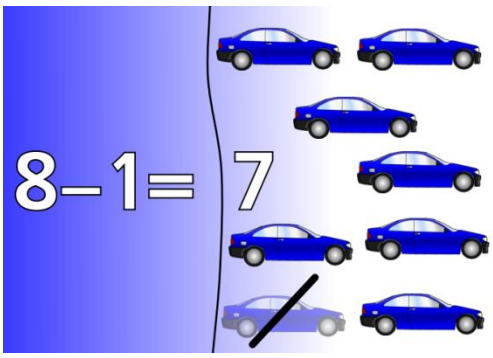
5 little speckled frogs…

5 little ducks went swimming one day.



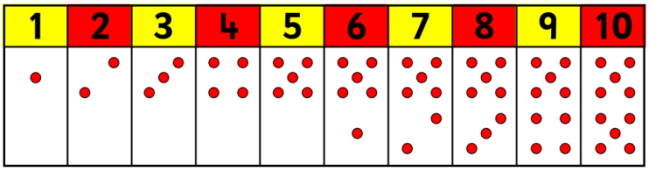
Step Three

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



Step Four

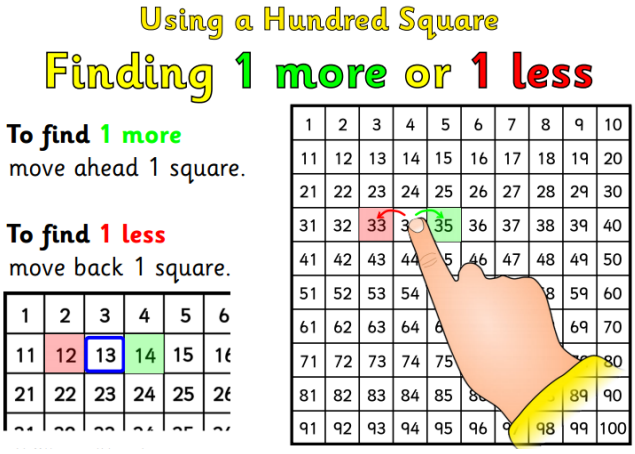
Counting back using number lines, tracks or ladders.



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

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).

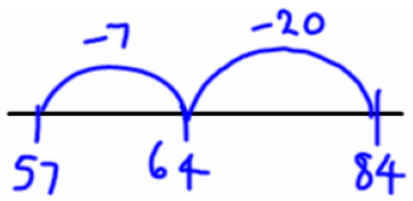
Step Seven

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

A number line can be used to support this.

84 – 27 =

I cut 27cm off a ribbon measuring 84cm, how much is left?



Step Eight

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 borrow at all.

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

5 – 2 = 3

3 – 1 = 2

Step Nine

The children will begin to 'borrow ten from next door'.

$$\begin{array}{r} 3\overset{5}{\cancel{4}}\overset{1}{6} \\ -\ 228 \\ \hline 118 \\ \hline \end{array}$$

You cannot do 6 subtract 8 so you borrow ten from next door (the 4). The 4 becomes a 3 then the ten is carried to make 6 turn into 16.

16 – 8 = 8

Now you can do 3 – 2 = 1

3 – 2 = 1

Step Ten

Borrow from a 0.

$$\begin{array}{r} {}^{2}\,{}^{9}\,{}^{1} \\ \cancel{3}\cancel{0}7 \\ -\quad 98 \\ \hline 209 \\ \hline \end{array}$$

You cannot do 7 – 8. Also, you cannot take away from 0. Therefore you need to borrow from the 30. If you subtract 1 from 30 you get 29. Place the remaining 1 ten with the 7. You can now do 17 – 8.

Continue with the rest of the calculation

9 – 9 = 0

2 – 0 = 2

307 – 98 = 209

Work with larger numbers up to 10 million.

Step Eleven

Subtract decimals using column subtraction.

$$\begin{array}{r} 44{}^{6}\cancel{7}.{}^{1}2 \\ -\ 323.7 \\ \hline 123.5 \\ \hline \end{array}$$

Step Twelve

Include 0 as a place holder before completing the calculation.

$$\begin{array}{r} 32.4 \\ -19.26 \\ \hline \\ \hline \end{array}$$

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

$$\begin{array}{r} {}^{2}\cancel{3}{}^{1}2.{}^{3}\cancel{4}{}^{1}0 \\ -19.26 \\ \hline 13.14 \\ \hline \end{array}$$

Step Fourteen

At all stages, children apply their knowledge in context with deeper learning activities and word problems.

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

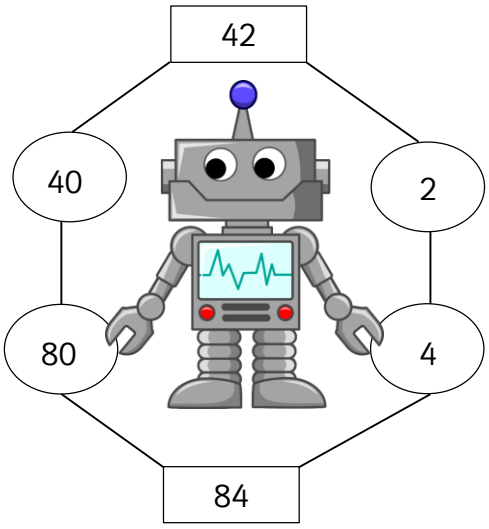
Doubling numbers e.g. 5 + 5 = 10.

Say things like, "What is double 4?"

The 'X' symbol is then introduced.

5 x 2 = 10

Children will use objects to double. A 'robot' can be used to partition when doubling:



Step Three

Repeated addition.

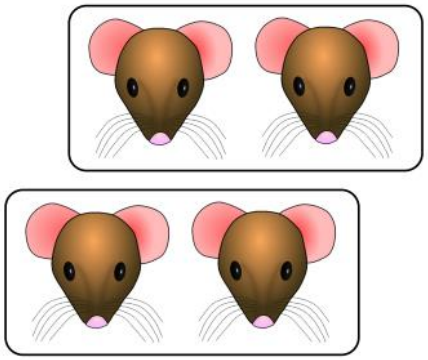
2 + 2 + 2 = 6

OR

3 + 3 = 6

Therefore, 3 x 2 = 6

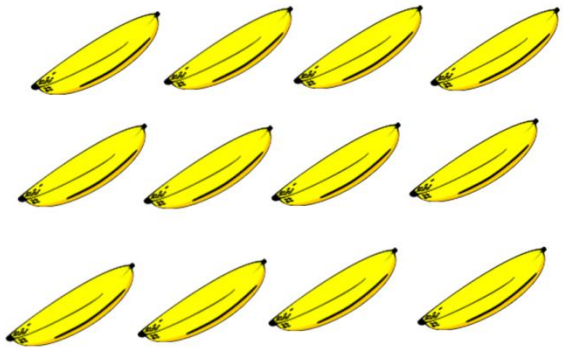
This can be supported using pictures, diagrams and objects.



2 + 2 = 4
2 groups of 2 = 4
2 × 2 = 4

Step Four

Arrays are used to show multiplication in a pictorial form.



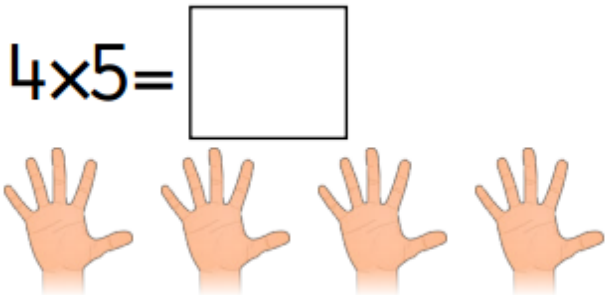
4 x 3 = 12 or 3 x 4 = 12

This also illustrates repeated addition because
4 + 4 + 4 = 12

3 + 3 + 3 + 3 = 12

Step Five

Multiplication tables are taught. Number sentences are written with missing numbers and tips and tricks are used to help the children recognise numbers (multiples and factors) from different multiplication tables.



There are tricks for many of the times tables which can support children's quick fact recall.

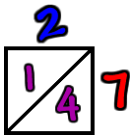
E.g.

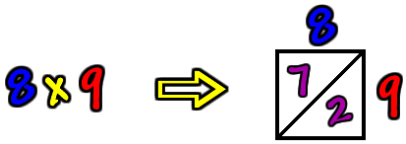
Step Six

Lattice Method can be used to multiply larger numbers efficiently:

When we look at a number, remember...

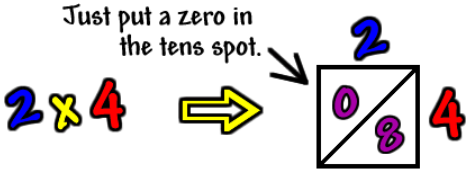
So, we'll put the 1 (the tens digit) in the top spot and the 4 (the ones digit) in the bottom spot:



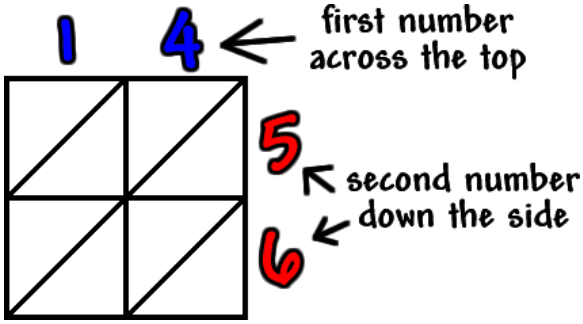


So, 8x9=72

What do we do when our answer is just a single digit?



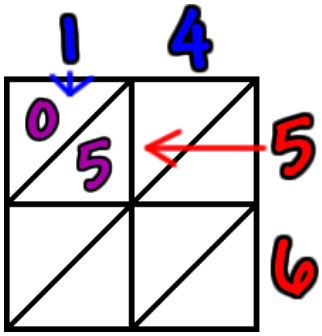
So, 2x4=8



The following four steps takes you through the calculation:

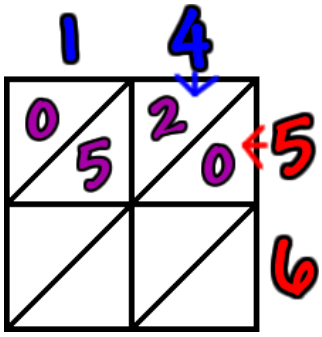
First, we do

1 x 5



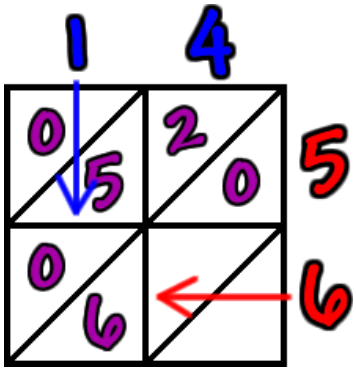
Then, we do

4 x 5



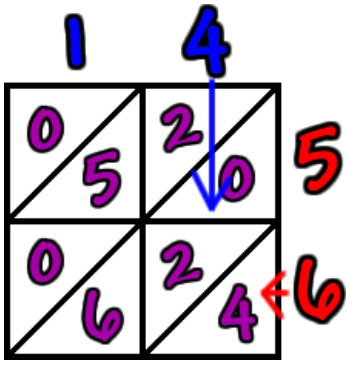
Then, we do

1 x 6

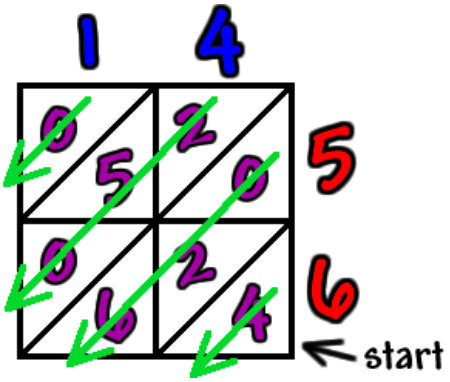


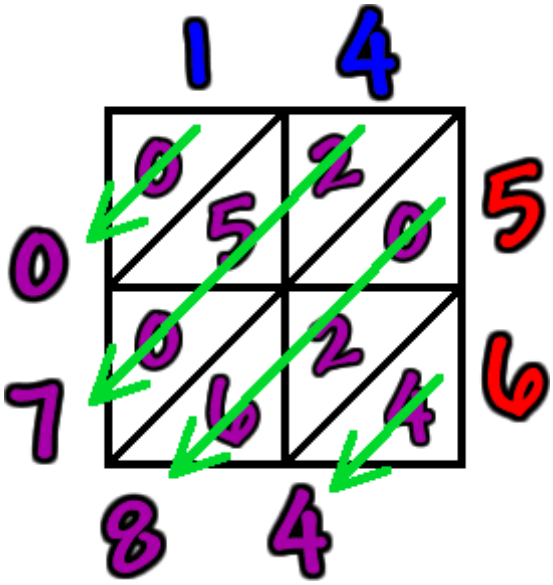
Then, the last one:

4 x 6



Now, just add down the diagonal stripes... Start at the bottom and work your way up the stripes:





The answer is therefore 784.

14 x 56 = 784

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 Seven

Multiplying decimals using the Lattice 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 × 1.1**
multiply without decimal points:	**3 × 11 = 33**
0.03 has **2 decimal places**, and 1.1 has **1 decimal place**, so the answer has **3 decimal places**:	**0.033**

Step Eight

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

24 × 6 becomes

$$\begin{array}{cccc} & & 2 & 4 \\ \times & & & 6 \\ \hline 1 & 4 & 4 & \\ \hline & & 2 & \end{array}$$

Answer: 144

Broken down, this calculation shows:

4 x 6 = 24

The 4 is placed in the equals sign and the 2 from 20 is carried to the next column.

2 x 6 = 12 then add the 2 from the first part which equals 14.

Step Nine

As the calculations become more complex, Long Multiplication can be used to work with bigger numbers.

24 × 16 becomes

$$\begin{array}{cccc} & & 2 & \\ & & 2 & 4 \\ \times & & 1 & 6 \\ \hline 2 & 4 & 0 & \\ 1 & 4 & 4 & \\ \hline 3 & 8 & 4 & \\ \hline \end{array}$$

Answer: 384

10 x 24 = 240

6 x 24 = 144

Add 240 and 144 = 384

Step Ten

The children would then begin to solve problems using different multiplication methods, working with larger numbers as they progress. Deeper learning activities will be used to develop understanding at each stage.

Division (÷)

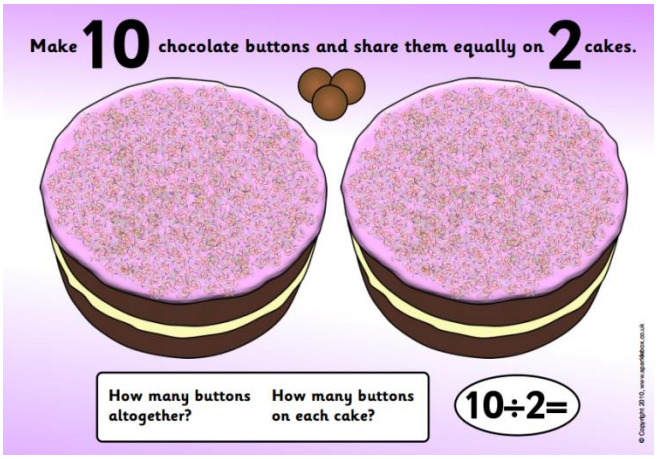
Step One

Halving numbers is the first step when dividing.

Sharing into sets or groups.

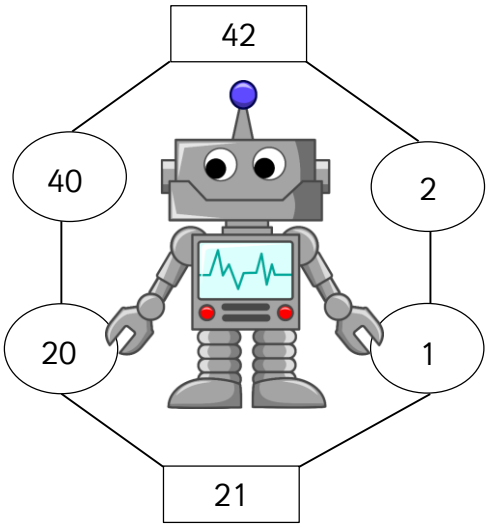
Hoops and boxes can be used.

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



Step Two

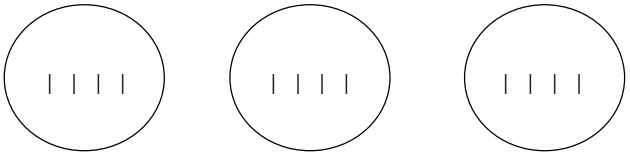
Use a 'robot' for halving:



Step Three

Draw plates to share out:

What's 12 ÷ 3 ?



12 ÷ 3 = 4 on each plate

Step Four

Begin using multiplication facts to help with division number sentences.

E.g.

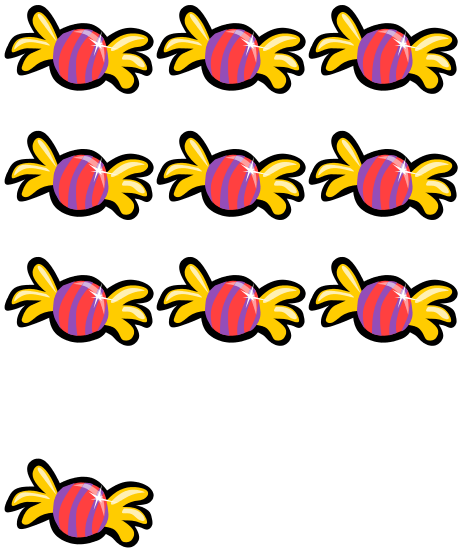
5 x 3 = 15

Therefore, 15 ÷ 3 = 5 and 15 ÷ 5 = 3

Step Five

Share objects with remainders (some left over).

10 ÷ 3 = 3 r 1 (r means remainder)



Step Six

Bus Stop Method (Short Division) can be used to divide larger numbers.

98 ÷ 7 becomes

$$\begin{array}{r|ccc} & 1 & 4 & \\ \hline 7 & 9^{2} & 8 & \end{array}$$

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

$$\begin{array}{r|ccc} & 8 & 6 & \text{r}\,2 \\ \hline 5 & 4\,3^{3} & 2 & \end{array}$$

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

The children should also show their remainders as a fraction:

$86\ \frac{2}{5}$

Step Seven

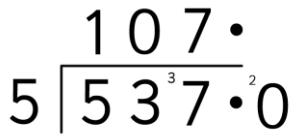
The children will then also learn to find the answer as a decimal (up to 3 decimal places).

$$5\overline{)537}$$

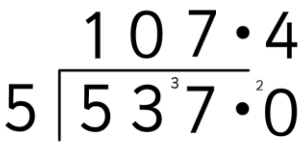
When we have completed as much of the calculation as we can, we see that there is still a remainder of 2:

$$\begin{array}{r|ccc} & 1 & 0 & 7 \\ \hline 5 & 5\,3^{3} & 7 & \end{array}\ \textbf{r2}$$

If a decimal point is added (as seen below), the children can then continue to calculation as follows:



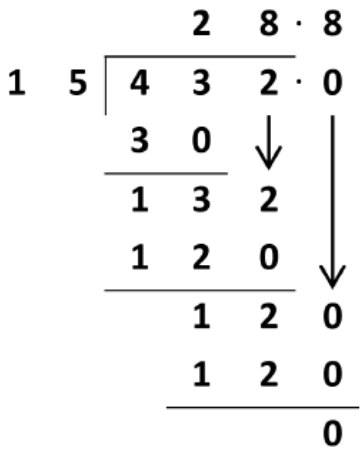
Therefore our answer to 537 ÷ 5 = 107·4



Step Eight

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 problems using different multiplication methods, working with larger numbers as they progress. Deeper learning activities will be used to develop understanding at each stage.

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.

Use the space below to try out some of the methods: