Holy Name Catholic Primary School

Calculation Policy

February 2016

(*reviewed November 2017)

Introduction

With the introduction of the new Mathematics Curriculum starting in September 2014, we have updated our current calculation policy.

The policy focuses on the four operations of addition, subtraction, multiplication and division and includes a list of the key mental maths skills that support these written methods.

For each operation there are four stages, starting with the practical methods that support conceptual understanding moving through to methods that allow children to demonstrate efficiently in procedural approaches.

It is important to emphasise that alternative methods may be more appropriate for certain calculations and that informal methods currently used successfully in our school may continue to be taught to your child.

Throughout the school day we are continuously referencing and highlighting the importance of numeracy in all aspects of everyday life. These calculation skills are a way to solve numerical problems but we always make sure numeracy for life is central to our mathematics teaching.

Addition

Written methods for addition

It is important that children's mental methods of calculation are practised on a daily basis and secured alongside their learning and use of written methods of addition.

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use a written method accurately and with confidence.

There are some key basic skills that children need to help with addition, these include:

◊ counting

◊ estimating

◊ recalling all addition pairs to 10, 20 and 100 (7+3=10, 17+3=20, 70+30=100 etc)

◊ knowing number facts to 10 (6+2=8 etc)

◊ adding mentally a series of one digit numbers (5+8+4)

◊ adding multiples of 10 (60+70) or of 100 (600+700) by using the addition fact, 6+7=13 and their knowledge of place value.

◊ partitioning two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways (432 into 400+30+2 and also 300+130+2)

◊ understanding and using addition and subtraction as the inverse of each other (3+7=10 so 10-7+3)

Using and applying is a key theme and one of the aims of the new national curriculum and before children move onto the next written stage it is vital that their use and application is widened in a range of contexts, these include:

◊ using the inverse

◊ missing box questions

◊ using units of measurement including money and time

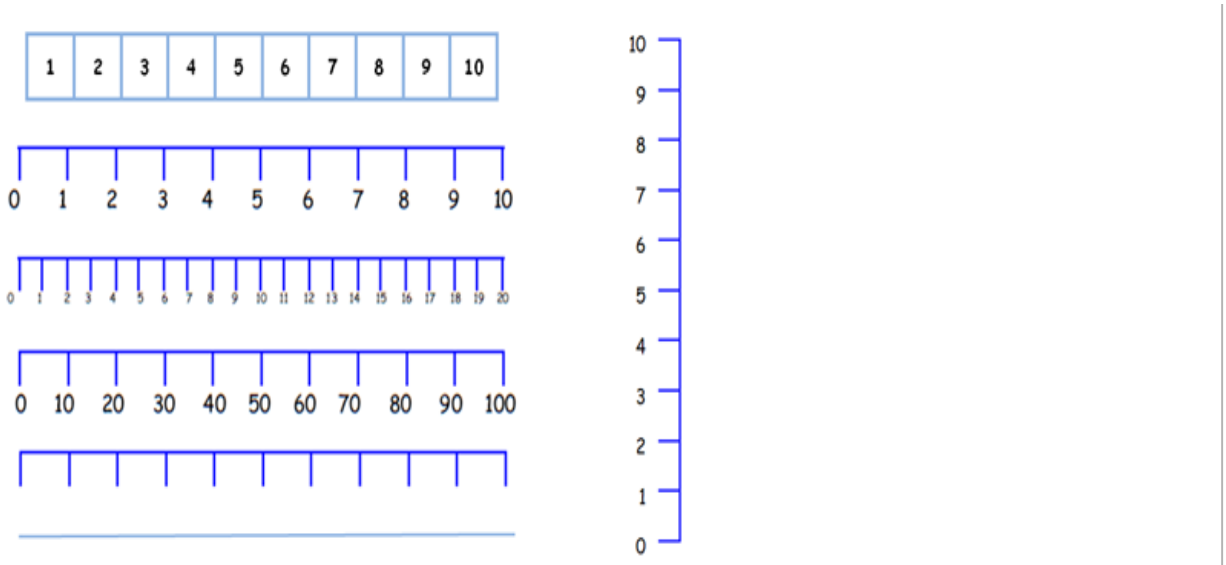
◊ word problems

◊ open ended investigations

Stage 1: Practical (combining) and adding on (increasing)

Prior to recording addition steps on a number line, children will work practically with equipment where they are **combining** sets of objects. As they become more confident, this practical addition of sets of objects will be mirrored on a number line so that the two are being done together and children are **adding on**. This will prepare them for the abstract concept of adding numbers rather than objects.

Stage 2: Number tracks and number lines



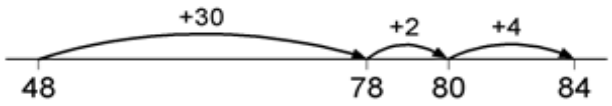
Steps in addition can be recorded on a number line. The steps often bridge through a multiple of 10 and, this is more efficient if children know how to partition 1-digit numbers

8 + 7 = 15

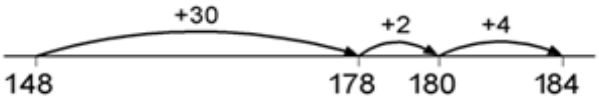
In this example, 7 has been partitioned into 2 and 5 which makes bridging through 10 more efficient

48 + 36 = 84

or



In these examples, the 6 in 36 has been partitioned into 2 and 4 which makes bridging through 10 more efficient



With practice, children will need to record fewer jumps

Stage 3: Partitioning (expanded method)

Partition both numbers into tens and units or hundreds, tens and units (using a grid makes this easier)

48 + 36 = 84

	40	8	
+	30	6	
	70	$^{1}4$	84

148 + 36 = 184

	100	40	8	
+		30	6	
	100	70	$^{1}4$	184

This builds on children's mental maths skills of partitioning and recombining

40 + 30 = 70

8 + 6 = 14

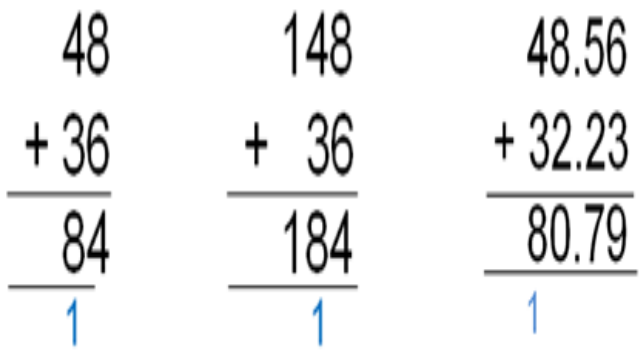
48 + 36 = 84

This introduces the children to the idea of 'carrying'.

Stage 4: Efficient (column method)

During all these stages it is important to note that the children will still be having lots of experiences with practical apparatus to ensure they have a full and complete understanding.

Stage 4: Column (efficient)



Children should be encouraged to estimate their answers first

Children will be taught about the importance of place value throughout.

Subtraction

Written methods for subtraction

It is important that children's mental methods of calculation are practised on a regular basis and secured alongside their learning and use of written methods.

Children will also be taught to see the relationships between the four number operations. Addition and subtraction are the opposite (inverse) of each other and that division is just like repeated subtraction.

There are some basic key skills that children need to help with subtraction, which include:

◊ counting

◊ estimating

◊ recalling all addition pairs to 10, 20 and 100 with their inverses (7+3=10, 10-7=3, 17+3=20, 20-3=17, 70+30=100, 100-30=70)

◊ knowing number facts to 10 and their inverses (6+2=8, 8-2=6)

◊ subtracting multiples of 10 (160-70=90, by using 16-7=9)

◊ partitioning two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways (432 into 400+30+2 and also 300+120+12)

◊ understanding and using subtraction and addition as inverse operations

Using and applying is a key theme and one of the aims of the new national curriculum and before children move onto the next written stage it is vital that their use and application is widened in a range of contexts, these include:

◊ using the inverse

◊ missing box questions

◊ using units of measurement including money and time

◊ word problems

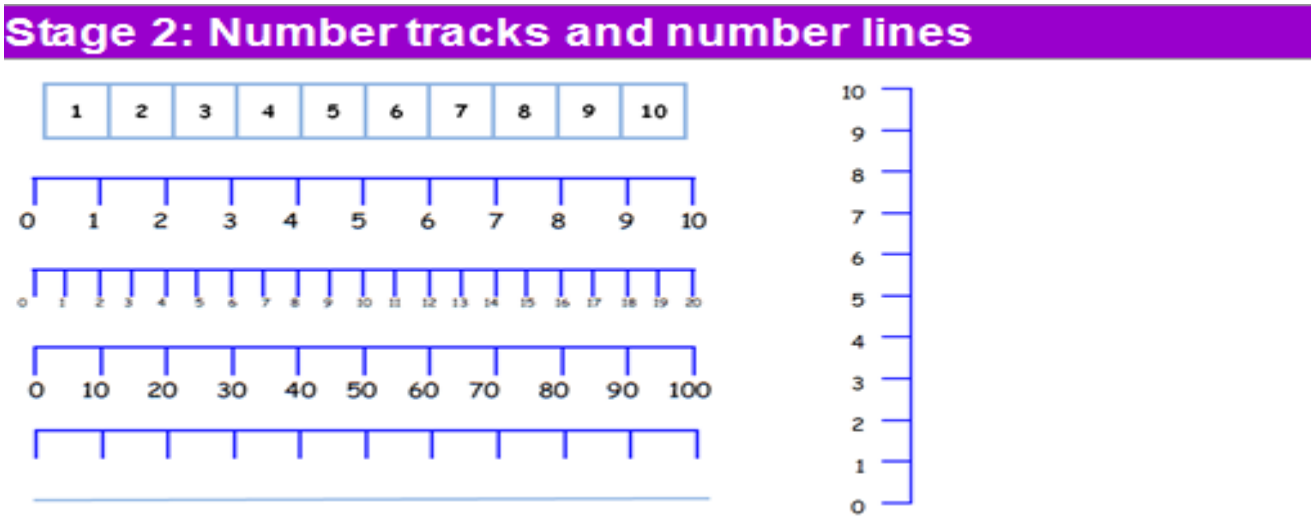
◊ open ended investigations

Stage 1: Practical (taking away)

Prior to recording subtraction steps on a number line, children will work practically with equipment where they are 'taking away' a small group from a larger set of objects. As they become more confident, this practical subtraction will be mirrored on a number line so that the two are being done together. This will prepare them for the abstract concept of subtracting numbers rather than objects.

Stage 2: Number tracks and number lines

Many experiences of practical and concrete images will be used (number beads etc)



Counting back is to be introduced before counting up (on the number line)
Steps in subtraction will start by being recorded from right to left FIRST! This reinforces the concept that the child is taking away.

COUNTING BACK

Partition the second number only

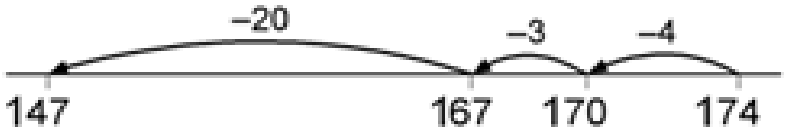
15 – 7 = 8

74 – 27 = 47

In the above example, 7 has been partitioned into 2 and 5 which makes bridging through 10 more efficient.

Or

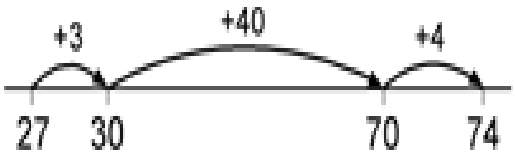
174 – 27 = 147



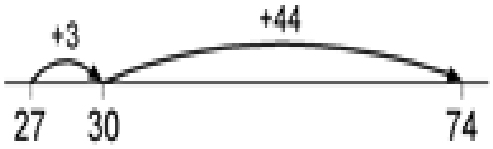
In these examples, 27 has been partitioned into tens and units then the 7 in the 27 has been partitioned into 3 and 4 which makes bridging through 10 more efficient.

With practice, children will need to record fewer jumps.

This then leads on to **'counting on'.** These steps are recorded from left to right on a number line and often bridge through a multiple of 10.



or



When carrying out money calculations that involve finding change or when calculating time duration, children should use this method

With practice, children will need to record fewer jumps

Stage 3: Partitioning (expanded method)

Partition both numbers. Using a grid can make it easier.

	60	4	
	70	4	
−	20	7	
	40	7	47

	100	60	4
		70	4
−		20	7
	100	40	7

74 – 20 = 47

174 – 27 = 147

Stage 4: Efficient (column method)

Stage 4: Column (efficient)

$$\begin{array}{r} {}^{6}\not{7}{}^{1}4 \\ -\ 27 \\ \hline 47 \end{array} \qquad \begin{array}{r} {}^{6}1\not{7}{}^{1}4 \\ -\ 27 \\ \hline 147 \end{array} \qquad \begin{array}{r} 48.56 \\ -\ 32.23 \\ \hline 16.33 \end{array}$$

Children should be encouraged to estimate their answers first

Multiplication

Written methods for multiplication

It is important that children's mental methods of calculation are practised on a regular basis!

Particularly when it comes to learning their tables.

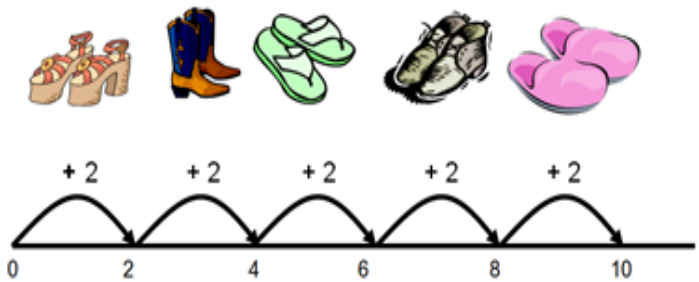
They must know up to, and including, 12 x 12 by year 4.

Included in this is ALL associated division facts. Example:

If they know 6 x 7 = 42, they can use this to work out 42 ÷ 7 = 6 then extend 600 x 7 = 4,200, 4,200 ÷ 600 = 7, 0.6 x 0.7 = 0.42, 0.42 ÷ 0.7 = 0.6 and so on. To reach this level of understanding it is essential that children are practising their tables at home for 5 minutes EVERYDAY from year one!

Stage 1: Practical (repeated addition)

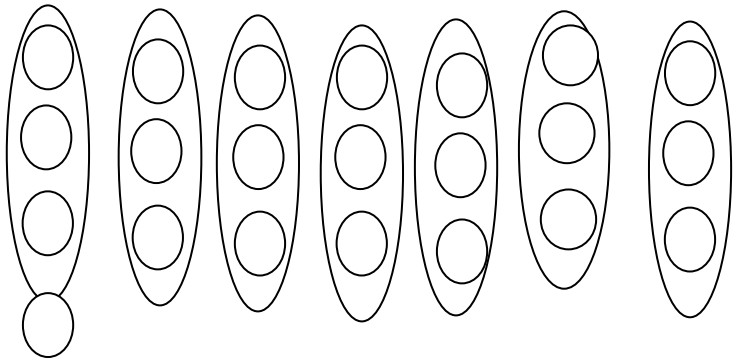
Children will work practically with equipment grouping objects to see multiplication as repeated addition. As they become more confident, this practical; grouping of objects will be mirrored on a number line using the vocabulary 'lots of', 'groups of', 'how many lots', 'how many times' so that the two are being done together. This will prepare them for the abstract concept of multiplying numbers rather than objects.



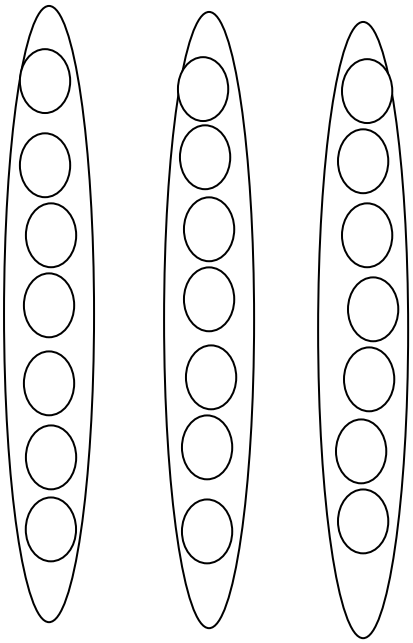
This image can be expressed as:

- 2 multiplied by 5
- Two, five times
- 5 groups of 2
- 5 lots of 2
- 5 jumps of 2 on a number line

We need to get the children used to 'showing' what multiplication means:



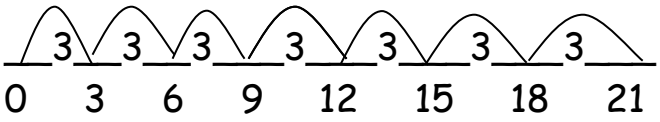
This shows 7 'lots of' 3 so we write it as 3 x 7 = 21



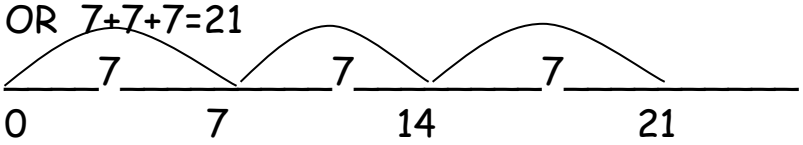
This shows 3 'lots of' 7 and we write this as 7 x 3 = 21

Using these models children will soon begin to understand the commutative law for multiplication facts.

We can also put it on a number line to show the relationship with addition – repeated addition….3+3+3+3+3+3+3 = 21



OR 7+7+7=21



Stage 3: Partitioning (grid method)

24 x 3 = 72

X	20	4	
3	60	12	72

24 x 32 = 768

X	20	4	
30	600	120	720
2	40	8	48
			768

Stage 4: Short (column)

24 x 3 = 72

$$\begin{array}{r} 24 \\ \times\ 3 \\ \hline 72 \\ \hline 1 \end{array}$$

241 x 3 = 723

$$\begin{array}{r} 241 \\ \times\ 3 \\ \hline 723 \\ \hline 1 \end{array}$$

1241 x 3 = 3723

$$\begin{array}{r} 1241 \\ \times\ 3 \\ \hline 3723 \\ \hline 1 \end{array}$$

Stage 5: Long (column)

24 x 32 = 768

```
  24
x 32
  48
 720
 1
 768
```

1245 x 13

```
   1 1
  1245
x   13
  3735
 12450
 16185
 1
```

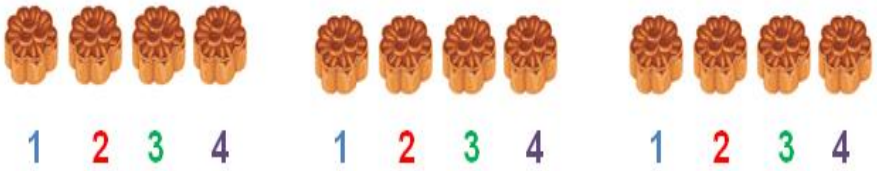
In the examples given, it is also correct to multiply starting with the tens digit (ie multiplying by the most significant digit first)

Division

As with addition, subtraction and multiplication it is vital that the basic skills needed are practised daily.

- counting
- estimating
- understanding multiplication as repeated addition
- recalling all multiplication facts to 12 × 12
- partitioning numbers into multiples of one hundred, ten and one
- working out products (70 × 5, 70 × 50, 700 × 5, 700 × 50) using the related fact 7 × 5 and their knowledge of place value
- adding two or more single-digit numbers mentally
- adding multiples of 10 (60 + 70) or of 100 (600 + 700) using the related addition fact, 6 + 7, and their knowledge of place value
- adding combinations of whole numbers
- understanding and using division and multiplication as inverse operations

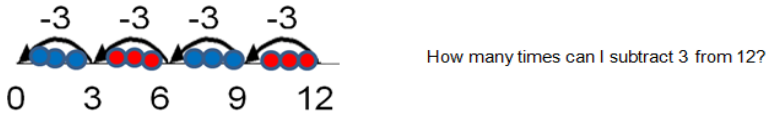
Stage 1: Practical (sharing)



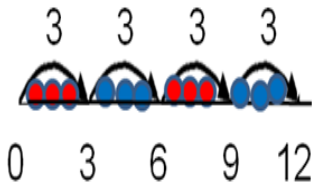
One to one correspondence – lots of practice is needed.

Stage 2: Number lines (grouping)

Each cake box holds 3 cakes, if I have 12 cakes, how many cake boxes will I need?



This is a good way of linking to repeated subtraction too!



How many groups of 3 are there in 12?

First without and then with remainders and ensuring that divisors offer an appropriate level of challenge

There is now quite a large gap in time between this stage and short division. Children tend to find division the most difficult of the four number operations and so must be completely confident in stage 2. There are also a number of informal methods that may be taught at this point.

Stage 3: Short division

372 ÷ 3 = 124

$$3\overline{)372} = 124$$

432 ÷ 15 = 28 r12

$$15\overline{)432} = 28_{r12}$$

$$15\overline{)432} = 28\tfrac{12}{15}$$

remainder as a fraction

$$15\overline{)432} = 28\tfrac{4}{5}$$

$$15\overline{)432} = 28.8$$

remainder as a decimal

It is a good idea to link to decimals and fractions at this point.

Stage 4: Long division

560 ÷ 24 = 23 r8

$$
\begin{array}{r}
23_{r8} \\
24\overline{)\,560} \\
48 \\
\hline
80 \\
72 \\
\hline
8
\end{array}
$$

432 ÷ 15 = 28 r12

$$
\begin{array}{rrrl}
 & & 2 & 8\ \text{r}12 \\
1 & 5 & 4\ 3 & 2 \\
 & & 3\ 0 & 0 \quad 15\times20 \\
\hline
 & & 1\ 3 & 2 \\
 & & 1\ 2 & 0 \quad 15\times8 \\
\hline
 & & 1 & 2
\end{array}
$$

$$
\begin{array}{rrrl}
 & & 2 & 8 \cdot 8 \\
1 & 5 & 4\ 3 & 2 \cdot 0 \\
 & & 3\ 0 & \downarrow \\
\hline
 & & 1\ 3 & 2 \\
 & & 1\ 2 & 0 \\
\hline
 & & 1 & 2\ 0 \\
 & & 1 & 2\ 0 \\
\hline
 & & & 0
\end{array}
$$

(12 ÷ 15 = 0.8)

remainder as a decimal

$$
\begin{array}{rrrl}
 & & 2 & 8\ \frac{4}{5} \\
1 & 5 & 4\ 3 & 2 \\
 & & 3\ 0 & \downarrow \\
\hline
 & & 1\ 3 & 2 \\
 & & 1\ 2 & 0 \\
\hline
 & & 1 & 2 \\
 & & 1 & 2
\end{array}
$$

$(0.8 = \frac{4}{5})$

remainder as a fraction

With long division, there is the opportunity to teach an expanded method first (ie chunking)

As **a guide**, the following tables will provide a guide as to the methods used in each year.

PROGRESSION ACROSS THE YEAR GROUPS ADDITION		
	Typical Calculations	Suitable Methods
Reception	U+U TU + U	Practical
Year 1	U+U TU + U	Practical Number line
Year 2	TU + U TU + multiples of 10 TU + TU U+U+U	Practical Number line Partitioning (expanded)
Year 3	HTU+U HTU + TU HTU + HTU	Practical Number line Partitioning (expanded)
Year 4	ThHTU + HTU ThHTU + ThHTU	Partitioning (expanded) Column
Year 5	ThHTU.t + ThHTU.t ThHTU.th + ThHTU.th	Partitioning (expanded) Column
Year 6	ThHTU.tht+ ThHTU.tht	Column

PROGRESSION ACROSS THE YEAR GROUPS SUBTRACTION		
	Typical Calculations	Suitable Methods
Reception	U - U	Practical
Year 1	U – U TU – U (to 20 including zero)	Practical Number line
Year 2	TU – U TU – multiples of 10 TU –TU U – U - U	Practical Number line Expanded
Year 3	HTU – U HTU – TU HTU - HTU	Number line Expanded Column
Year 4	ThHTU – HTU ThHTU - ThHTU	Expanded Column*
Year 5	ThHTU.t - ThHTU.t ThHTU.th - ThHTU.th	Expanded Column*
Year 6	ThHTU.tht - ThHTU.tht	Column*

*The number line is also used for number close together or when adding/subtracting time differences

PROGRESSION ACROSS THE YEAR GROUPS MULTIPLICATION		
	Typical Calculations	Suitable Methods
Reception	U x U	Practical (repeated addition) Picture arrays
Year 1	U x U	Practical (repeated addition) Picture arrays
Year 2	U x U	Practical (repeated addition) Picture arrays
Year 3	TU x U	Grouping on a number line progressing into expanded (grid) and short
Year 4	TU x U HTU x U	Expanded (grid) Short
Year 5	HTU x U ThHTU x U TU x TU	Expanded (grid) progressing into short (xU) Expanded (grid) progressing into long (xTU)
Year 6	ThHTU x U TU x TU HTU x TU ThHTU x TU U.t x U U.th x U U.t x TU	Short Expanded (grid) progressing into long Long Expanded (grid) progressing into short Expanded (grid) progressing into Long

PROGRESSION ACROSS THE YEAR GROUPS DIVISION		
	Typical Calculations	Suitable Methods
Reception	U ÷ U	Practical - sharing
Year 1	U ÷ U TU÷ U	Practical sharing Number line grouping
Year 2	U ÷ U TU÷ U	Practical sharing Number line grouping
Year 3	TU ÷ U	Grouping on a number line progressing to Short
Year 4	TU ÷ U HTU ÷ U	Grouping on a number line progressing to Short Short (with remainders to be expressed as r)
Year 5	HTU ÷ U ThHTU ÷ U	Short (remainders to be expressed as r, then as a fraction and then as a decimal)
Year 6	ThHTU ÷ U HTU ÷ TU ThHTU ÷ TU U.th ÷ U TU.th ÷ U HTU.th ÷ U ThHTU.th ÷ U	Short (remainders to be expressed as r, then as a fraction and then as a decimal) Chunking (remainders to be expressed as r, fraction or decimal) leading to long if teacher directs. Short (remainders to be expressed as decimal)

Anytime a child is dividing by a single digit then Short division is taught.

For each of the four number operations they will be taught in sequences (shown below)

<table>
<tr><th colspan="3">The Calculation Sequence – Holy Name Catholic Primary School - 2014</th></tr>
<tr><th>The sequence</th><th>The prompts</th><th>Examples</th></tr>
<tr><td>Provide an estimation for the calculation</td><td>Using knowledge of number and the number system, rounding and approximating, make a reasonable estimate.</td><td>116 x 50 = ?
120 x 50 = 6000 so less than 6000.</td></tr>
<tr><td>Practice the calculation skill</td><td>What is the objective you are teaching? Provide opportunities for extension. Demonstrate both practically or using formal calculations.</td><td>116 x 50
<table><tr><td>X</td><td>100</td><td>10</td><td>6</td></tr><tr><td>50</td><td>5000</td><td>500</td><td>300</td></tr></table>= 5000
500
300
A= 5 800</td></tr>
<tr><td>Complete the inverse</td><td>Give children the opportunity to check their calculations using the inverse operation.</td><td>5,800 ÷ 5 = 1160
So 5800÷ 50 must be 116
_1 1_60__
5 | 58 ^{3}00</td></tr>
<tr><td>Solve similar calculations to include units of measure (ml, cm, £ etc)</td><td>Which units of measurement do you need to include? Does tour answer make sense?</td><td>Each container holds 50ml of fluid. How many containers do I need for 5.8L of fluid?</td></tr>
<tr><td>Complete missing box calculations</td><td>Include units to increase difficulty. The boxes may cover single digits or entire numbers. Vary the position of the box/letter</td><td>N x 50 = 5800
116 x N = 5800
5ΔΔΔ ÷ 50 = 116</td></tr>
<tr><td>Complete 1,2 and 3 step word problems</td><td>Include a variety of levels to ensure pushing the more able.</td><td>Barry works for a packing company. He packs pencils in boxes of 12. Each crate contains 432 pencils – how many boxes are in each crate? A company needs 600 pencils, how many boxes do they need?</td></tr>
<tr><td>Solve open ended investigations</td><td>This takes a lot of planning to ensure the objectives are met. Ensure the children are working with the appropriate calculations.</td><td>Bill has 20 metre long fence panels. He needs to build a fenced area for his pigs. How many different ways can he do this? Does the area ever stay the same?</td></tr>
</table>