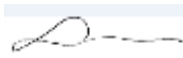| Formally adopted by the Governing Board/ Trust of:-	Corvus Education Trust
On:-	26th & 28th November 2018
Chair of Governors/Trustees:-	Clair De'ath & Stuart Page
Date for Review:-	2021

Corvus Education Trust Calculation Policy

Aims

This Calculation Policy aims to ensure all pupils:
- see mathematics as both a written and spoken language
- are competent in fluency, reasoning and problem solving
- understand important mathematical concepts and make connections within mathematics
- are taught consistent calculation strategies in a methodical manner across the academy trust
- understand the progression of skills and key concepts for the four operations through a concrete, pictorial and abstract approach
- are able to add, subtract, multiply and divide efficiently

Overview

Within the Corvus Trust we believe that it is essential for children to move from a conceptual understanding to an abstract understanding of mathematics. This will enable children to develop a secure knowledge of mathematics and become confident in applying their mathematical skills. The calculation strategies we have outlined in this document are progressive and at each stage make links between concrete, pictorial and abstract recording before moving to more formal written methods.

Mental Skills

It is essential that pupils are provided with daily opportunities to develop their mental calculation skills. They need to be able to:

- recognise the size, place value and position of numbers
- count on and back in steps of different sizes from any number, including where they need to bridge through ten
- know number bonds
- partition and recombine numbers
- recognise doubles and halves
- quickly recall multiplication facts and derive associated division facts
- use known facts to generate related number facts

Representations

All schools use a variety of concrete, pictorial and abstract representations of numbers and calculations. Pupils should have an opportunity to manipulate and experience a variety of models, images, and resources to enable them to choose the most suitable representation for each calculation. In the picture below you can see some examples of models, images and resources: arrow cards, bead strings, counters, ten frames, dice, Base 10, digit cards, multilink, number fans, number lines, number tracks, Numicon, Cuisenaire, sorting objects etc.
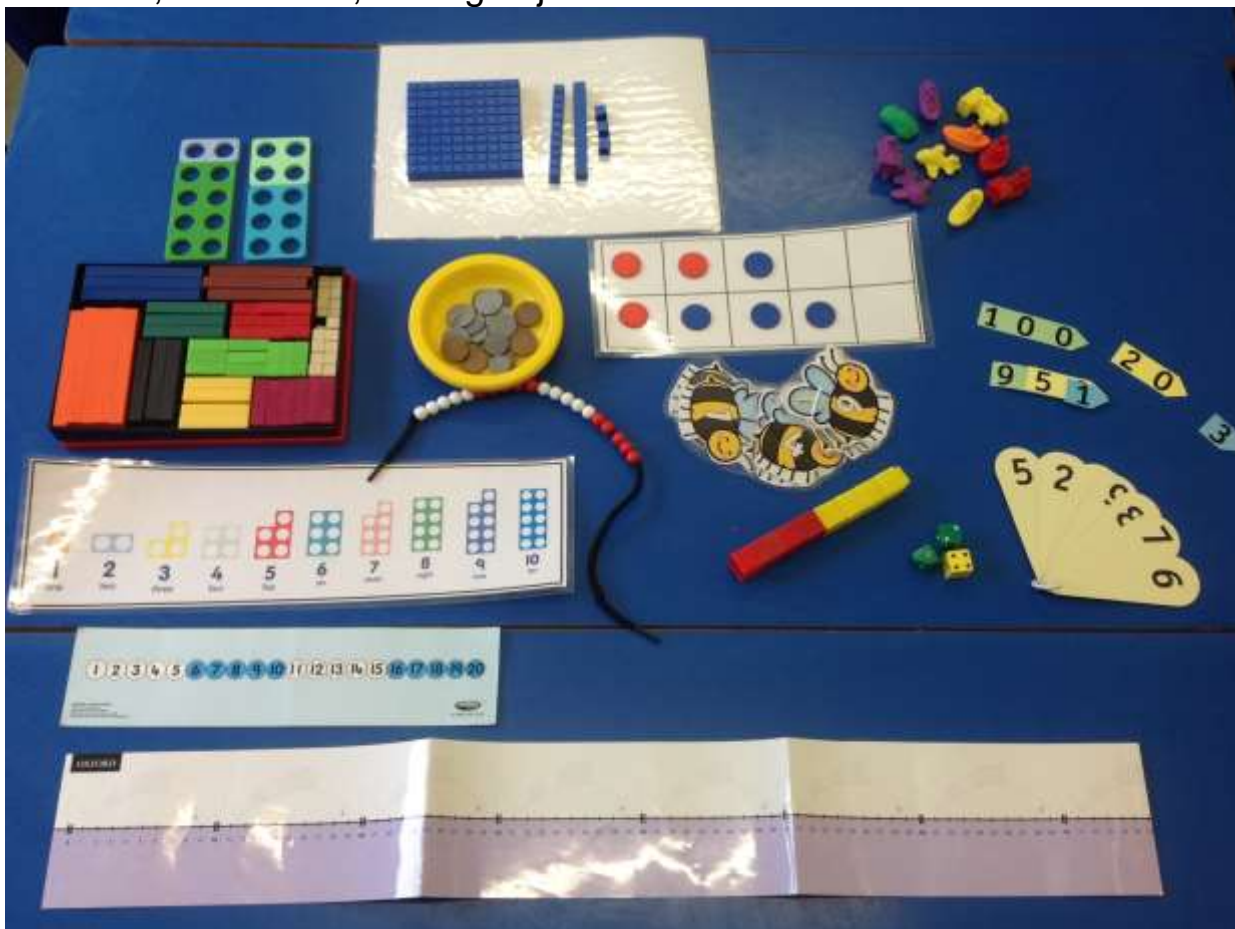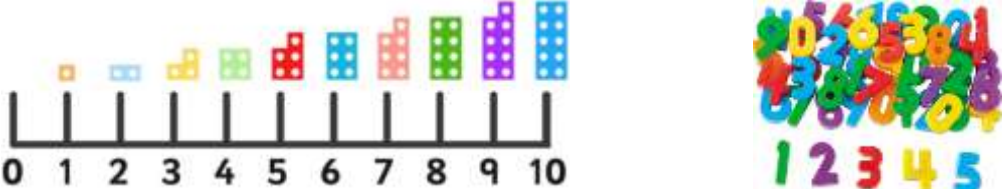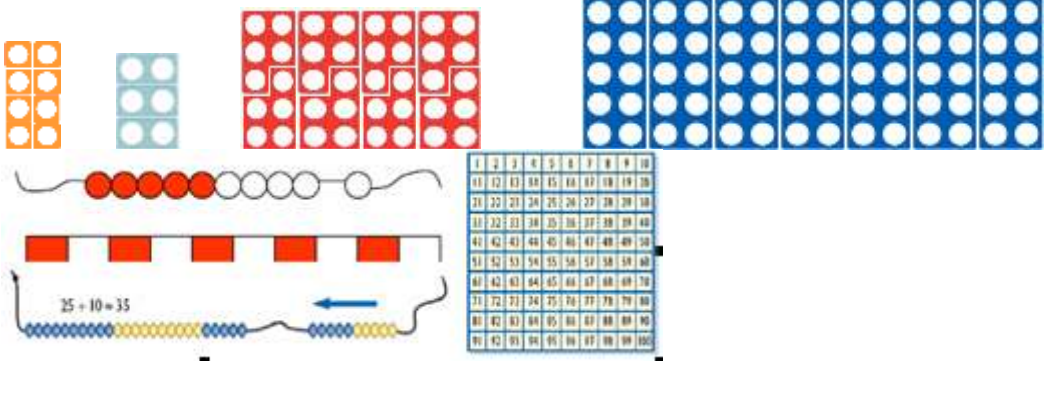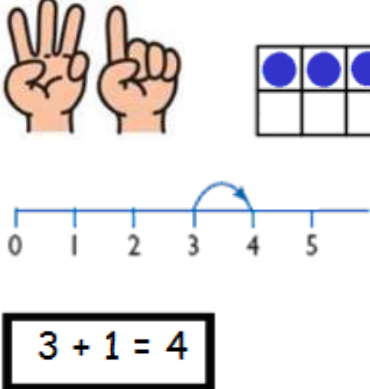

Algebra
The development of algebra begins early on and should be a focus of early mathematical teaching. As soon as children are introduced to symbols, calculations
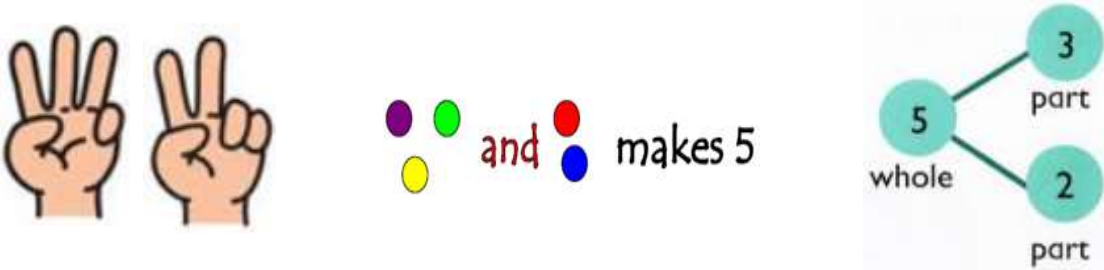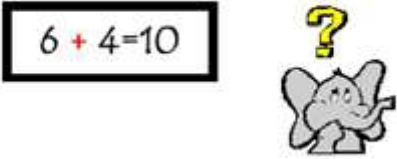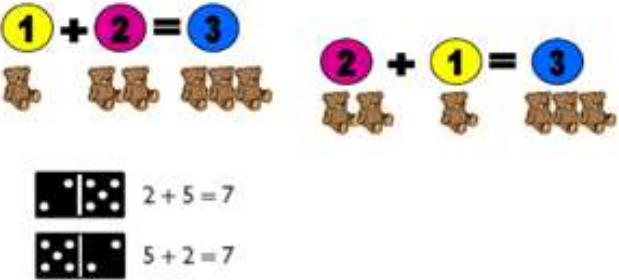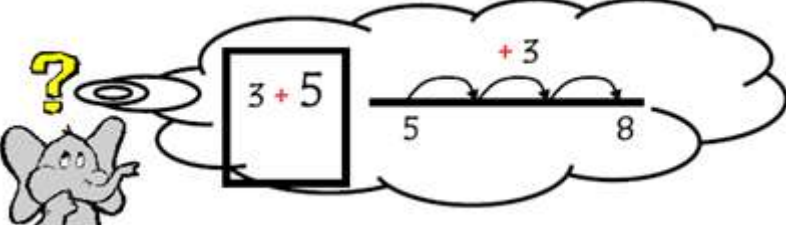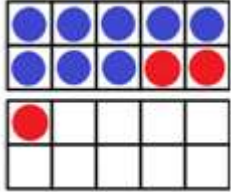
need to be presented in different ways. Children need to learn that, in maths, equality (=) means two sets are balanced and inequality (≠) means an imbalance.

They need to see number sentences as equations that can be represented in numerous ways e.g. 7 + 3 = 10 could also be represented as 10 = 3 + 7. They can also be represented as balanced equations e.g. 1 + 9 = 6 + 4 or 7 + 3 = 12 − 2. To deepen their understanding, children should have opportunities to experience some examples of inequality e.g. 9 ≠ 6 + 2.
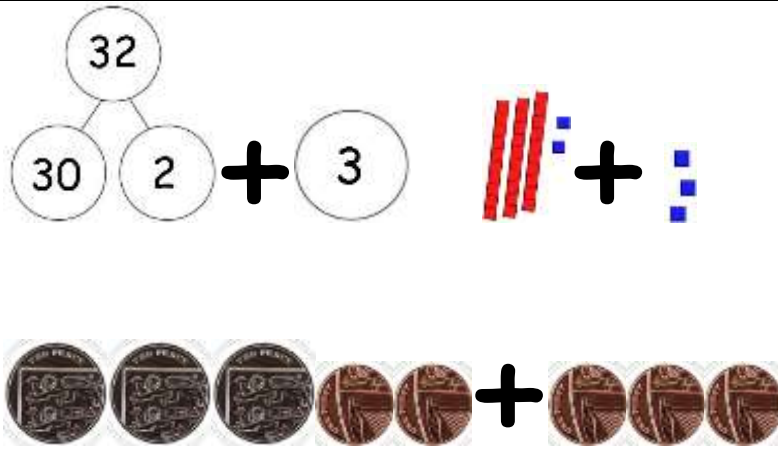
Progression in Teaching Addition

Key Vocabulary

More, count on, increase, add, plus, addition, sum, total, altogether, equals, partition, recombine, commutative.
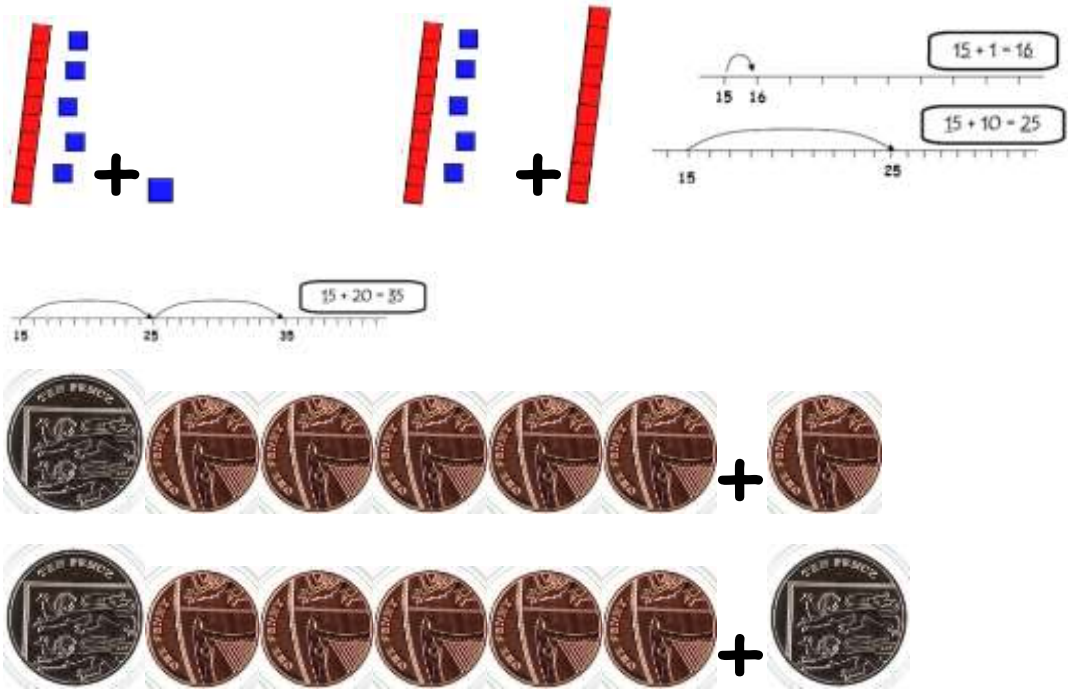
Progression of skills	Addition method
Count reliably up to 10 everyday objects	1, 2, 3, 4, 5, 6… there are 6.
Understand the 'numberness' of a number (subitize)	Estimate the number of objects by glancing at a set.
Recognise numbers 0 to 10	0 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5
Count on in ones, twos, fives and tens	25 + 10 = 35
Find one more than a number.	0 1 2 3 4 5 3 + 1 = 4 1 more than 3 is 4, 2 more then 3 is 5, 3 more than 3 is 6. 4 is one more than 3

Begin to relate addition to combining two parts to make a whole.		
Count along a number line to add numbers together (within ten).	$3 + 2 = 5$	
Begin to use the + and = signs to record mental calculations in a number sentence	$6 + 4 = 10$	
Know that addition can be done in any order (commutative law)	$1 + 2 = 3$ $2 + 1 = 3$ $2 + 5 = 7$ $5 + 2 = 7$	
Count on from the biggest number.	$3 + 5$ 5 +3 8	
Regrouping to make 10.	8 + 3 8 + 2 = 10 10 + 1 = 11	

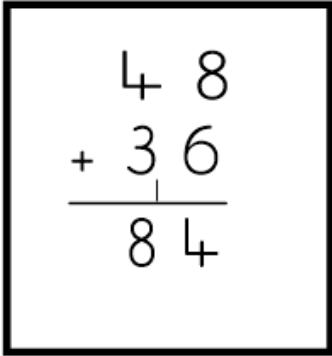|	
Begin to partition numbers in order to add.	
Know which digit changes when adding ones or tens to any number	
Partitioning and recombining	15 + 13 10 + 5 + 10 + 3 = 20 + 8 = 28
Partitioning and recombining (counting on from the biggest number)	15 + 13 15 + 10 = 25 25 + 3 = 28
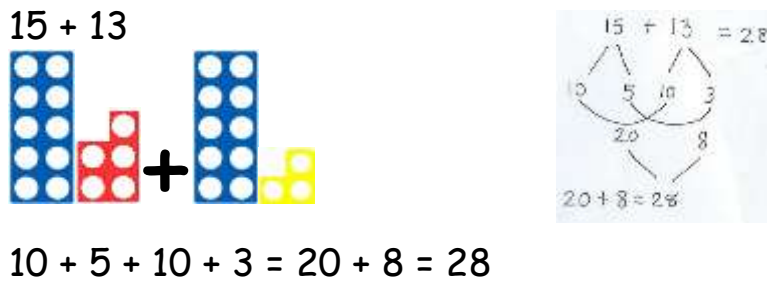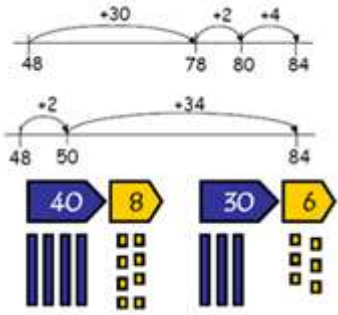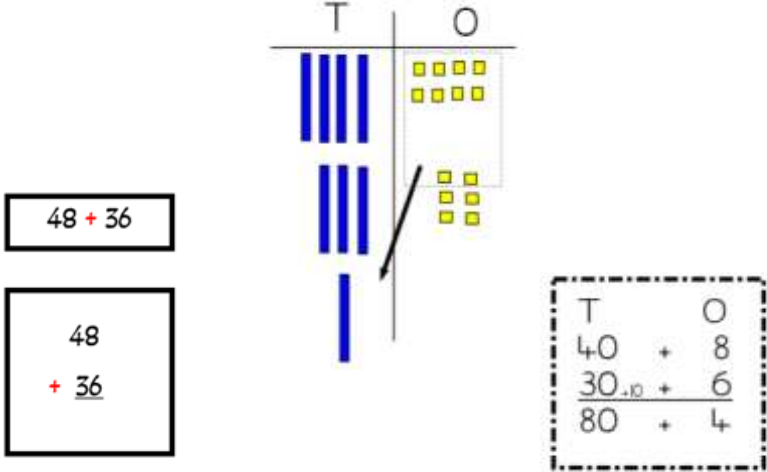
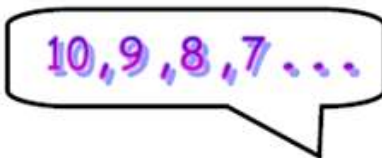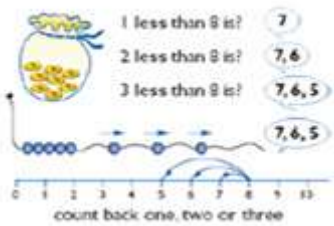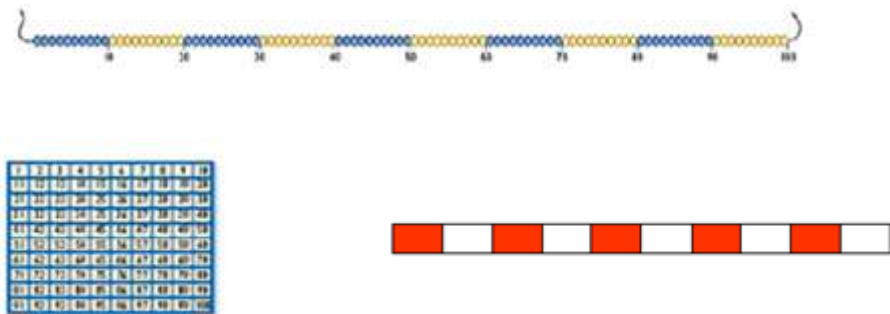|	
Addition on a blank number line using more efficient strategies.	
Expanded method	It is important that the children have a good understanding of place value and partitioning using concrete resources and visual images to support calculations. The expanded method enables children to see what happens to numbers in the standard written method. 48 + 36 48 + 36 T O 40 + 8 30.₁₀ + 6 80 + 4
Standard written method	The previous stages reinforce what happens to the numbers when they are added together using more formal methods. 4 8 + 3 6 ――― 8 4

To add successfully, children need to be able to:
- recall all addition pairs to 9 + 9 and number bonds
- add mentally a series of one-digit numbers, such as 5 + 8 + 4
- add multiples of 10, 100, 1000 and beyond using related addition facts and their knowledge of place value e.g. 6 + 7, 60 + 70, 600 + 700 and so on.
- Partition numbers in different ways

Progression in Teaching Subtraction

Key Vocabulary

less, fewer, count back, decrease, take away, minus, subtraction, difference, left, equals, partition, inverse.

Progression of skills	Subtraction method
Begin to count backwards in familiar contexts such as number rhymes and stories	
Continue the count back in ones from any given number	
Begin to relate subtraction to 'taking away'	
Find one less than a number	
Count back in multiples of ten and in tens from any given number	

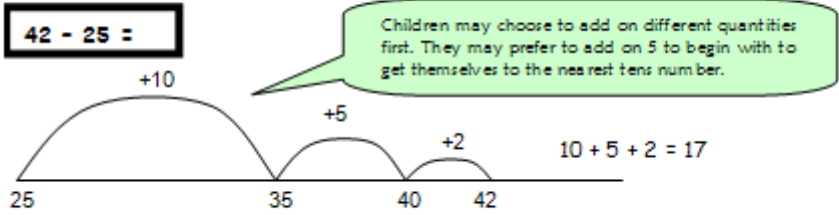|	
Count backwards along a number line to take away	If I take away four shells there are six left
Recognise that subtraction is the inverse of addition and vice versa.	$5 + 3 = 8$ $3 + 5 = 8$ $8 - 3 = 5$ $8 - 5 = 3$
Begin to use the – and + signs to record mental calculations in a number sentence	Maria had six sweets and she ate four. How many did she have left? $6 - 4 = 2$
Begin to partition numbers in order to take away	$43 - 20 = 23$ $23 - 7 = 16$
Begin to find the difference by counting up	The difference between 11 and 14 is 3. $14 - 11 = 3$ $11 + \square = 14$

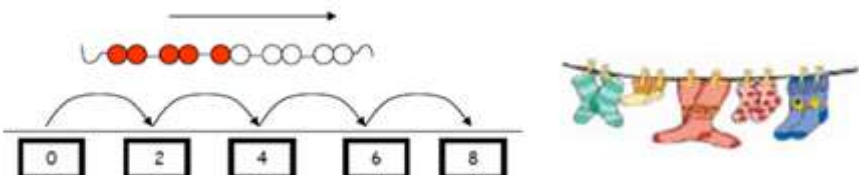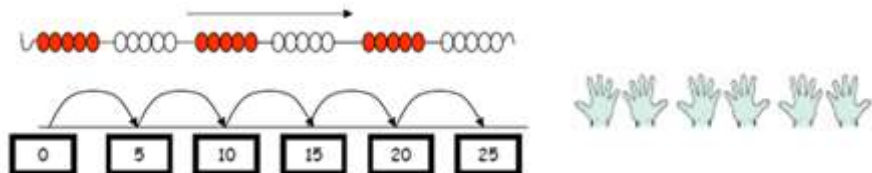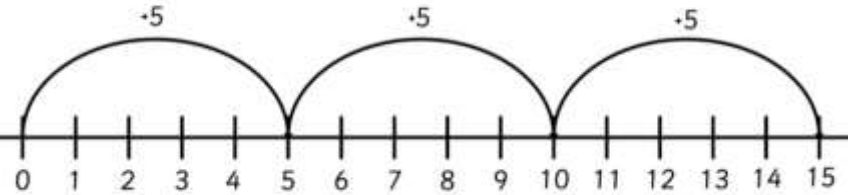|	
Continue to use a number line to find the difference (including bridging through the tens boundary) Using more efficient strategies.	42 - 25 = Children may choose to add on different quantities first. They may prefer to add on 5 to begin with to get themselves to the nearest tens number. +10 +5 +2 10 + 5 + 2 = 17 25 35 40 42
Expanded method	It is important that the children have a good understanding of place value and partitioning using concrete resources and visual images to support calculations. The expanded method enables children to see what happens to numbers in the standard written method. T O $^{30}40$ $^{10}+3$ -20 $+7$ 10 $+6$
Standard written method	The previous stages reinforce what happens to the numbers when they are subtracted using more formal methods. It is important that the children have a good understanding of place value and partitioning. $^3 4 ^1 3$ $-\ 2\ 7$ $\overline{\ \ 1\ 6}$
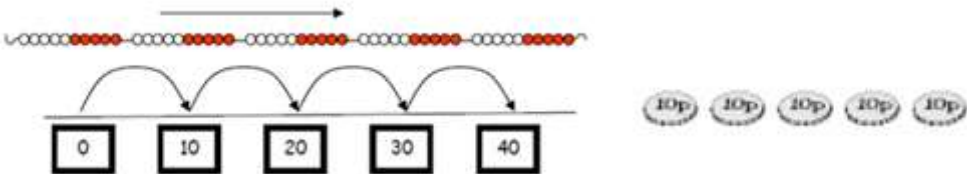
To subtract successfully, children need to be able to:
- recall addition and subtraction facts to 20
- subtract mentally a series of one-digit numbers, such as 17 – 3 – 4
- subtract multiples of 10, 100, 1000 and beyond using related subtraction facts and their knowledge of place value e.g. 8 - 5, 80 - 50, 800 - 500 and so on
- Partition numbers in different ways

Progression in Teaching Multiplication

Key Vocabulary

Repeated addition, groups, array, multiply, multiplication, product, total, altogether, equals, partition, commutative, distributive.

Progression of skills	Multiplication method
Count in tens from zero	
Count in twos from zero	
Count in fives from zero	
Understand multiplication as repeated addition	2 + 2 + 2 + 2 4 groups of 2 2 + 2 + 2 + 2 = 8 2 multiplied by 4 2 x 4 = 8
Use a number line to represent repeated addition	5 x 3 = 5 + 5 + 5 = 15

Use arrays to illustrate commutativity	2×4 $2 \times 4 = 8$ 4×2 $4 \times 2 = 8$ $4 \times 2 = 8$ $2 \times 4 = 8$
Know multiplication facts to 12 x 12	× 5 $2 \times 5 = 10$ $6 \times 5 = 30$ $3 \times 5 = 15$ $8 \times 5 = 40$ ×2 ×2 ×2 0 3 6 9 12 15 18 21 24 27 30 ×2 0 6 12 18 24 30 36 42 48 54 60 $12 \times 2 = 24$ Twice as many Use known facts to work out new ones
Use factors to multiply (distributive law)	Understand that … 24 × 20 = 24 × 2 × 10 24 × 50 = 24 × 5 × 10
Use partitioning to support the multiplication of O x TO alongside the grid method	13 × 4 10 3 Visual 4 40 12 10 3 Written recording 4 40 12 40 + 12 = 52 When first introducing the grid method, use resources to show the visual process, as well as recording the workings within a grid.

Multiplying TO x TO	14 x 33 | X	30	3	
---	---	---	---
10	300	30	= 330
4	120	12	= 132	 462 300 120 30 + 12 462
Expanded column method	38 x 7 = 30 + 8 x 7 56 (7 x 8 = 56) 210 (7 x 30 = 210) 266 *To demonstrate the process, it may help to record, in brackets, each step. Move away from this as children are ready.* 38 x 7 = 38 x 7 56 210 266
Formal column method	**Standard written method** 38 x 7 = 38 x 7 266 5 *This step involves adding the 56 and 210 mentally.* 38 x 27 = 38 x 27 266 760 1026 1 *This method can then be used to multiply TU by TU numbers. If needed, the brackets, as in previous step, could be used to support mental workings.*
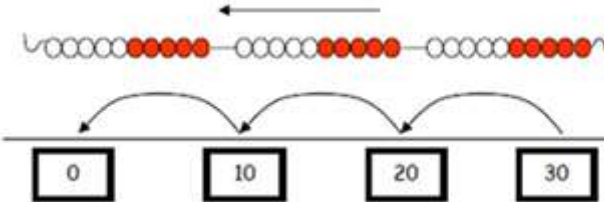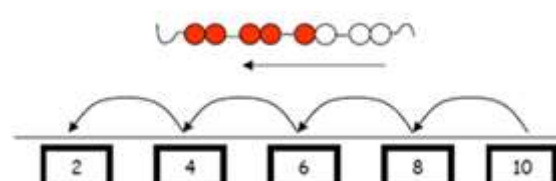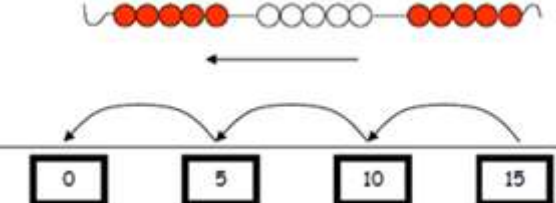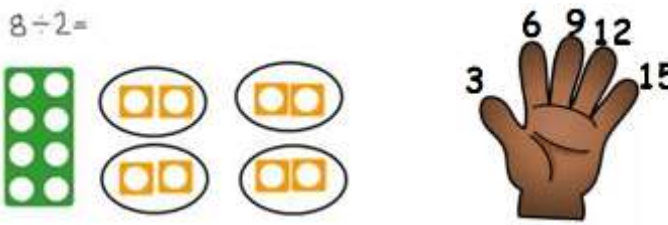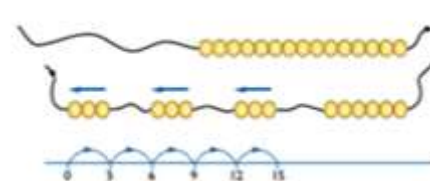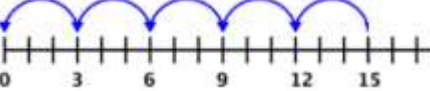
To multiply successfully, children need to be able to:
- recall all multiplication facts to 12 x 12
- partition numbers in different ways, not just multiples of hundreds, tens and ones
- have a secure knowledge of place value and addition
- work out products e.g. 70 x 5, 70 x 50, 700 x 5 using the related fact 7 x 5.
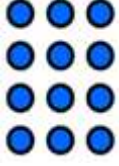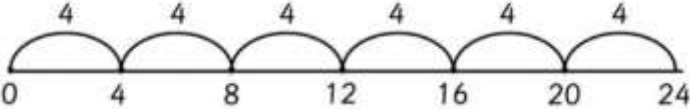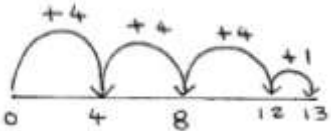
Progression in Teaching Division

Key Vocabulary

Repeated subtraction, groups, share, array, divide, division, equals, partition, fraction, inverse, remainder, factor, numerator, denominator

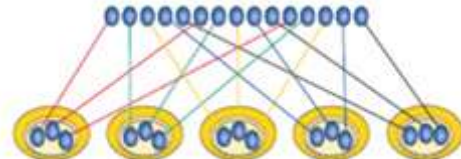| Progression of skills	Division method
Count back in tens	
Count back in twos	
Count back in fives	
Understand division as sharing	$15 \div 5 = 3$ 15 shared between 5
Understand division as grouping	$8 \div 2 =$ How many 3s $15 \div 3 = 5$
Understand division as repeated subtraction	 $15 - 3 - 3 - 3 - 3 - 3 = 0$

Reinforce division as grouping through the use of arrays	 12 divided into groups of 3 gives 4 groups 12 ÷ 3 = 4 12 divided into groups of 4 gives 3 groups 12 ÷ 4 = 3
Use known multiplication facts to work out corresponding division facts	If $2 \times 10 = 20$ then $20 \div 10 = 2$ $20 \div 2 = 10$
Represent division on a number line	$24 \div 4 = 6$ 0 4 8 12 16 20 24
Understand the concept of having remainders	 $13 \div 4 = 3$ remainder 1 $20 \div 9 = 2$ remainder 2
Chunking method	What facts do I know about the 7 times-table? $100 \div 7 = 14 \, r \, 2$ 100 $-70 \quad (10 \times 7)$ 30 $-28 \quad (4 \times 7)$ 2 $518 \div 7 = 74$ 518 $-350 \quad (50 \times 7)$ 168 $-140 \quad (20 \times 7)$ 28 $-28 \quad (4 \times 7)$ 0. Fact Box $1 \times 7 = 7$ $2 \times 7 = 14$ $5 \times 7 = 35$ $10 \times 7 = 70$ $20 \times 7 = 140$ $50 \times 7 = 350$ $100 \times 7 = 700$
Standard written method (short division)	2 7 3) 8 ²1 • use this method for larger numbers HTU ÷ U, ThHTU ÷ U • use this method to divide numbers with up to 2 decimal places. • solve division problems involving measures and money. • use as the inverse operation to check multiplication calculations.

Standard written method (long division)	To calculate 748 divided by 51,

To calculate 748 divided by 51,

First, set the sum out as shown:

51$\overline{)748}$

As we are dividing by 51, children may find it useful to write their 51 times tables down the side of there page to support them. This can be done using mental repeated addition.

We work out 74 divided by 51, and write the answer (1) above the 4.

1 × 51 = 51, so we write this underneath 74.

Subtract 51 from 74 to get the remainder (23).

```
      1
51)748
   -51
    23
```

We now bring down the next digit (8) and write it on the end of the 23. This is the same as writing the remainder at the top:

```
      1
51)748
   -51
   238
```

We now work out 238 divided by 51, and write the answer (4) above the 8. You use estimation skills here: 51 is roughly 50 and 4 × 50 = 200. You can work out 51 × 4 = 204 separately.

We write 204 underneath the 238 and subtract to find the remainder. There are no more digits to bring down, so we have our answer:

```
       14
51)748
    -51
    238
   -204
     34
```

So the answer is 14 remainder 34.

NB: In Year 6, children working at a level 5 may also be expected to convert their remainder to a decimal answer.

To divide successfully, children need to be able to:
- understand division as repeated subtraction
- estimate how many times one number divides into another
- multiply numbers mentally up to 12 x 12 and know some related multiplaction facts.
- have a secure knowledge of place value and subtraction

Conclusion

Although these strategies are progressive, children should not be encourage to stick to one prescribed strategy. They should be encouraged to reflect upon which method or strategy they find most reliable and suits their style of learning. It is important that children are allowed to record their working out and this should be encouraged from an early age.