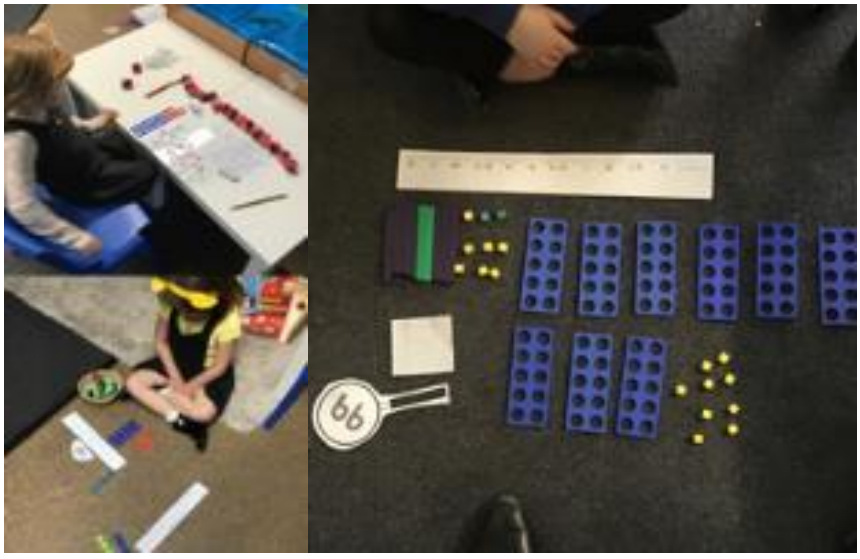
Alexander Hosea School

Calculation Policy

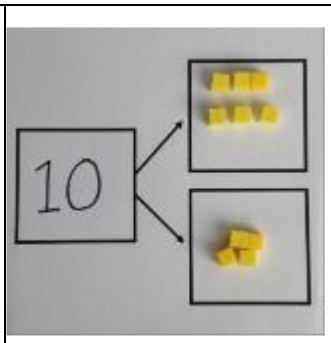
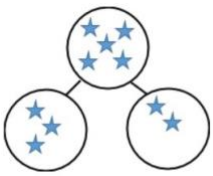
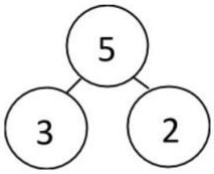
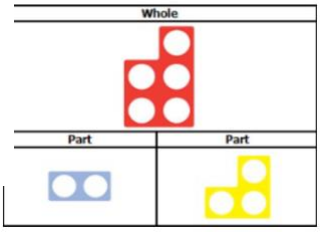
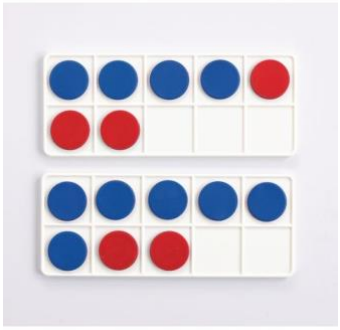
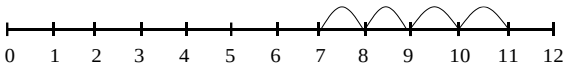
'roots to grow, wings to fly'

May 2020



Our aim is to build resilient Mathematicians who are not afraid to solve problems and have a foundation of different methods and strategies to draw on. This calculation policy explains the different methods and strategies that can be taught at each stage to help develop confident mathematicians.

Foundation Stage Addition

Explore part part whole relationship—combining two parts to make a whole.	 **Concrete** Groups of objects to make a number. **Pictorial** Use part part whole pictorial images and move to writing numbers   
Using the ten frame to support addition of single digits—counting all/combining two groups Solving problems	 4 + 3 = 7 6 + 2 = 8
Starting at the bigger number and counting on	**Concrete** Start with the larger number (for example on the bead string) and then count on to the smaller number 1 by 1 to find the answer.  **Pictorial**  Recording by - drawing jumps on prepared lines Start at the larger number on the number line and count on in ones to find the answer. **Abstract** Place the larger number in your head and count on the smaller number to find your answer. 7 + 4 = 11

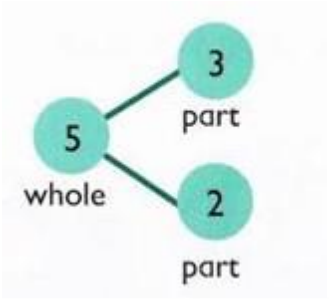
Year 1 - Addition

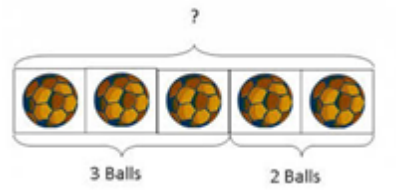
Combining two parts to make a whole: part whole model. Joining two groups and then recounting all objects (lots of practice making 10 and numbers to 10 e.g. 6 + 4 = 10 or 3 + 5 = 8)

Concrete

3 + 4 = 7

Pictorial



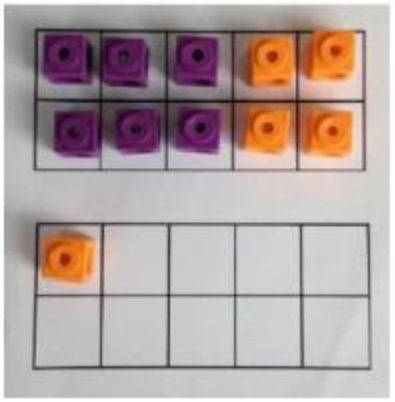


Using the Whole part Model to move to the **Abstract**: 3 + 2=5

Regrouping to make 10.
This is an essential skill for column addition later.

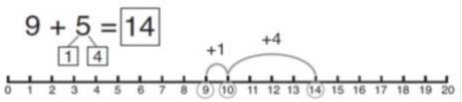
Concrete

Using tens frames or Numicon, start with the bigger number and then use the smaller number to make the 10.
6 + 5 = 11 (one group of 10 and one more)



Pictorial

Use pictures or a number line. Regroup or partition the smaller number using the part part whole model to make 10.

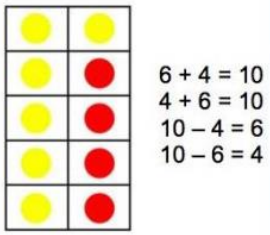


Abstract

6 + 5= 11

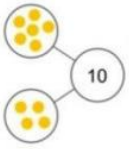
If I am at 6, how many more do I need to make 10. How many more do I add on now?

Number Bonds
Learn number bonds to 20 and demonstrate related facts. Addition and subtraction taught alongside each



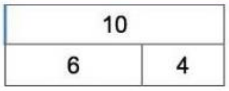
6 + 4 = 10
4 + 6 = 10
10 – 4 = 6
10 – 6 = 4

Tens Frame



6 + 4 = 10
4 + 6 = 10
10 – 4 = 6
10 – 6 = 4

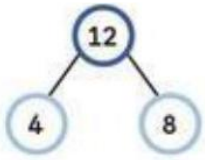
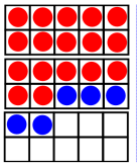
Part Whole Model

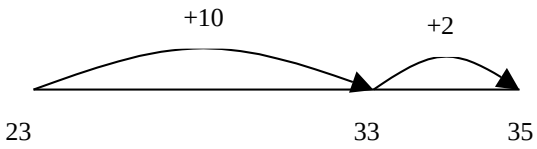
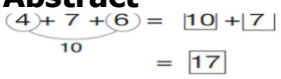
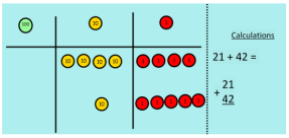


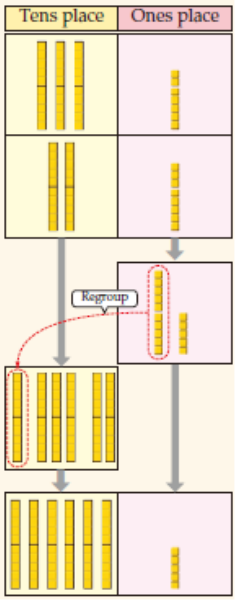
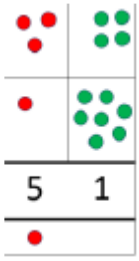
6 + 4 = 10
4 + 6 = 10
10 – 4 = 6
10 – 6 = 4

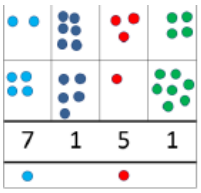
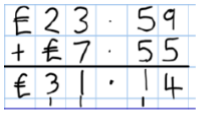
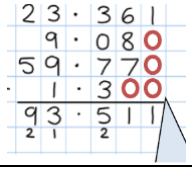
Bar Model

Identify chains of reasoning:

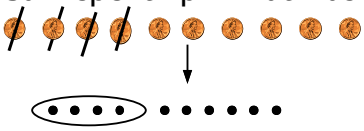
other as pupils need to see the relationship between the facts.	8 + 4 = 12 4 + 8 = 12 12= 4 + 8 12 – 8 = 4 12 – 4 = 8   Children have time to explore and see relationships to 20 and beyond 20.
Year 2 Addition	
Add a two digit number and ones	**Concrete**  Use a tens frame to make tens and explore patterns: 17 + 5 = 22 27 + 5 =32 37+ 5=42 **Pictorial** Draw could use a bar model or number line.  **Abstract** Explore related facts: Explore related facts 17 + 5 = 22 5 + 17 = 22 22—17 = 5 22—5 = 17
Add a two digit number and tens	**Concrete**  Use dienes to add tens, explore how the ones do not change. 2 5 + 40 = 65 **Pictorial** Use number lines and number squares to add multiples of 10. **Abstract** 23 + 10 = 33 23 + 20 = 43 23 + □ = 53
Add two 2-digit numbers	Concrete Model using dienes , place value counters and numicon (as above)

	Pictorial Bridging 23 + 12 = 23 + 10 + 2 = 33 + 2 = 35  **Abstract** Partition into tens and ones and recombine 12 + 23 = 10 + 2 + 20 + 3 10 + 20 = 30 2+3 = 5 30 + 5=35
Add 3 1 digit numbers	**Concrete** Combine objects to make ten if possible and then add third number (or bridge ten and then add third number) 4 + 6 + 3 **Pictorial** Regroup and draw representation **Abstract**  Combine number that make ten(or bridge ten) then add the third number.
Year 3 Addition	
Column addition with no regrouping	**Concrete** Model using dienes or numicon.  24 +15 Add together ones first and then tens. Move on to place value counters  **Pictorial** Children to draw dienes or place value counters in a place value frame:

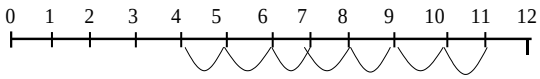
	Abstract Children taught to add ones first, then tens then hundreds. 2 3 3 + 1 2 4 3 5 7
Column addition with regrouping	**Concrete** Exchange ten ones for a ten. Model using dienes, numicon and place value counters.  **Pictorial** Children can draw dienes or Place value counters on a grid to support understanding:  34 + 17 **Abstract** Start by partitioning numbers before moving to compact: 47 + 76 40 + 70 = 110 7+ 6= 13 110 13 123 Finally once understood moving on to contracted format: 76 + 47 123 1 1
Year 4-6 Addition	
Add numbers with up to 4 digits	**Concrete** Use dienes or place value counters to exchange hundreds, tens and ones. (see above year 3 concrete)

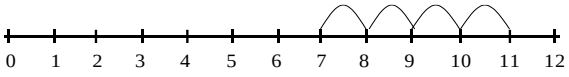
	 **Pictorial** Draw representations using place value grid. **Abstract** Progressing to numbers with at least four digits 3587 + 675 = 4262 3587 + 675 4262 Continue with previous learning on carrying but now progressing to carrying hundreds as well.
Add numbers with more than 4 digits. Add decimals up to 2 places, including money.	**Concrete** Introduce decimal place value counters and model exchange for addition.  Pictorial Children could draw representations using place value grid. **Abstract** Extend abstract methods to numbers with any number of digits and decimals with 1 and 2 decimal places. 124.9 + 117.25 = 242.15 124.90 + 117.25 242.15 11
Add several numbers of increasing complexity Including adding money, measure and decimals with different numbers of decimal points.	 Insert Zeros as place holders to prevent errors of putting numbers in the incorrect places. 

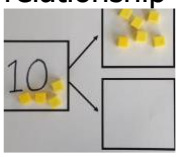
<table>
<tr><th colspan="2">Foundation Stage - Subtraction</th></tr>
<tr><td>Part, Part Whole model</td><td>Link addition and subtraction using the part, whole model. As with addition use concrete and pictorial version of whole and part</td></tr>
<tr><td>Take ones away</td><td> 
Concrete
Using range of objects and taking away a number of objects from the set.

<u>Pictures / marks</u>
Sam spent 4p. What was his change from 10p?
  </td></tr>
<tr><td>Using the ten frames, numicon and number lines to support subtraction by taking away</td><td>Use of Numicon:

Number lines (numbered)

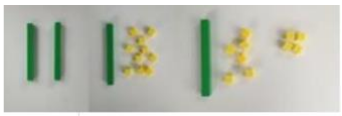
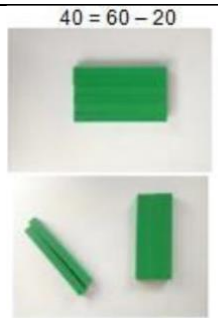
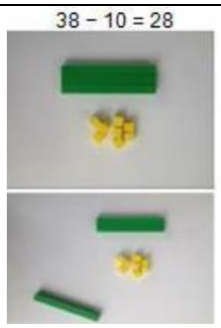
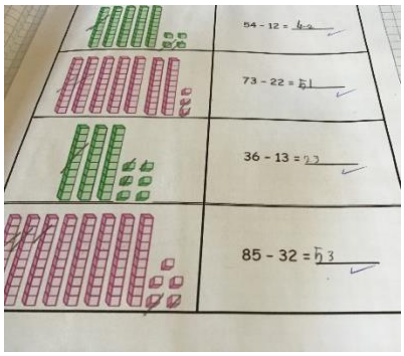
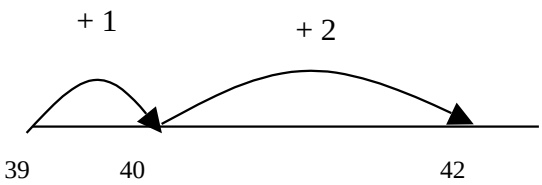
11 – 7
(Counting back)
 

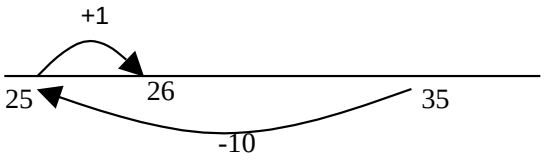
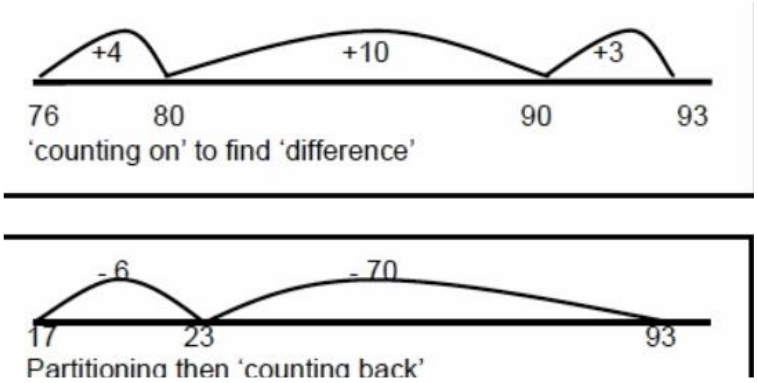
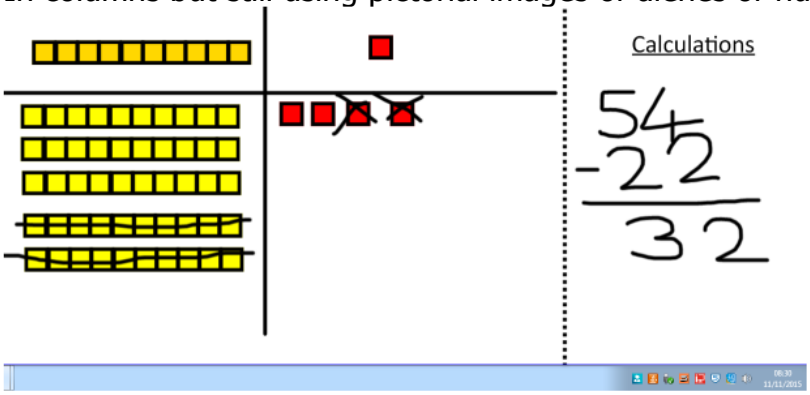
The difference between 7 and 11
(Counting up)
 

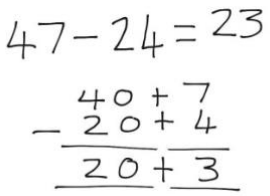
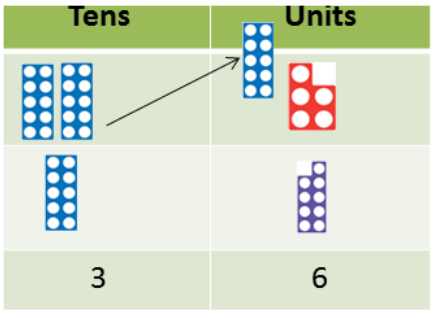
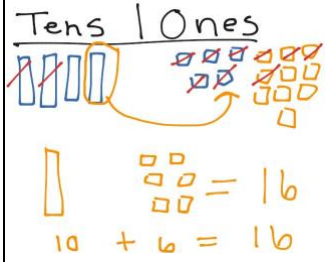
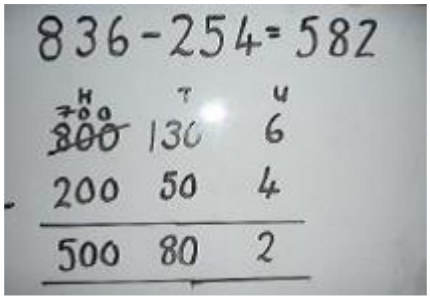
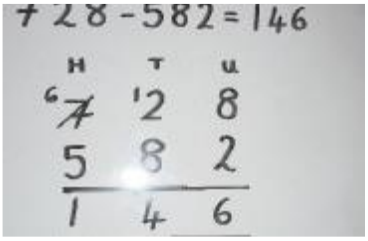
  </td></tr>
<tr><td colspan="2">Year 1 Subtraction</td></tr>
<tr><td>Represent and use number bonds and related subtraction facts within 20</td><td>Concrete
As with addition use part, part whole models, tens frames, bar model number lines and Numicon to model the inverse relationship with addition.
 

Pictorial
Use pictorial representations to show the part.
 
Bar model to show inverse relationship.
Abstract

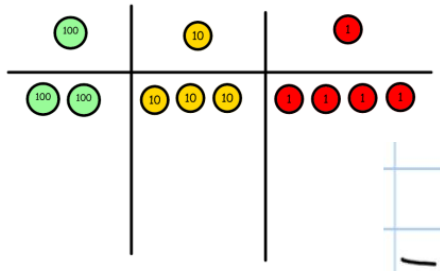
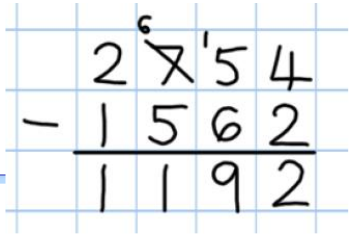
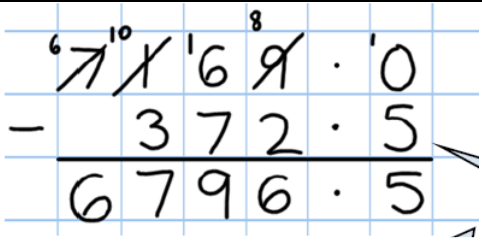
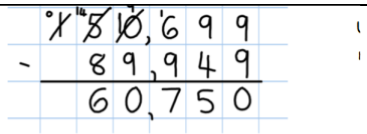
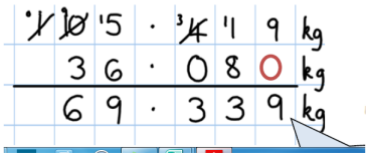
Move to using numbers within the part whole model.</td></tr>
</table>

Regroup a ten into ten ones	20-4 = use dienes to change a ten into ten ones to subtract.  Draw the dienes and subtract.
Subtracting Multiples of 10. Using the vocabulary of 1 ten, two tens, etc, alongside 10, 20, 30 is important	  **Concrete** Use dienes blocks to subtract 10s Moving on to crossing off **pictorial** tens blocks. **Abstract** take from the tens column.
Year 2 Subtraction	
Partitioning to subtract without re-grouping.	 **Concrete** Use Dienes to show how to partition the number when subtracting without regrouping Children can then move to drawing **pictorial** representations of dienes and crossing off. Finally move to **abstract** 36-13 =23 by taking away ones from the ones and then tens from the tens.
Make ten strategy *Progression should be crossing one ten, crossing more than one ten, crossing the hundreds.*	Subtraction is taught as counting back and counting on depending on the numbers. 42-39 - counting on mentally or using number line. 

	Subtract 9 or 11. Begin to add/subtract 19 or 21 35 – 9 = 26  **Bridging** 27-14=13 20-10=10 7-4=3  93-76=17
Year 3 Subtraction	
Column subtraction without regrouping	**Concrete** Use dienes or numicon in columns to model this first **Pictorial** In columns but still using pictorial images of dienes or numicon 

	Abstract  Using this intermediate step to explain before moving to compact method.
Column subtraction with regrouping	 **Concrete** Begin with dienes or Numicon. Move to place value counters, modelling the exchange of a ten into ten ones. Use the phrase 'take and make' for exchange.  **Pictorial** Children may draw dienes or place value counters and cross off. 45 – 29 = 16  Begin by partitioning into place value columns.  Then move to formal compact method.

Year 4- 6 Subtraction

Subtracting tens and ones Year 4 subtract with up to 4 digits. *Introduce decimal subtraction through context of money*	 Concrete Model the process using place value counters first.  Before moving to 4 digit subtraction with exchange.
Year 5- Subtract with at least 4 dig-its, including money and measures. *Subtract with decimal values, including mixtures of integers and decimals and aligning the decimal*	 Use zeros as place holders.
Year 6—Subtract with increasingly large and more complex numbers and decimal values.	 

Foundation Stage- Multiplication

Doubling- Experience equal groups of objects. Problem solving with doubling.

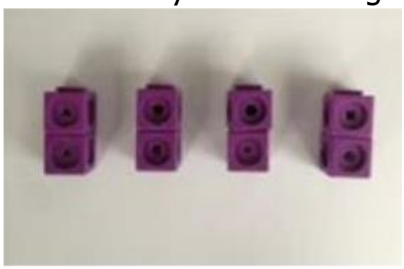
They will think about doubling when solving practical problems.
Using a range of different materials and objects. Move on to pictorial parts and whole when ready.

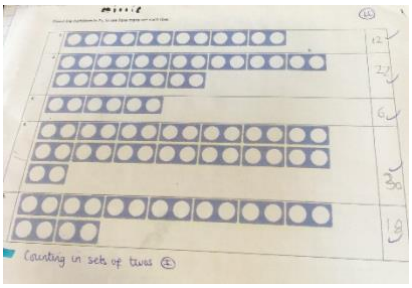
Year 1 Multiplication

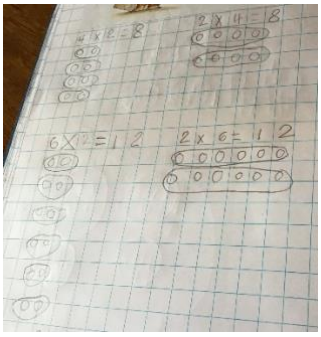
Counting in Multiples of 2, 5 and 10 from zero.
Children should count the number of groups on their fingers as they are skip counting.

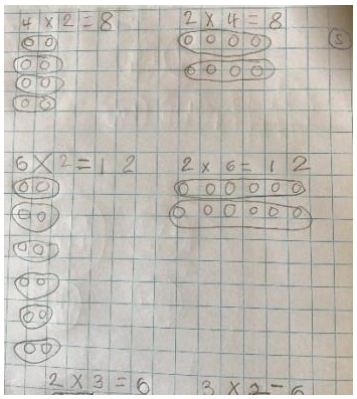
Making equal groups and counting the total

Concrete
Count the concrete groups as children are skip counting, children may use their fingers as they are skip counting.



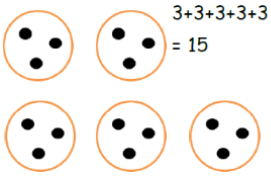
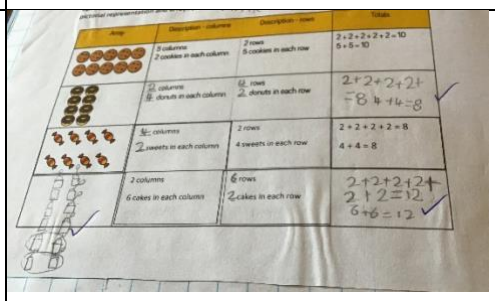
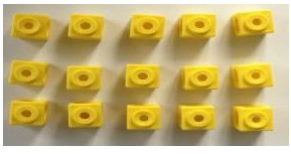


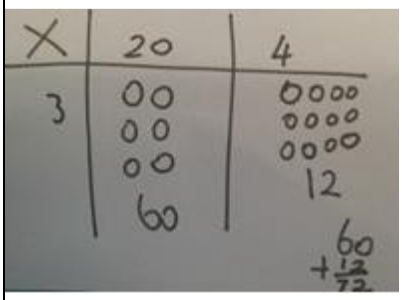


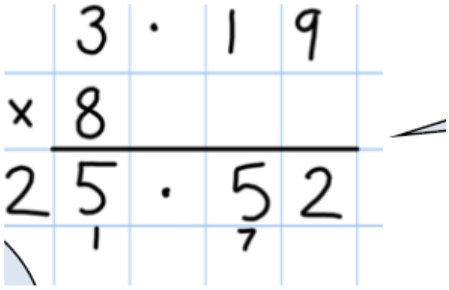


Pictorial
Children make representations of the groups, to show counting in multiples.

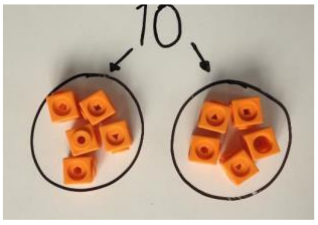
Abstract
Count in multiples of a number aloud.
Write sequences with multiples of numbers.
2, 4, 6, 8, 10
5, 10, 15, 20, 25 , 30

Repeated addition	 **Concrete** Use different objects to add equal groups.  **Pictorial** Use pictorial as well as number lines to solve problems. Make equal jumps on the number line. **Abstract** Write addition sentences to describe objects and pictures. 5 + 5 + 5 + 5=20
Understanding arrays	 **Concrete and pictorial** Use different objects (or pictures of objects) set out in arrays to find answers to problems such as 2 groups of 3. **Abstract** Move to writing as multiplication 2 groups of 4 can be written as 2 x 4. 2x4 = 8
Year 2 Multiplication	
Counting in multiples of 2, 3, 4, 5, 10 from 0 (repeated addition)	Use **concrete and pictorial** ways to represent groups of objects (see year 1) Count in multiples of a number aloud. **Abstract** Write sequences with multiples of numbers. 0, 2, 4, 6, 8, 10 0, 3, 6, 9, 12, 15 0, 5, 10, 15, 20, 25 , 30 3 x 6 ☐ =
Multiplication is commutative	**Concrete** Children should create their own arrays using different objects e.g cubes, counters and numicon.  **Abstract** Children need to understand that arrays can represent different multiplication

Using the Inverse *This should be taught alongside division, so pupils learn how they work alongside each other.*	sums but that they are commutative and it doesn't effect the answer. 3 x 5 = 15 and 5 x 3 = 15 Time should be spent using the arrays to explore different calculations: 3 x 4=12 4 x 3 = 12 3 + 3 + 3 + 3=12 4 + 4 + 4 = 12 Using the inverse explore the other related calculations 2 x 4 = 8 4 x 2 = 8 8 ÷ 2 = 4 8 ÷ 4 = 2
Year 3 Multiplication	
Children should be able to recall the 2, 5, 10, 3, 4 and 8 multiplication tables. Multiply a 2 digit number by a 1 digit number.	**Concrete** Start with place value counters and dienes apparatus to show multiplying tens and ones .  **Pictorial** Children can then represent what they have just done by drawing circles to represent the place value counters. **Abstract** 24 x 3 = 20 x 3 + 4 x 3 24 x 3=60 + 12 24 x 3 = 72 May Move forward if they are ready to a compact method
Year 4 Multiplication	
Children know all times tables up to 12 x 12. Column multiplication for a 3 or 4 digit number by a single digit.	 Children may start with a **concrete** and **Pictorial** recap from year 3 with place value counters to represent the multiplication (473 x 2) as a grid. The ones, tens and hundreds are then added.

	314 x 3 12 (3 x 4) 30 (3 x 10) + 900 (3 x 300) 942 An expanded column method is used first before moving to compact column multiplication. 237 x 4 948 1 2
Year 5 -6 Multiplication	
Column multiplication 2 digit by up to 4 digits.	Manipulatives may still be used by some children with the corresponding long multiplication modelled alongside. **multiplication of 2-digit numbers by a 2-digit number.** Estimate first: 70 x 40=2800 **72** **x 38** **576** **2160** **2736**
Multiplying decimals up to 2 decimal places by a single digit.	Remind children that the single digit belongs in the units column. Line up the decimal points in the question and the answer. 

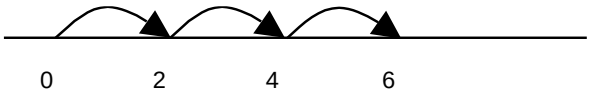
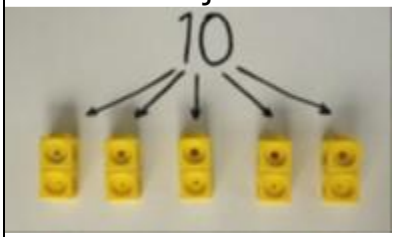
<table>
<tr><th colspan="2">Foundation Stage - Division</th></tr>
<tr><td>Sharing practical objects.

Hearing and being exposed to language to describe half and seeing visual representations.</td><td>Concrete
 

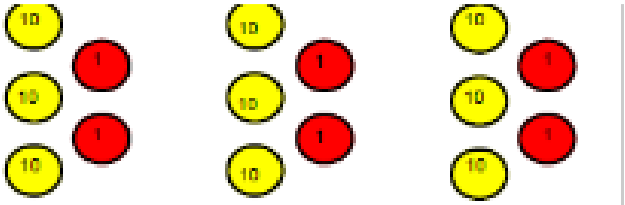
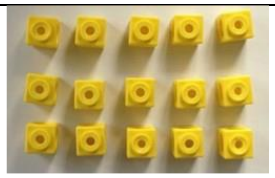
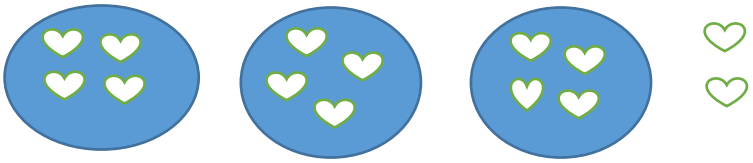
I have 10 cubes, can I share them equally into 2 groups.
Exploring using various objects which numbers can share into 2 groups and which can't.</td></tr>
<tr><th colspan="2">Year 1 - Division</th></tr>
<tr><td>Division as sharing and grouping</td><td>Using Concrete and pictorial to share and group to solve problems.
Sharing – 6 sweets are shared between 2 people. How many do they have each?

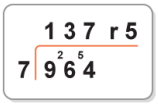
6 ÷ 2 can be modelled as:

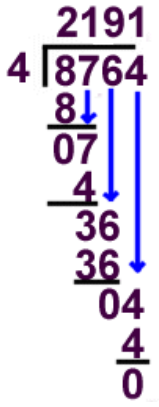
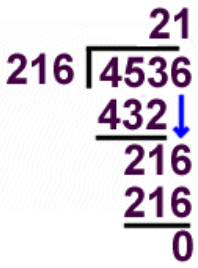
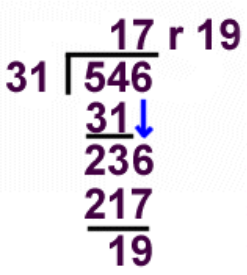
Grouping – There are 6 sweets. How many people can have 2 each? (How many 2's make 6?)

 
</td></tr>
<tr><th colspan="2">Year 2 Division</th></tr>
<tr><td>Division with sharing and grouping</td><td>As with year 1. Lots of experience of sharing and grouping with concrete objects
 

(use cubes, counters, objects or place value counters to aid understanding)
Use pictorial images and number lines to show groupings.</td></tr>
</table>

	Abstract Leading to written number sentences. 28 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?
Year 3 Division	
Division as grouping	**Concrete and pictorial** Use cubes, counters, numicon, objects or place value counters to aid understanding.  24 divided into groups of 6 = 4 How many groups of 6 in 24? 24 ÷ 6 = 4  Use Place value counters to group. 96 ÷ 3 =32
Division as arrays	 Use cubes, objects to make arrays. Make number sentences about the array, linking division to multiplication. Find inverse and 8 linking calculations. 3 x 5 = 15 15÷5= 5 15 = 3x 5 15= 3÷5 5 x 3= 15 15 ÷5 = 3 15= 5 x 3 15 = 5÷3
Division with remainders	14 ÷ 3 = Divide **concrete** objects between groups and see how much is left over  4 in each group and 2 left over. **Pictorial** Draw dots and group them to divide an amount and clearly show a remainder. 

	Abstract Complete written divisions and show the remainder using r. 28÷ 3=9 remainder 1 = 9 r 1
Year 4-6 Division	
Short division, divide at least 3 digit by a single digit	Place value counters and drawing of dots (see year 3) can still be used to help dividing if needed. **Abstract** Begin with divisions that divide equally with no remainder. 15 5 | 75 Move onto divisions with a remainder  1 3 7 r 5 7 | 9 ^{2}6 ^{5}4 . Finally move into decimal places to divide the total accurately. By Year 6 remainders should be written as a fraction of a quotient or decimal. 72 ÷ 5 =14 r2 written as 14 2/5 Or extended to: 14. 4 5 | 72. 0

Long Division, divide by a two digit number (Year 6)	**Long Division** Long Division is easiest thought of in 4 stages: **DIVIDE** **MULTIPLY** **SUBTRACT** **BRING DOWN**    Remainders can be expressed as Fractions or decimals by continuing the long division sum.