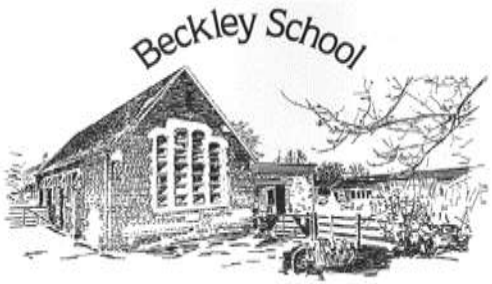
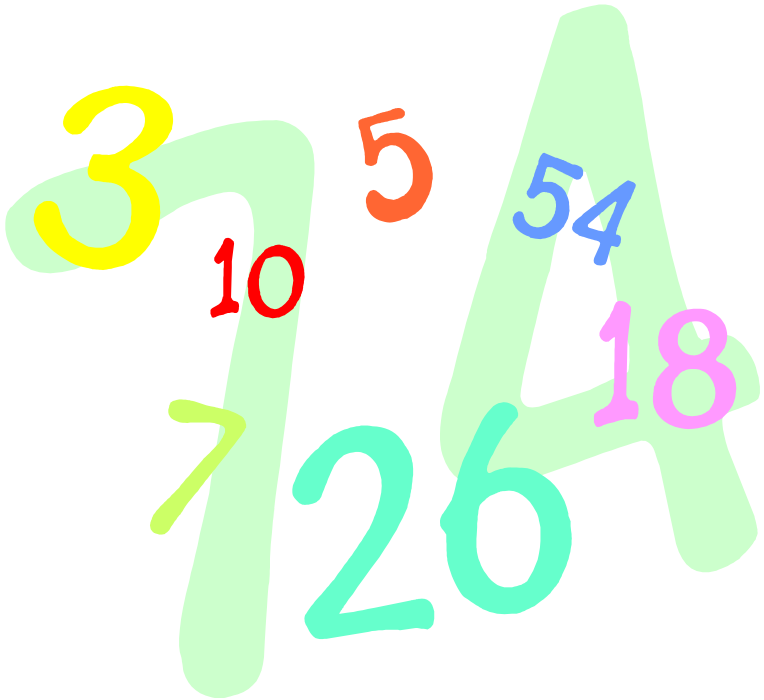


Calculation Policy

May 2017

Source	OCC
Ratified by Governors (signature / date)	
Signed - Headteacher	
Next Review Date	May 2020

Calculation Policy



Introduction:

Children are introduced to the processes of calculation through practical, oral and mental activities. As they begin to understand the underlying ideas, they develop ways of recording to support their thinking and calculation methods, so that they develop both **conceptual understanding** and **fluency** in the fundamentals of mathematics. Whilst interpreting signs and symbols involved with calculation, orally in the first instance, children use models and images to support their mental and written methods of calculation. As children's mental methods are strengthened and refined they begin to work more efficiently, which will support them with using succinct written calculation strategies as they are developed.

The ability to calculate mentally forms the basis of all methods of calculation and has to be maintained and refined. A good knowledge of numbers or a 'feel' for numbers is the product of structured practice through progression in relevant practical maths experiences and visual representations.

By the end of Year 6, children will be equipped with efficient mental and written calculation methods, which they use with fluency. Decisions about when to progress should always be based on the security of pupils' understanding and their readiness to progress to the next stage. At whatever stage in their learning, and whatever method is being used, children's strategies must still be underpinned by a secure understanding and knowledge of number facts that can be recalled fluently.

The overall aims are that when children leave primary school they:

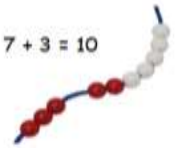
- Are able to recall number facts with fluency, having developed conceptual understanding through being able to visualise key ideas – such as those related to place value - through experience with practical equipment and visual representations;
- Make use of diagrams and informal notes to help record steps and part answers when using mental methods that generate more information than can be kept in their heads;
- Have an efficient, reliable, written method of calculation for each number operation that they can apply with confidence when undertaking calculations that they cannot carry out mentally;
- Are able to make connections between all four number operations, understanding how they relate to one another, as well as how the rules and laws of arithmetic can be applied.

Addition:

Mental Calculation Strategies for Addition and Subtraction

Number Bonds

7 + 3 = 10

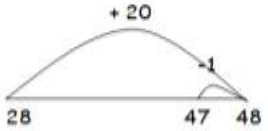


Doubles

Near Doubles

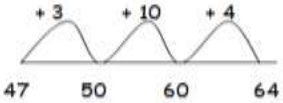
Adjusting

28 + 19 = 47



Bridging

47 + 17 = 64



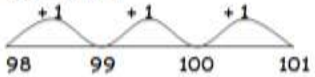
Partitioning

44 + 34 = 78

70 + 8 = 78

Finding the Difference

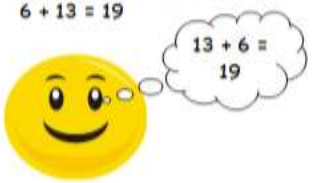
101 - 98 = 3

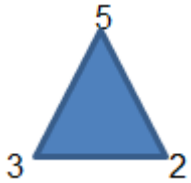
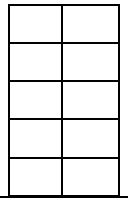
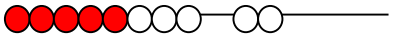
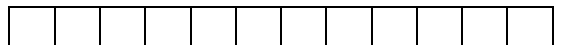


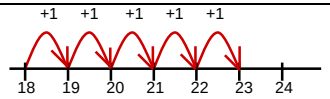
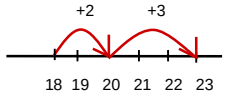
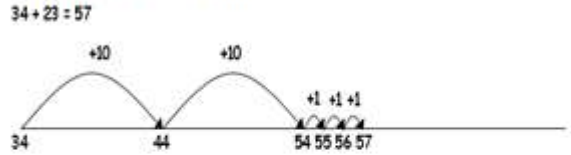
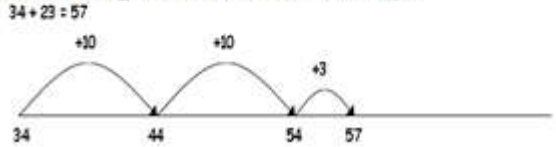
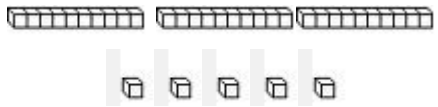
Reordering

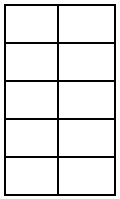
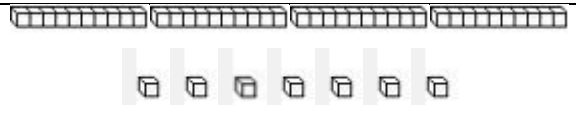
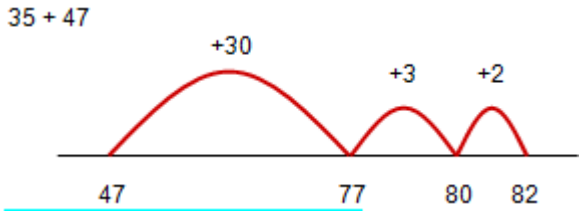
e.g. put big number in head when counting on

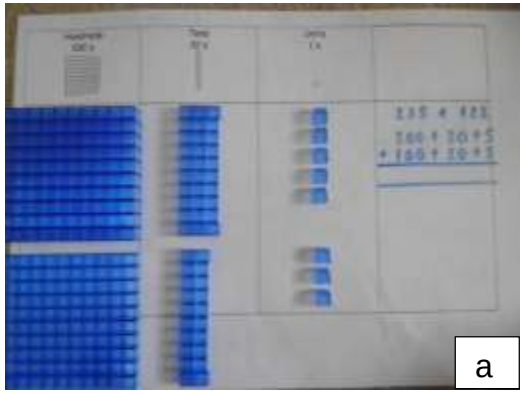
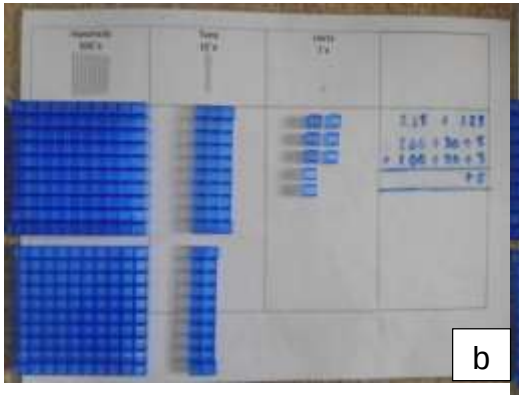
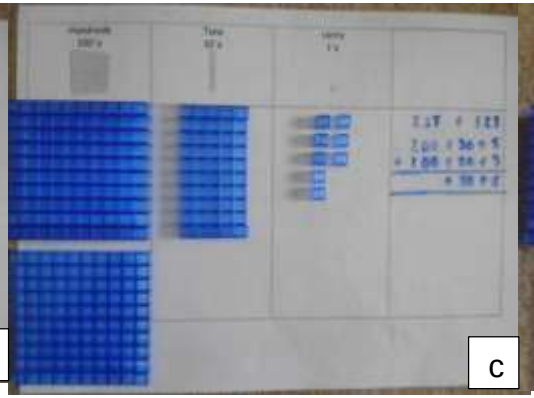
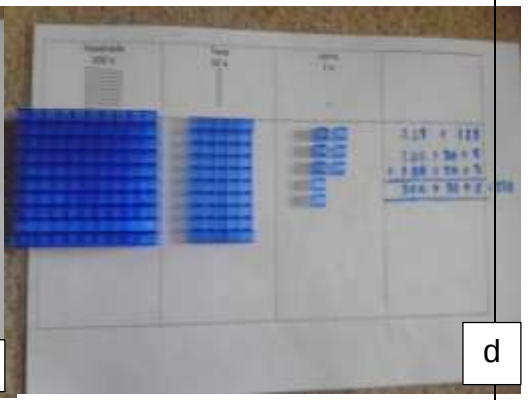
6 + 13 = 19

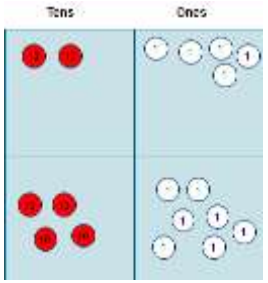


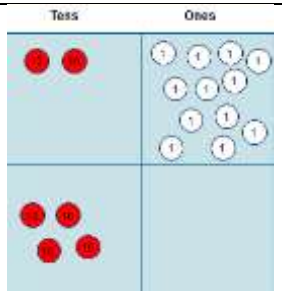
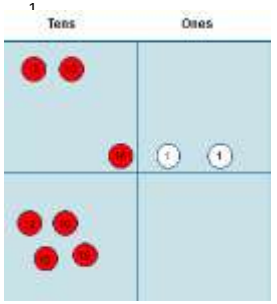
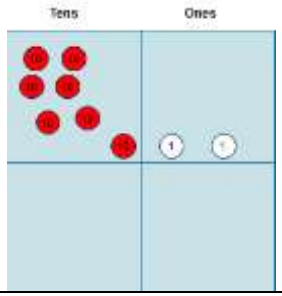
	Counting	**Mental maths strategies**	**Rapid recall**	**Written calculation and appropriate models and images to support conceptual understanding**	
Stage 1:	Count in ones to and across 100 forwards and backwards starting from 0, 1 and other numbers. Count in multiples of two, five and ten.	Pupils use apparatus to explore addition as the inverse of subtraction. .  4 add 1 is 5 5 subtract 4 leaves 1	Rapid recall of all pairs of numbers totalling numbers up to 10. Recall addition facts for all numbers to 20. Use structured apparatus – i.e. Numicon, tens frames, abaci, etc. 	**Combining two groups:** • Children develop a mental picture of the number system for use with calculation. A range of key models and images support this, alongside practical equipment. • Teachers model use of number tracks to count on or line up counters/objects along the number track. This is a precursor to use of a fully numbered number-line.	 3 + 2 = 5  ‘eight add two more makes ten’ ‘one more than four is five’
Stage 2:	Continue practicing above skills. Count in steps of 2, 3 and 5, 10	Reorder numbers when adding, i.e. start with largest	Embed addition facts for all numbers to 20.	**Counting on from any number:** • Children embed use numbered lines to support their own calculations, initially counting in ones before beginning to work more efficiently.	Number line with all numbers labelled  18 + 5

	forwards and backwards to and from any number. Count in tens from any number – link to coins in a piggy bank as well as a number square.	number, find bonds, etc. Add doubles and derive near doubles. Round numbers to the nearest 10. Compare numbers to 100 and order. Use greater than and less than signs to order. < = >	Number bonds to 100. Double and half numbers below 100.	**Counting on from the largest number:** • Children reorder calculations to start with the largest number.	 …to…  Use of questions such as: 'How might I rearrange these to find the total?' Counting on in tens and ones to solve an addition calculation:  Counting on more efficiently: 
Stage 3:	Continue practicing above skills. Count from 0 in multiples of 4, 8, 50 and	Partitioning by bridging through 10 and multiples of 10 when adding.	Connect pairs totalling ten to pairs of multiples of	**Expanded horizontal addition:** • Add numbers using structured apparatus to support understanding of place value. • Make connections between partitioning both numbers using	Add…  …and…

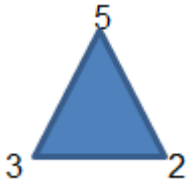
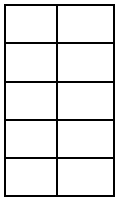
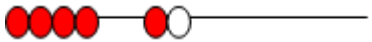
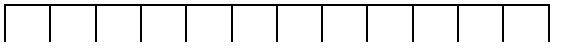
	100. Count on by 10 or 100 from any two digit number. Link to counting stick: counting forwards and backwards flexibly. Count up and down in tenths – linking to visual image.	Adjusting when adding 11 or 9 to a number. Relating inverse number operations – using structured apparatus to explore and understand that subtraction undoes addition. Round numbers to the nearest 10.	10 totalling 100.  Use 10ps in tens frame. Recall pairs of two-digit numbers with a total of 100, i.e. 32 + ? = 100.	structured apparatus and partition the second number only using a number line.	 By partitioning and recombining 30+ 40 = 70 5 + 7 = 12 70 + 12 = 82 
Stage 4:	Continue practicing previous skills. Count forwards and backwards from 0 in multiples of 6, 7, 9, 25 and 1000 using counting sticks, number lines,	Bridging through 60 for time, i.e. 70 minutes = 1 hour and 10 minutes. Rounding any number to the nearest 10, 100 or 1000. Rounding numbers with one decimal place to	As above. Use known facts and place value to derive new ones, i.e. 'If I know 8 + 3 = 11, I also know 0.8 + 0.3 = 1.1 and 8/100 + 3/100 = 11/100.'	**Expanded horizontal method, leading to columnar addition:** • Written recording should follow teacher modelling around the size of numbers and place value using a variety of concrete materials, e.g. straws, Numicon, Dienes and place-value cards. • Teachers model how numbers can be partitioned into tens and ones, as well as in different ways, e.g. 20 + 5 10 + 15	It is crucial that empty number lines are kept as well as using more formal written calculation methods.

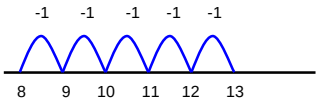
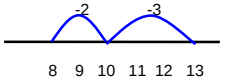
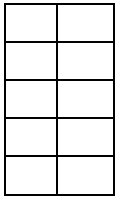
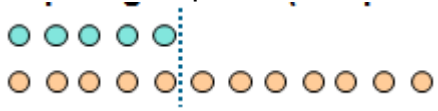
	number squares, etc. Count up and down in tenths, hundredths and simple fractions using models and images, i.e. Dienes equipment, counting stick, ITPs.	nearest whole number. Explore inverse as a way to derive new facts and to check accuracy of answers.	Sums and differences of pairs of multiples of 10, 100 or 1000. Addition doubles of numbers to 100. Pairs of fractions totalling 1.	• As children move towards using a columnar method, links continue to be made with earlier models and images, including the number line.	
Illustration of how to use Dienes equipment to ensure children have an understanding of place value when using columnar addition.  a  b  c  d					
Stage 5:	Count forwards and backwards in steps of powers of 10 for any given number up to one million.	Use apparatus and knowledge of place value to add decimals, i.e. 3.8 + 2.5 = 5 + 1.3 Reorder increasingly	Continue to practice previous stage and make links between known facts and addition pairs for	**Expanded vertical method, leading to columnar addition:** • Teachers model a column method that records and explains partial mental methods. • There remains an emphasis on the language of calculation, e.g. 'Forty plus seventy equals one-hundred and ten.'… 'Seven add	Informal columnar: Adding the tens first: 47 + 76 110 13 123 Adding the ones first:

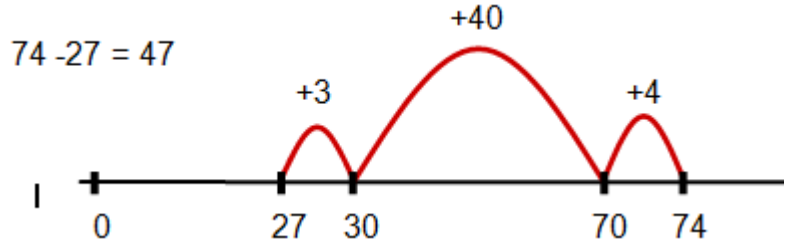
	Continue to count forwards and backwards in simple fractions. Count forward and backwards in appropriate decimals and percentages.	complex calculations, i.e. 1.7 + 2.8 + 0.3 = 1.7 + 0.3 + 2.8 Compensating – i.e. 405 + 399 → add 400 and then subtract 1.	fractions, percentages and decimals Doubles and halves of decimals, i.e. half of 5.6, double 3.4. Sums and differences of decimals, i.e. 6.5 + 2.7	six equals thirteen.' …before recombining numbers. Teachers also model the language of: 'Four tens add seven tens total eleven tens or 110.' • Teachers similarly advance to model the addition of two 3-digit numbers with the expectation that as children's knowledge of place value is secured, they become ready to approach a formal compact method.	47 + 76 13 110 123
Stage 6:	Continue to practice previous skills. Count forwards and backwards in simple fractions, decimals and percentages.	Bridging through decimals, i.e. 0.8 + 0.35 = 0.8 + 0.2 + 0.15 using empty number lines. Partitioning using near doubles, i.e. 2.5 + 2.6 = 5 + 0.1 Reorder decimals, i.e. 4.7 + 5.6 – 0.7 …as… 4.7 – 0.7 + 5.6 = 4 + 5.6.	Ensure all children are confident recalling basic facts to 20 and deriving facts using place value. Make links between decimals, fractions and percentages.	**Columnar addition (formal written method):** • The concept of exchange is introduced through continued use of practical equipment (manipulatives). • Teachers model: 1. "I have two tens and five ones, which need adding to four tens and seven ones." 2. "I add five ones to seven ones, which gives me twelve ones." 3. "I exchange ten of my twelve ones for a ten counter." 4. "I add my three tens and four tens to make seven tens." "Altogether, I have seven tens and two ones."	**Pupils to be encouraged to consider mental strategies first.** Formal columnar: 25 +47  25 +47 2 1 12

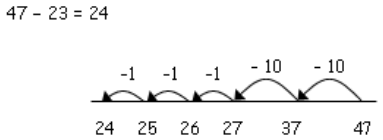
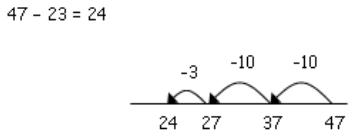
				• Teachers similarly advance to model the addition of two 3-digit numbers, e.g. 587 475 1 1 1062	 25 +47 2 1  25 +47 72 1 

Subtraction:

	Counting	Mental strategies	Rapid Recall	Written calculation and appropriate models and images to support conceptual understanding	
Stage 1:	Count in ones to and across 100, forwards and backwards starting from 0, 1 and other numbers. Count in multiples of two, five and ten.	Pupils use apparatus to explore addition as the inverse of subtraction: .  'four add one is five.' 'five subtract four leaves one'	Rapid recall of subtraction facts for numbers up to 10. Use structured apparatus, i.e. Numicon, tens frames, abaci etc. 	**Subtraction as taking away from a group:** • Children develop a mental picture of the number system for use with calculation. A range of key models and images support this, alongside practical equipment. • Teachers model use of number tracks to count back or remove counters/objects from the number track or set. This is a precursor to use of a fully numbered number-line.	 5 - 2 = 3  'six take away two leaves four' 'one less than six is five'
Stage 2:	Continue practicing above skills.	Bridging through two digit numbers, i.e. 24 – 19 = 19 +	Recall subtraction (and addition)	**Subtracting by counting back and on:**	Number line with all numbers labelled 

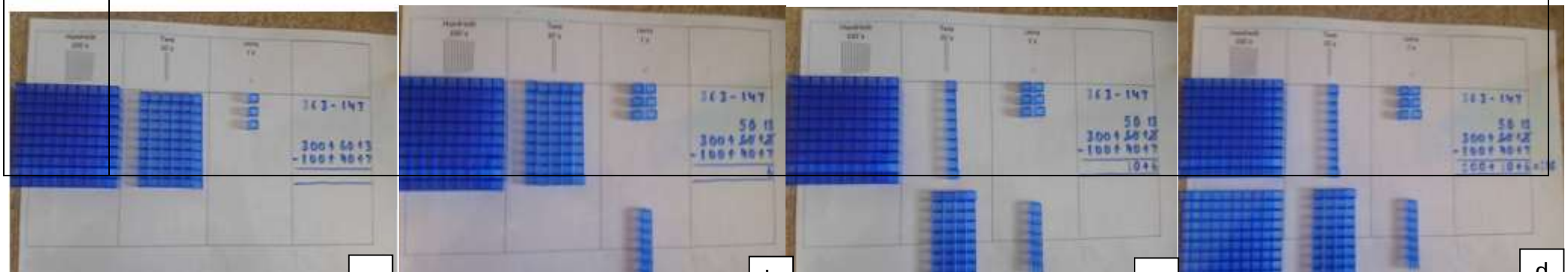
	Count in steps of 2, 3 and 5, forwards and backwards to and from zero. Count in tens from any number – link to counting teddies as well as a number square.	1 + 4 using number lines. Subtracting 11 by subtracting 10 and then 1 more. Move to subtracting 9 by subtracting 10 and adding 1 using apparatus.	facts for all numbers to 20.	• Children begin to use numbered lines to support their own calculations, initially counting back in ones before beginning to work more efficiently.	13 – 5 = 8  13 – 5 = 8 
Stage 3:	Continue practicing above skills. Count from 0 in multiples of 4, 8, 50 and 100. Count on and back by 10 or 100 from any two digit number. Link to counting stick counting forwards and backwards flexibly.	Partitioning by bridging through 10 and multiples of 10 when subtracting. Continue to practice adjusting when subtracting 11 or 9 from a number. Relating inverse number operations – use structured apparatus to explore and understand that subtraction undoes addition.	Connect subtractions from ten to subtractions from multiples of 10 totalling 100.  Use 10ps in tens frame. Subtract two digit numbers	**Finding the difference:** • Teachers model how to find the difference when two numbers are relatively 'close together.' • Initially children compare two sets before moving on to a number line comparison. • **Pupils are taught to choose whether to count on or**	Comparing two sets: comparison or difference.  Finding the difference on a number line ***Counting on to subtract:*** **Note: Finding the difference is often the most efficient way of solving a subtraction problem,** e.g. 61 – 59 2,003 – 1,997

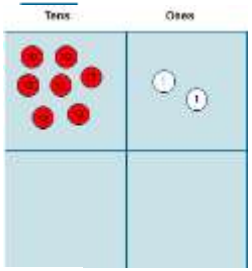
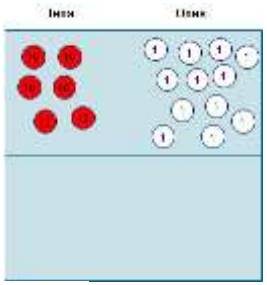
	Count up and down in tenths – linking to visual image.		from 100 i.e. ? = 100 - 78	**back** depending on which is more efficient.	
Stage 4:	Continue practicing of previous skills. Count forwards and backwards from 0 in multiples of 6, 7, 9, 25 and 1000 using counting sticks, number lines, number squares, etc. Count up and down in tenths, hundredths and simple fractions using models and images, i.e. Dienes equipment, counting stick, ITPs.	Bridging through 60 for time, i.e. 70 minutes = 1 hour and 10 minutes Rounding any number to the nearest 10, 100 or 1000. Rounding numbers with one decimal place to nearest whole number. Explore inverse as a way to derive new facts and to check accuracy of answers.	As above. Use known facts and place value to derive new ones, i.e. 'If I know 11 - 3 = 8, I also know 1.1 - 0.3 = 0.8 and 8/100 - 3/100 = 5/100.' Sums and differences of pairs of multiples of 10, 100 or 1000. Subtraction of fractions totalling 1, i.e. 1 – 0.3 = 0.7	**Subtracting HTU –HTU and ThHTU – ThHTU:**	Use empty number lines to find the difference by bridging through multiples of ten.  Subtract by starting with the first number and partitioning the second, i.e. 74 - 27 74 – 20 = 54 54 – 4 = 50 50 – 3 = 47

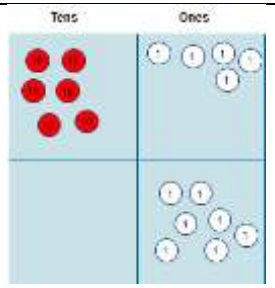
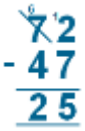
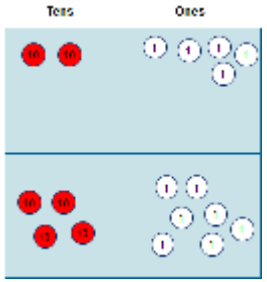
Stage 5:	Count forwards and backwards in steps of powers of 10 for any given number up to one million. Continue to count forwards and backwards in simple fractions. Count forward and backwards in appropriate decimals and percentages.	Use apparatus and knowledge of place value to subtract decimals, i.e. 3.8 - 2.5 = 1.3 Reorder increasingly complex calculations, i.e. 1.7 – 5 – 0.7 = 1.7 – 0.7 – 5. Compensating – i.e. 405 - 399 → subtract 400 and then add 1.	Continue to practice previous stage and make links between known facts and addition pairs for fractions, percentages and decimals. Doubles and halves of decimals, i.e. half of 5.6, double 3.4. Sums and differences of decimals, i.e. 6.5 + 2.7	**First stage of column method, including expanded method:** • Written recording should follow teacher modelling around the size of numbers and place value using a variety of concrete materials, e.g. straws, Numicon, Dienes and place-value cards.	Children should continue to use empty number lines and use more formal written methods when numbers become too big or complex. Counting back in tens and ones to solve an addition calculation:  Counting back more efficiently: 

363 – 147 = 216
50 13
300 + 60 + 3
100 + 40 + 7
200 + 10 + 6 = 216

Illustration of how to use Dienes equipment to ensure children understand transference of numbers when using columnar subtraction.



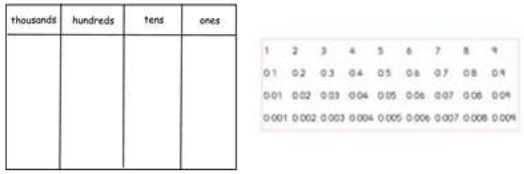
Stage 6:	Continue to practice previous skills. Count forwards and backwards in simple fractions, decimals and percentages.	Bridging through decimals, i.e. 1.5 – 0.8 = 1.5 – 0.5 then -0.3 using empty number line.	Ensure all children are confident recalling basic facts to 20 and deriving using place value. Make links between decimals, fractions and percentages.	**Second stage of column method:** • The concept of exchange is introduced through continued use of practical equipment (manipulatives). • Teachers model: 1. "I have seven tens and two ones. I need to subtract four tens and seven ones." 2. "At the moment, I cannot subtract seven ones from two ones, so I need to transfer one ten to	Formal columnar: 7 2 - 4 7  6 12 7 2 - 4 7  6 12 7 2 - 4 7 2 5

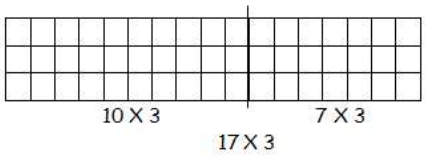
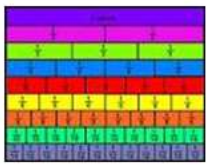
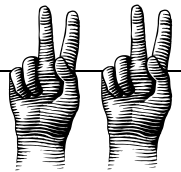
				become ten ones." 3. "Now I can take away seven ones from twelve ones, so that I have fives ones left. 4. "I can now subtract four tens from six tens, which leaves me with two tens." 5. "I recombine two tens and fives ones to understand that I am left with twenty-five." • Teachers similarly advance to model the subtraction of one 3-digit number from another, e.g. 5 1 5~~6~~3 246 317	  

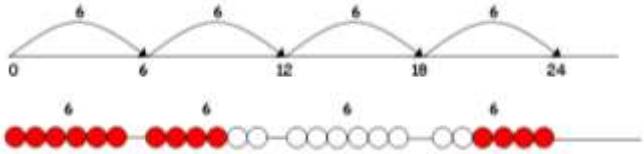
Multiplication:

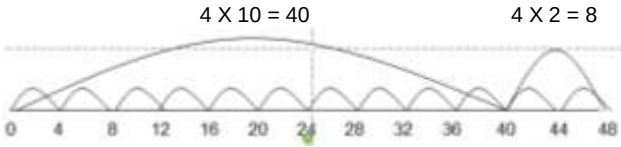
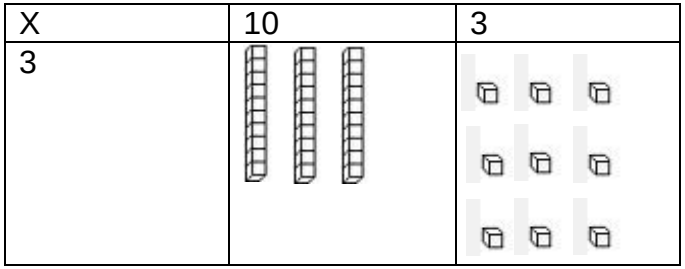
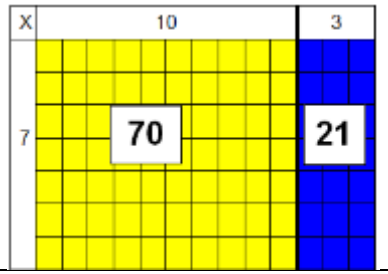
<table>
<tr><td></td><td colspan="5"><u>Mental Calculation Strategies for Multiplication and Division</u>

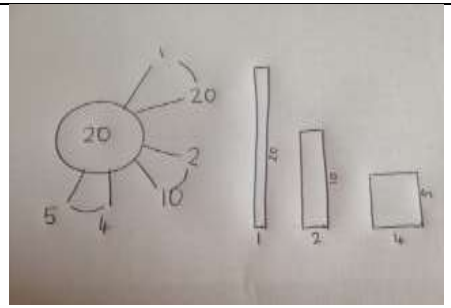
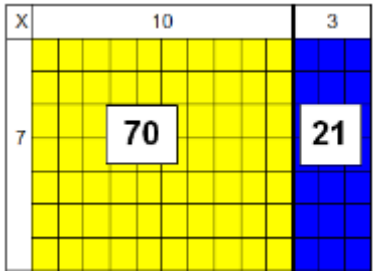
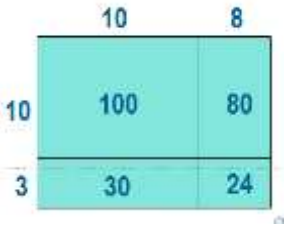
Knowing multiplication and division facts to 12 X 12

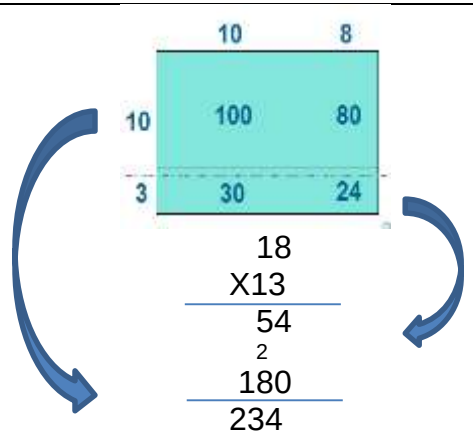
Multiplying and dividing by multiples of 10
 
Doubling and halving

Multiplying and dividing by single-digit numbers and multiplying by two-digit numbers
 
10 X 3 7 X 3
17 X 3
Finding fractions, decimals and percentages
 
 </td></tr>
<tr><td></td><td>Counting</td><td>Mental strategies</td><td>Rapid recall</td><td colspan="2">Written calculation and appropriate models and images to support conceptual understanding</td></tr>
<tr><td>Stage 1:</td><td>Count forwards and backwards</td><td>Doubling up to six and then ten whilst using related models and images.</td><td>Derive/recall doubles up to five and derive/recall</td><td>Developing early conceptual understanding of multiplication:</td><td>Use objects, pictorial representations and arrays to show the concept of multiplication:
  </td></tr>
</table>

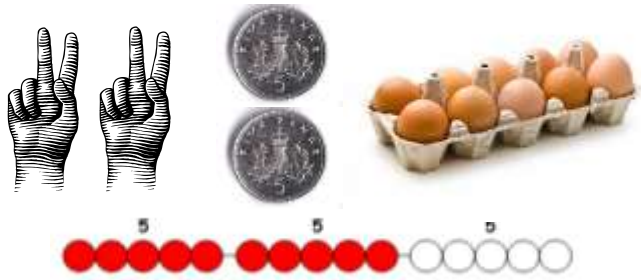
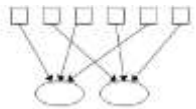
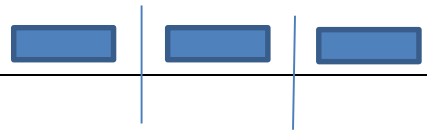
	in 2s, 5s and 10s		halves up to ten. Recall odd and even numbers to 10 in reference to structured apparatus. 		
Stage 2:	Count forwards and backwards in 2s, 3s, 5s and 10s from zero.	Begin to understand and use inverse number operations: Stories are used alongside a triad to help children understand links between number operations, e.g. “There are five pencils in two packs, which means that there are ten pencils altogether.”	Derive/recall doubles up to ten and derive/recall halves up to twenty. Recall odd and even numbers to 20 in reference to structured apparatus. Recall & use multiplication facts for the	**Understanding multiplication as repeated addition:** • Investigate multiplication as repeated addition, so that the law of cummutativity is understood. • Whilst arrays are also modelled explicitly at this stage, it is important to note that	Arrays: 5 X 3 and 3 X 5 Number lines: 6 X 4 = 24  So: ‘Six taken four times”

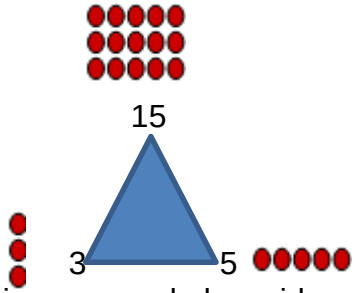
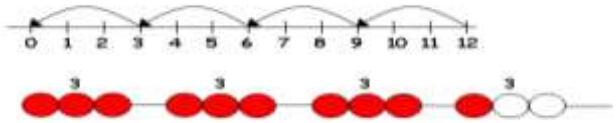
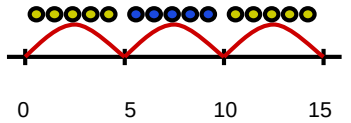
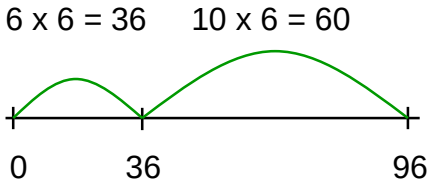
			2X, 5X and 10X-tables.	they will continue to be a key model at later stages, alongside more formal methods of calculation.	
Stage 3:	Counting forwards and backwards in 2s, 3s, 4s, 5s, 8s and 10s from zero. Count up and down in tenths.	Use doubling to make connections between the 2X, 4X and 8X-tables. Understand that multiplication can be undertaken by partitioning numbers, e.g. 12 X 4 = 10 X 4 + 2 X 4 Introduce the structure of scaling: e.g. Find a ribbon that is 4 times as long as the blue ribbon 2cm 8cm	Recall odd and even numbers to 100 in reference to structured apparatus. Recall and use multiplication facts for the 2X, 3X, 4X, 5X, 8X and 10X tables.	**Relate multiplying a 2-digit by 1-digit number using repeated addition and arrays to represent:**	Children use an empty number line to chunk efficiently: 4 X 12 = 48  3 X 13 = 39  7 X 13 = 91 
Stage 4:	Counting forwards	Derive factor pairs of numbers using models and images, e.g.	Recall & use multiplication	**Relate multiplying a 3/2-digit by 1-**	Relate multiplying a 3/2-digit by 1-digit number, now also setting it out as short multiplication.

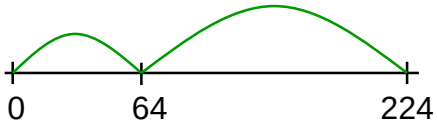
	and backwards in 2s, 3s, 4s, 5s, 7s, 8s, 10s, 25s and 1000s from zero. Count up and down in tenths and hundredths.	 Know what happens when a number is multiplied by zero or one. Use reordering to multiply three numbers.	facts for all times-tables up to 12 X 12.	**digit number with arrays towards using long/short multiplication:**	 7 X 13 = 91 7 X 10 = 70 7 X 3 = 21 = 91 At this stage, the **non-statutory** guidance in the national curriculum suggests teaching short multiplication; however, the team feel that an expanded form of calculation (as set out above) is be a better lead into long/short multiplication.
Stage 5:	Counting forwards and backwards in 2s, 3s, 4s, 5s, 6s, 7s, 8s, 9s, 10s, 25s and 1000s from zero.	Identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers.	Recall & use multiplication facts for all times-tables up to 12 X 12.	**Relate multiplying a 4/3/2-digit by 1/2-digit number with grid to using long multiplication:**	 18 X13 24 30 80 100 234

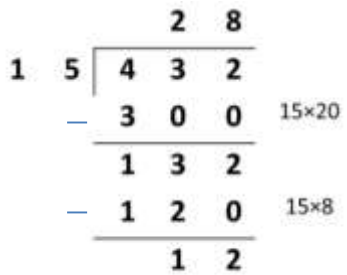
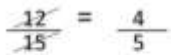
Stage 6:	Consolidate all previous counting, including forwards and backwards in fractions.	Perform mental calculations, including with mixed numbers and operations.	Recall & use multiplication facts for all times-tables up to 12 X 12. In addition, use facts confidently to make larger calculations.	**Relate multiplying a 4/3/2-digit by 1/2-digit number with grid to using short multiplication:**	

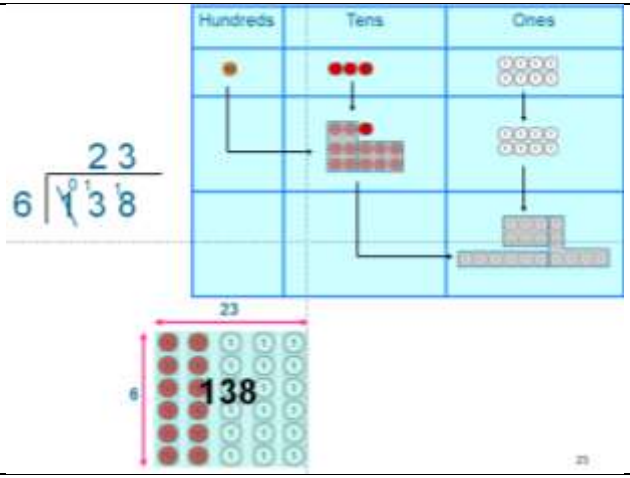
Division:

	Counting	**Mental strategies**	**Rapid recall**	**Written calculation and appropriate models and images to support conceptual understanding**	
Stage 1:	Count forwards and backwards in 2s, 5s and 10s	Doubling up to six and then ten whilst using related models and images.	Derive/recall doubles up to five and derive/recall halves up to ten. Recall odd and even numbers to 10 in reference to structured apparatus. 	**Developing early conceptual understanding of division as grouping and sharing:**	Use objects, pictorial representations and arrays to show the concept of division as grouping and sharing.  "Two children share six pencils between them"  "Six children are asked to get into three equal groups" 

Stage 2:	Count forwards and backwards in 2s, 3s, 5s and 10s from zero.	Begin to understand and use inverse number operations.  Stories are used alongside a triad to help children understand links between number operations, e.g. “15 children are asked to get into three groups and find out that there are five people in each group.”	Derive/recall doubles up to ten and derive/recall halves up to twenty. Recall odd and even numbers to 20 in reference to structured apparatus. Recall and use multiplication facts for the 2X, 5X and 10X-tables.	**Understanding division as repeated subtraction:** • Investigate division as repeated subtraction. • Through teacher modelling, children need to know that division is not commutative.	Number lines and arrays: 12 ÷ 3 = 4  15 ÷ 5 = 3 
Stage 3:	Counting forwards and backwards in 2s, 3s, 4s, 5s, 8s and 10s from zero.	Use doubling to make connections between the 2X, 4X and 8X-tables. Understand that multiplication can be undertaken by partitioning numbers, e.g. 12 X 4 = 10 X 4 + 2 X 4 Introduce the structure of scaling: e.g. Find a ribbon that is 4 times as long as	Recall odd and even numbers to 100 in reference to structured apparatus. Recall & use multiplication facts for the 2X, 3X, 4X,	**Dividing a 2-digit by 1-digit number, representing this efficiently on a number line:**	Children use an empty number line to chunk efficiently. 96 ÷ 6 = 16 

		the blue ribbon. 	5X, 8X and 10X tables.		
Stage 4:	Counting forwards and backwards in 2s, 3s, 4s, 5s, 7s, 8s, 10s, 25s and 1000s from zero.	Derive factor pairs of numbers using models and images. Know what happens when a number is multiplied by zero or one. Use reordering to multiply three numbers.	Recall & use multiplication facts for all times-tables up to 12 X 12.	**Dividing a 3/2-digit by 1-digit number, representing this efficiently on a number line, also in relation to long division:** • At this stage, no remainders are present unless in a practical context.	Children use an empty number line to chunk efficiently. 224 ÷ 8 = 28 8 x 8 = 64 20 x 8 = 160  28 8 | 224 - 160 (8 X 20) 64 - 64 (8 X 8) 0 …or… 28 8 | 224 20 X 8 = 160 64 8 X 8 = 64 0
Stage 5:	Counting forwards and backwards in 2s, 3s, 4s, 5s, 6s, 7s, 8s, 9s, 10s, 25s and 1000s from zero.	Identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers.	Recall & use multiplication facts for all times-tables up to 12 X 12.	**Dividing a 4/3/2-digit by 1-digit number, in relation to long division:** • By this stage, there is a statutory requirement that children can use a formal written calculation method, such as long division.	As schools have autonomy to decide children's progression in learning between long and short division in Years 5 and 6, the maths team suggest beginning with long division. Remainders should be interpreted in the following ways when long division is used: • as whole numbers • as fractions • through rounding in an appropriate way to the context Long division: 415 ÷ 9 = 46 and 1/9 46 and 1/9

				• Short division may begin to be taught alongside long division, but still with use of visual representations	9 415 - 360 (9 X 40) 55 - 54 (9 X 6) 1
Stage 6:	Consolidate all previous counting, including forwards and backwards in fractions.	Perform mental calculations, including with mixed numbers and different number operations.	Recall & use multiplication facts for all times-tables up to 12 X 12. In addition, use facts confidently to make larger calculations.	**Dividing a 4/3/2-digit by 2/1-digit number, in relation to long and then short division:** • By this stage, there is a statutory requirement that children can use formal written calculation methods, including long and short division. • Use of visual representations – like the ones opposite – remain important.	As schools have autonomy to decide children's progression in learning between long and short division in Years 5 and 6, the maths team suggest moving from long division to short division. Remainders should be interpreted in the following way when short division is used: • through rounding in an appropriate way to the context Long division: 432 ÷ 15 = 28 4/5   Answer: $28\frac{4}{5}$ Short division: 138 ÷ 6 = 23

					 Hundreds Tens Ones 23 6 138 23 6 138