Springwell Park

Calculation Policy 2022

Addition

Teaching for Mastery Calculation Policy

The aims of the policy

Mastery is for all children, and the aim of this policy is to ensure children leave Springwell Park with a secure understanding of the four operations and can confidently use both mental and written strategies in a range of contexts. It aims to ensure consistent strategies, model and images are used across our school to embed and deepen children's learning and understanding of mathematical concepts so children can:

- Become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils have conceptual understanding and are able to recall and apply their knowledge rapidly and accurately to problems.
- **Reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language.
- **Solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

How should this policy be used?

This policy is to support the teaching and planning of mathematics. This policy set out the progression of strategies and written methods children will be taught to develop their understanding of the four operations. Strategies set out in a Concrete, Pictorial and Abstract (CPA) approach to develop children's deep understanding and mastery of mathematical concepts. Children can use concrete objects to help them make sense of the concept or problem; this could be anything from real or plastic fruit, to straws, counters or cubes. This is then developed through the use of images, models and children's own pictorial representations before moving on to the abstract mathematics. Children will travel along the continuum again and again, often revisiting previous stages when a concept is extended. It is also worth noting that if a child has moved on from concrete to pictorial, it does not mean that the concrete cannot be used alongside the pictorial. Or if a child is working in the abstract, 'proving' something or 'working out' could involve use of the concrete or pictorial therefore building on prior learning. Then as children become more independent, they will be able to and encouraged to select strategies which are most efficient for the activity.

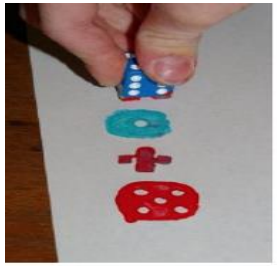
The strategies are separated into the 4 operations for easy reference. However, it is expected that addition and subtraction, and multiplication and division will be taught after each other to ensure that children are making connections and seeing relationships in their mathematics.

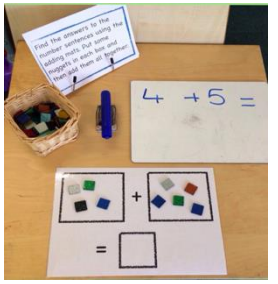
Children should be moved through the strategies at a pace appropriate to their age-related expectations as defined in the EYFS and National Curriculum. Teaching of the strategies rely on good levels of number sense, fluency and ability to reason mathematically. Children need to be supported to gain depth of understanding within the strategy through the CPA approach and not learn strategies as a procedure.

Addition

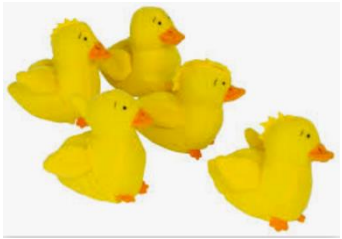
Nursery
Before addition can be introduced, children need to have a secure knowledge of number. Nursery aged children will be introduced to the concept of counting, number order and number recognition through practical activities and games. Using activities of child-initiated games e.g., hide and seek and I spy. Children will also learn how to count 1-1 (pointing to each object as they say the number) and that everything can be counted e.g., jumps, steps and claps. Along with reinforcing this with opportunities in the outdoor area for children to count e.g., twigs, stones.

Reception
Before addition can be introduced, children in Reception will build on skills taught in Nursery working on the 40 – 60 months objectives. Children need to have a secure knowledge of number before working on addition. Then children can be introduced to the concept of addition through practical activities and games. Children can act out addition by physically adding two groups of objects together and use arm actions to represent add, subtract and equal to. This can be reinforced in continuous provision areas for children to use addition e.g., adding together groups e.g., building bricks, leaves etc. Children can build on their previous knowledge of 'more' by learning that adding two groups of objects together gives them a larger number of objects. Adults can model addition vocabulary e.g., addition means to add two groups together, we put two lots of objects together. Equal means we find out how many we have got altogether, three add two equals to (is the same as) five. Adults support children in recording their addition number sentences in an abstract way by recording on whiteboards and maths books.

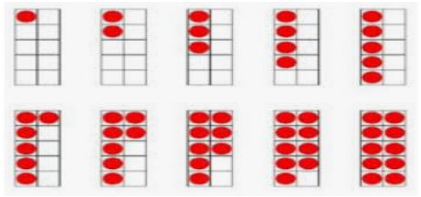




Progression in the teaching of counting

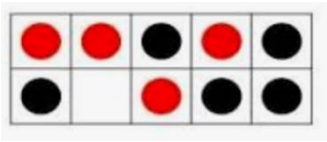
Pre-counting	**Counting**	**One to one correspondence**	**Cardinality (knowing the final number counted is the total number of objects)**
The key focus is an understanding of the concepts more, less and the same and an appreciation of how these are related. Children at this stage develop these concepts by comparison and no counting is involved.	Count by reciting the number names in order forwards and backwards from any starting point.	One number word has to be matched to each and every object. Lack of coordination is a source of potential error – it helps if children move the objects as they count, use large rhythmic movement, or clap as they count.	Count out a number of objects from a larger collection. Know the number they stop counting at will give the total number of objects.
Pre-counting ideas Provide children with opportunities to sort groups of objects explicitly using the language of more and less	**Counting ideas** Provide children with the opportunities to count orally on a daily basis. Rote count so that children are able to understand number order and can hear the rhythm and pattern. Use a drum or clap to keep the beat.	**One to one correspondence ideas** Play counting games together moving along a track, play games involving amounts such as knocking down skittles.	**Cardinality counting ideas** 
  Which group of apples have the most? Which group of apples have the least?		Use nursery rhymes and counting songs throughout the day ensuring children have the visual/kinaesthetic sources e.g., 5 little ducks or 10 green bottles 	How many bananas are in my fruit bowl? Allow children to physically handle the fruit. Provide children with objects to pint to and move as they count and say the numbers.

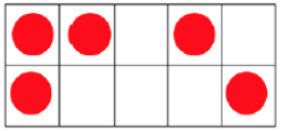
Subitising (recognise small numbers without counting them)
Children need to recognise small amounts without counting them e.g., dot patterns on dice, dots on tens frames, dominoes and playing cards as well as small groups of randomly arranges shapes stuck on cards.

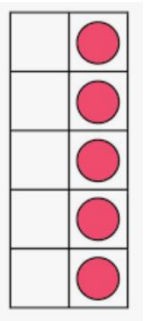


Abstraction (pictorial)
You can count anything – visible objects, hidden objects, imaginary objects, imaginary objects, sounds etc. Children find it harder to count things they cannot move around.
Children find it hard to count a mix of different objects, or similar objects of different sizes.

Conservation of number – Mastery
Children need to realise that when objects are rearranged the number of them stays the same.

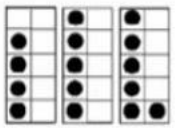


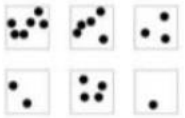


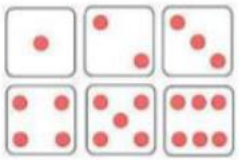


Subitising ideas

Provide children with opportunities to count by recognising amounts.





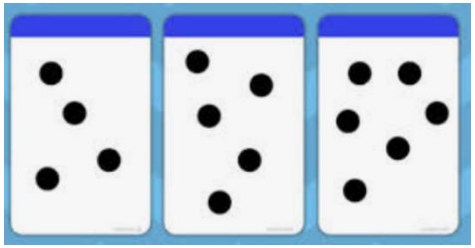


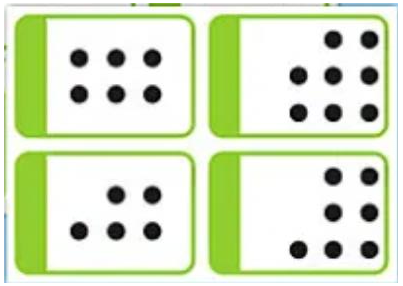
Abstraction ideas

How many seahorses?

Provide children with a variety of objects to count.

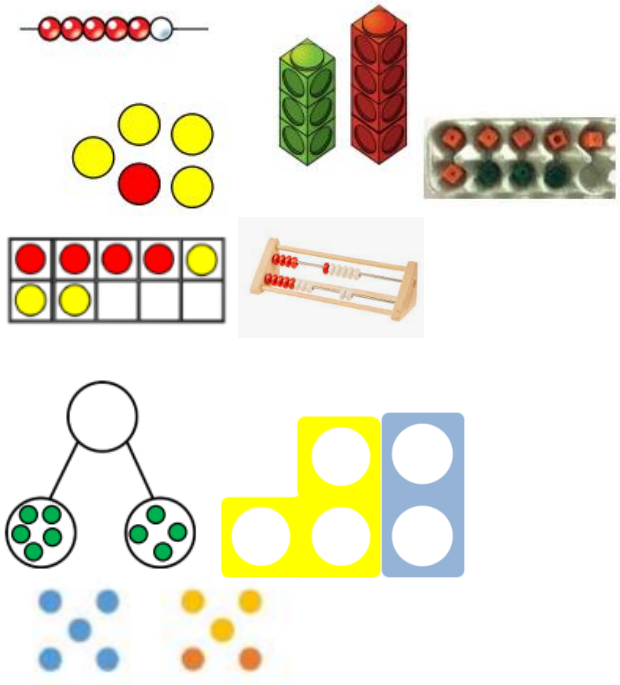
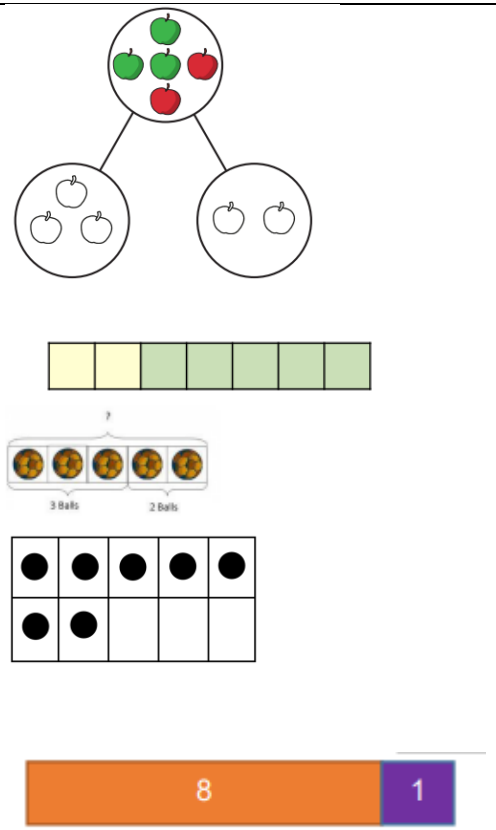
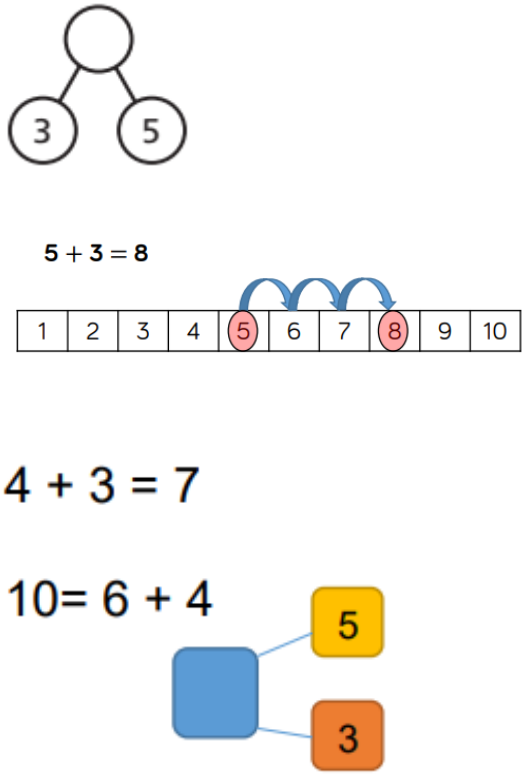
Conservation of number ideas





EYFS

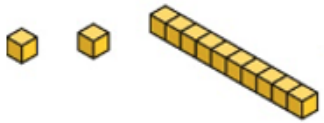
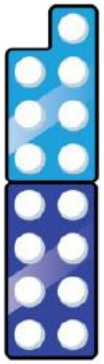
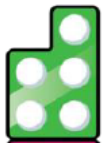
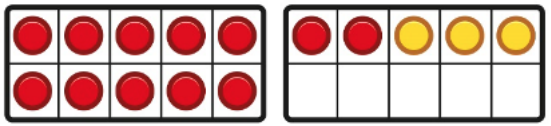
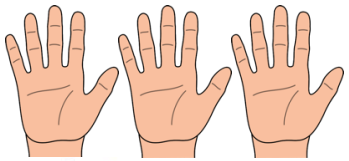
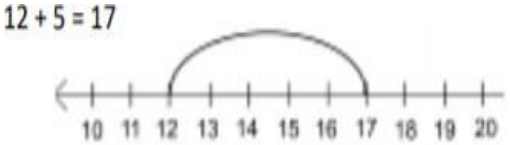
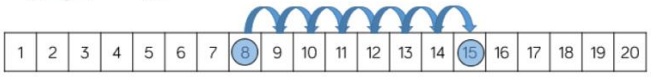
ELG Number Children at the expected level of development will:
Have a deep understanding of number to 10, including the composition of each number, subitise (recognise quantities without counting) up to 5, automatically recall (without reference to rhymes, counting or other aids) number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts
ELG Numerical Patterns Children at the expected level of development will:
Verbally count beyond 20, recognising the pattern of the counting system, compare quantities up to 10 in different contexts, recognising when one quantity is greater than, less than or the same as the other quantity, explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed

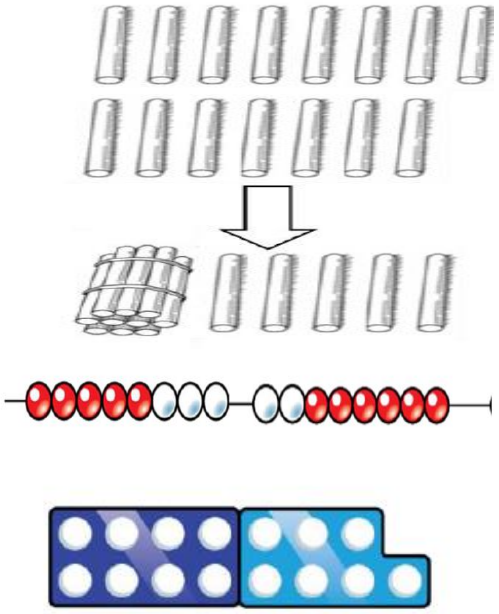
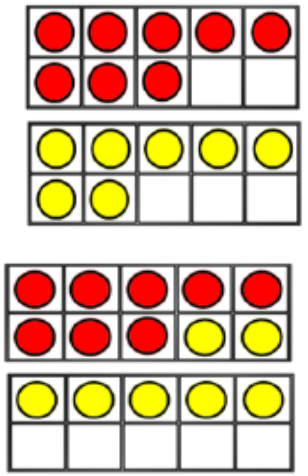
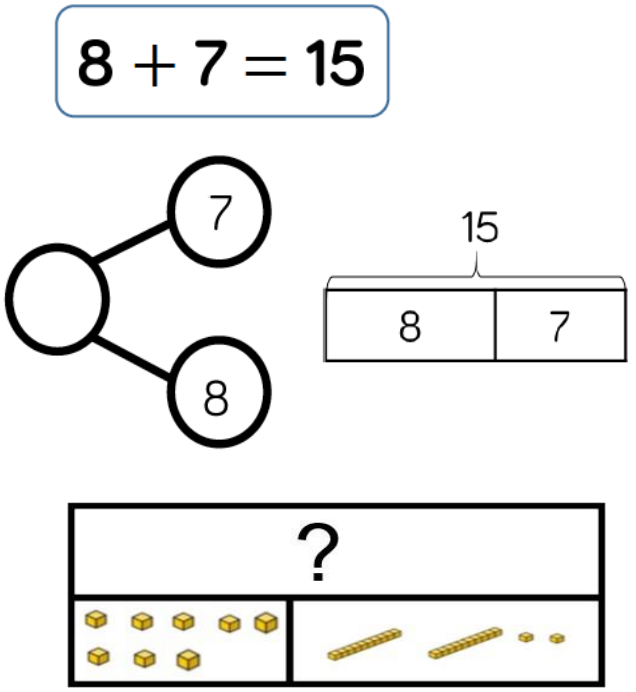
Addition within 10	Concrete	Pictorial	Abstract
When adding numbers to 10, children can explore combining two sets of objects (aggregation) and adding onto a set (augmentation). The part-whole model, discrete and continuous bar model, number shapes and ten frame support aggregation. The combination bar model, ten frame, bead string and number track all support augmentation.			

Year 1

Pupils should be taught to:

- read, write and interpret mathematical statements involving addition (+) and equals (=) signs
- represent and use number bonds within 20
- add one-digit and two-digit numbers to 20, including zero
- solve one-step problems that involve addition, using concrete objects

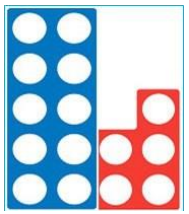
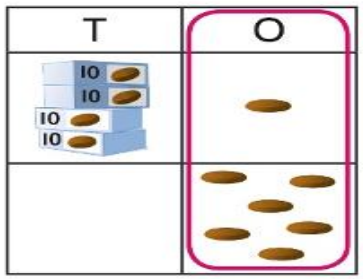
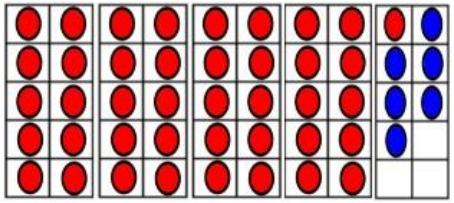
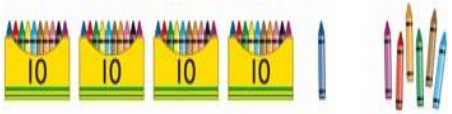
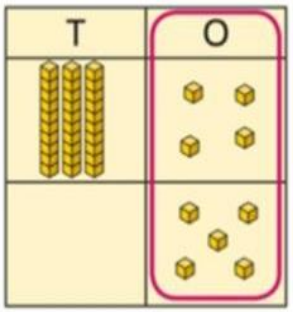
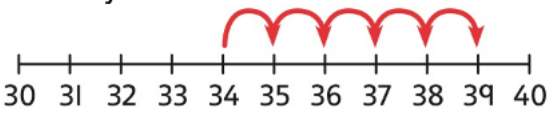
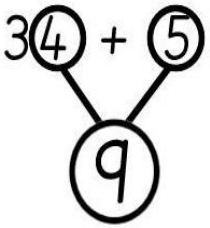
	Concrete	Pictorial	Abstract
Represent and use number bonds within 20 When adding one - digit numbers that cross 10, it is important to highlight the importance of ten ones equalling one ten. In Year 1, this is only done just by counting on. Add one-digit and two-digit numbers to 20	     	 *2 + 3 = 5* *12 + 3 = 15*    	 **12 + 3 = 15** **3 + 12 = 15** **15 = 12 + 3** **15 = 3 + 12** **16 + ? = 19** **? + 5 = 15** 8 + 7 = 15 

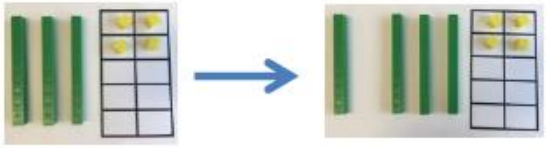
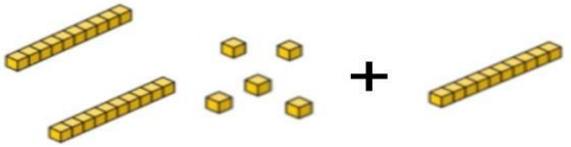
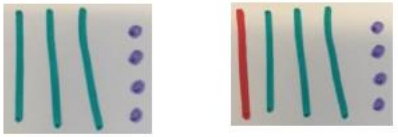
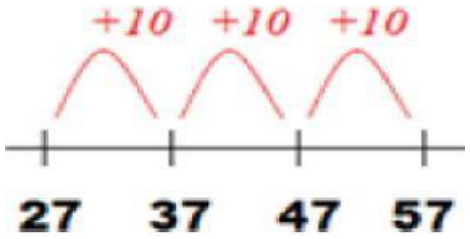
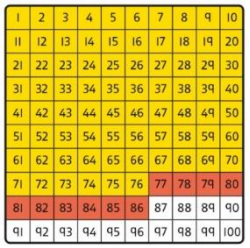
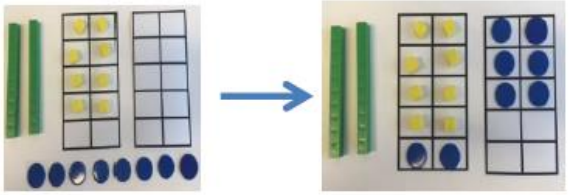
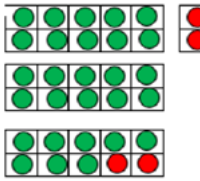
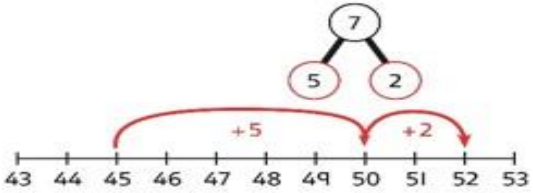
Addition of two 1-digit numbers crossing the boundary of 10			

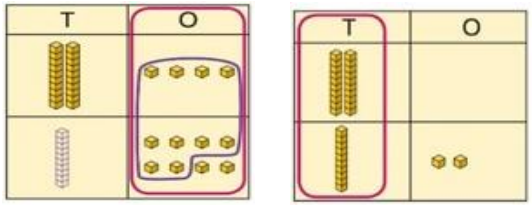
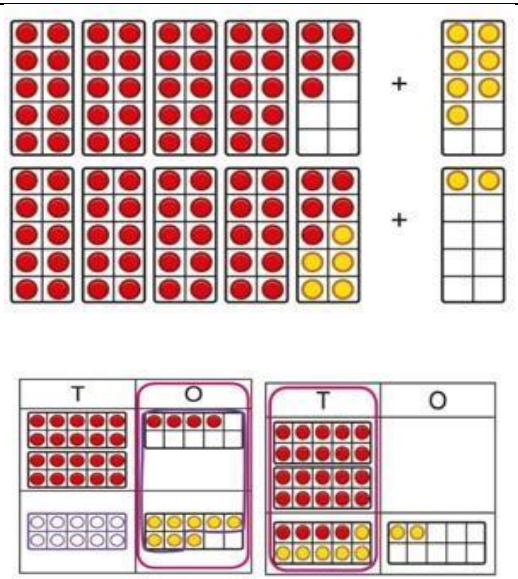
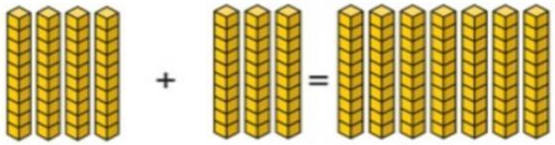
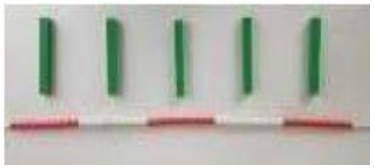
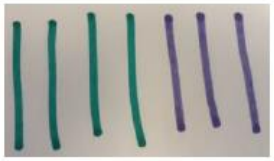
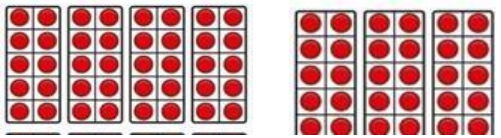
Year 2

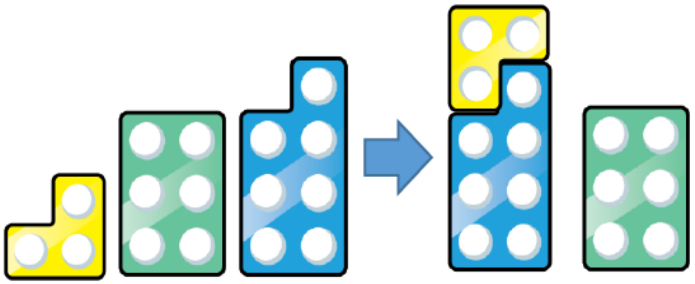
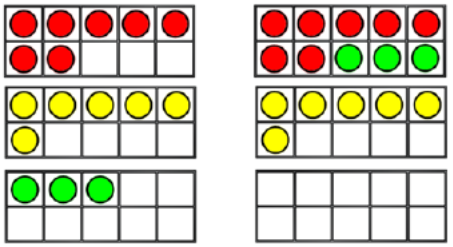
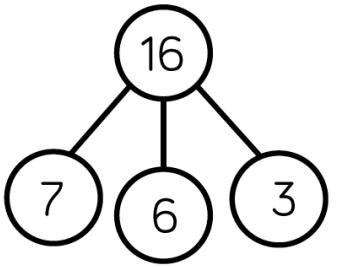
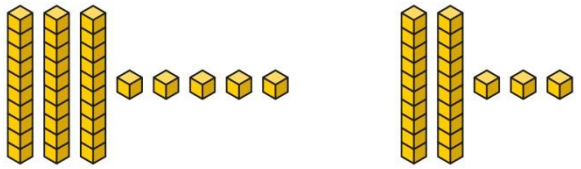
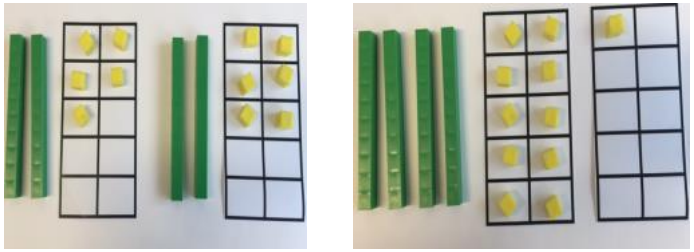
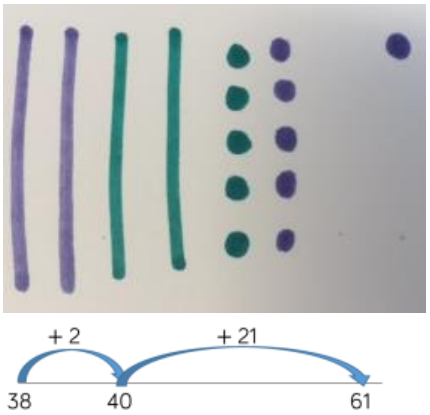
Pupils should be taught to:

- recall and use addition facts to 20 fluently, and derive and use related facts up to 100
- add numbers, including:
  - a two-digit number and 1s
  - a two-digit number and 10s
  - 2 two-digit numbers
  - adding 3 one-digit numbers

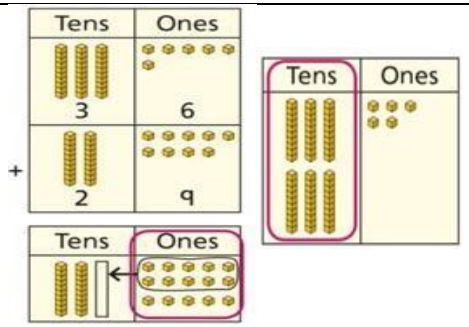
	Concrete	Pictorial	Abstract
Add two-digit number and 1s not crossing tens boundary From Year 2, different manipulatives can be used to represent this exchange alongside number lines to support children in understanding how to partition their jumps.	   	  	Understand the link between counting on and using known number facts. Children should be encouraged to use known number bonds to improve efficiency and accuracy.  This can be represented horizontally or vertically. *34 + 5 = 39* *or* T O 3 4 + 5 9 

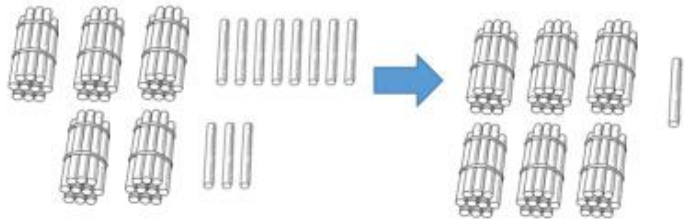
Add a two-digit number and 10s	  	  	34 + 10 = 44 30 + 10 + 4 = 44 40 + 4 = 44 *27 + 10 = 37* *27 + 20 = 47* *27 + ? = 57* *? + 40 = 67*
Add a two-digit number and 1s crossing tens boundary	 	 28 + 8 =28 + 2 + 6	**28 + 8 = 36** **2 6**  *7 = 5 + 2* *45 + 5 + 2 = 52*

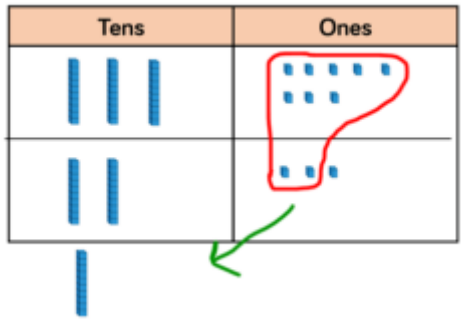
			*24 + 8* *(24+6)* *(30+2)*
Add multiple of 10 + multiple of 10	  	 	4 tens + 3 tens 40 + 30 **40 + 30 = 70** 20 + 30 = 50 70 = 50 + 20 40 + □ = 60

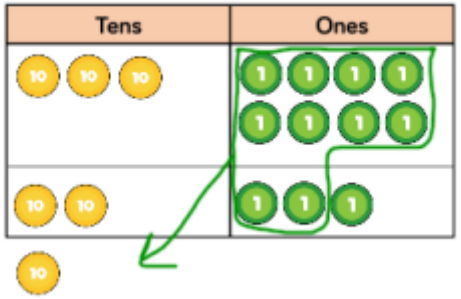
Adding 3 one-digit numbers When adding three 1 - digit numbers, children should be encouraged to look for number bonds to 10 or doubles to add the numbers more efficiently. This supports children in their understanding of commutativity. Manipulatives that highlight number bonds to 10 are effective when adding three 1 -digit numbers.			$7 + 6 + 3 = 16$ 
Add 2 two-digit numbers (within 100) Children can use a blank number line and other representations to count on to find the total. Encourage them to jump to multiples of 10	 		**25 + 26 = 51** 20 + 20 = 40 5 + 6 = 11 40 + 11 = 51 *Leading on to adjusting to make a multiple of 10.* 25 + 26 = 51 30 + 21 = 51 43 11 | 32

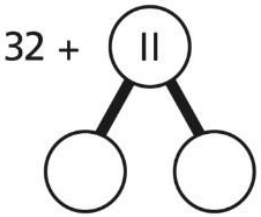
to become more efficient.





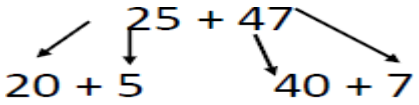






11 = 10 + 1
32 + 10 = 42
42 + 1 = 43

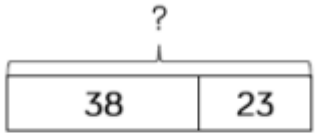
32 + 11 = 43

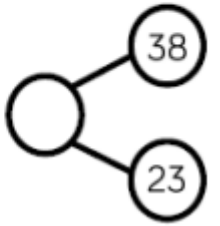


20 + 40 = 60

5+ 7 =12

60 + 12 = 72

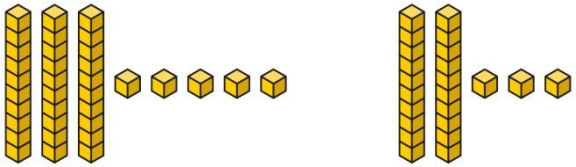
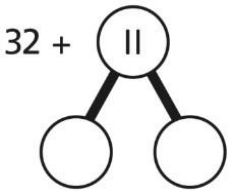


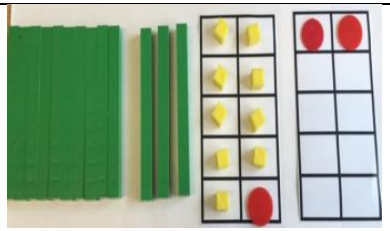
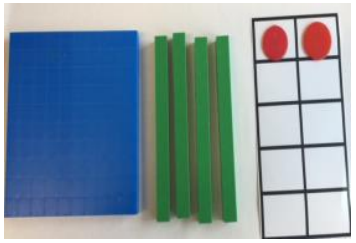
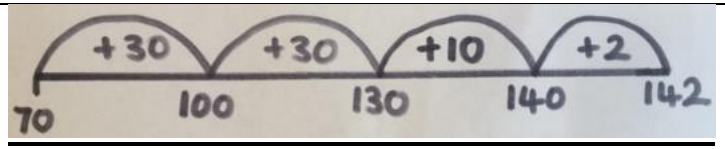
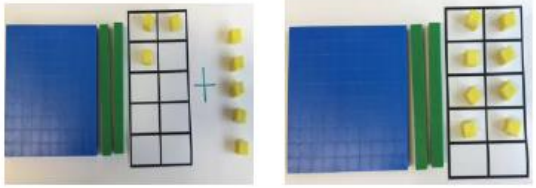
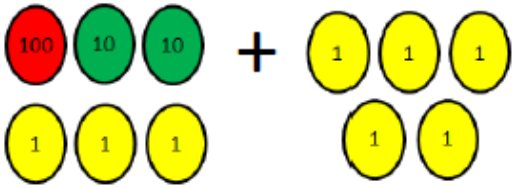


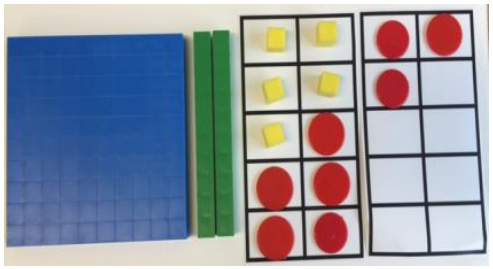
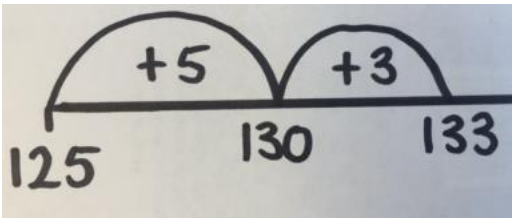
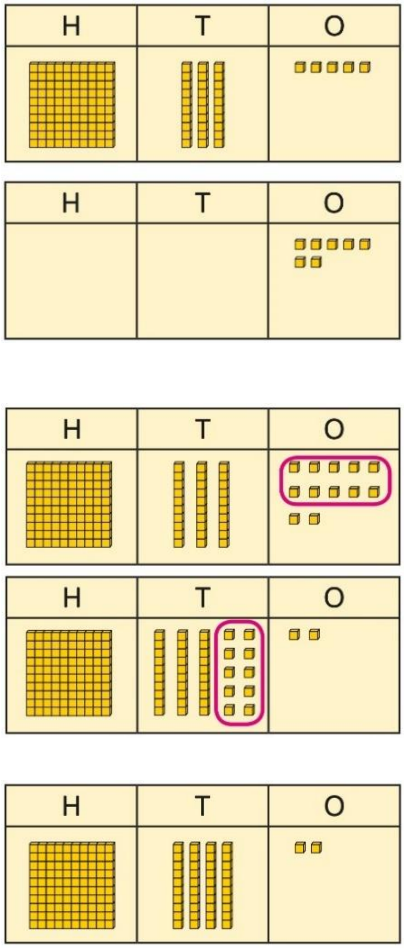
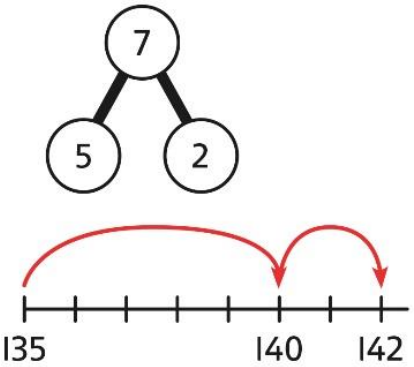
Year 3

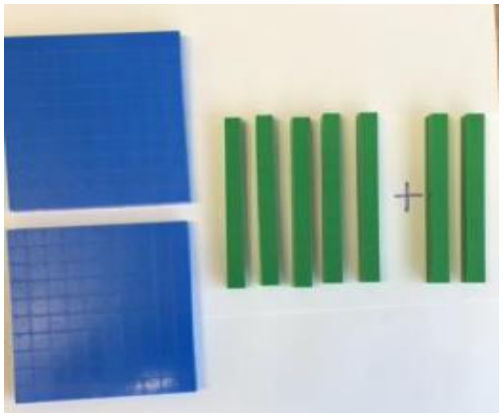
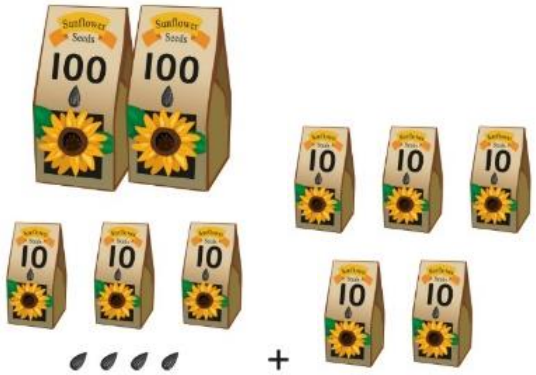
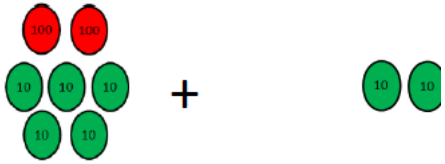
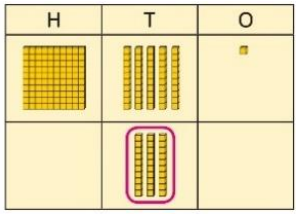
Pupils should be taught to:

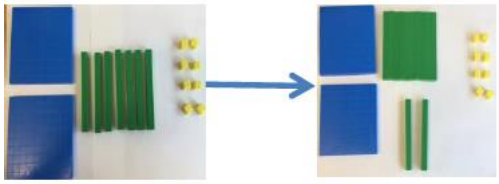
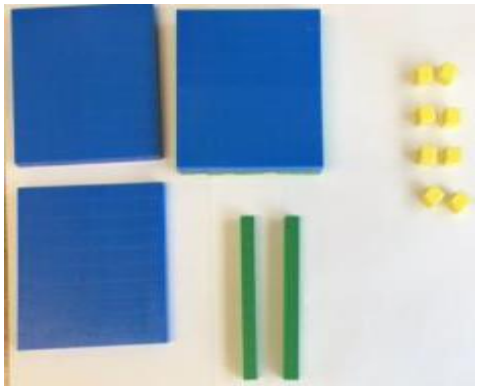
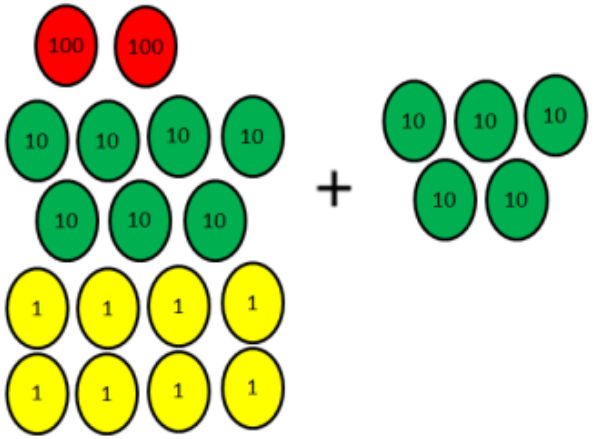
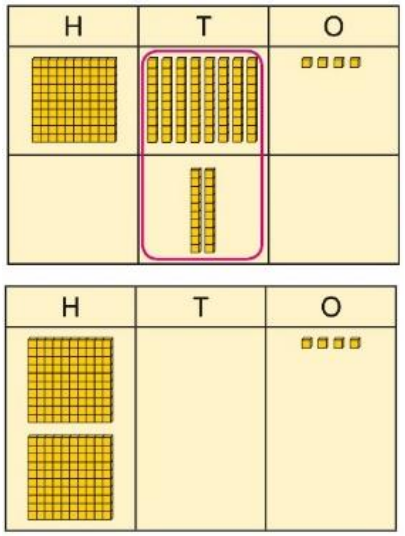
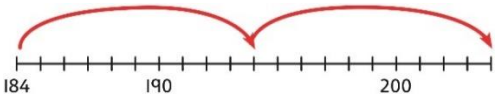
- add numbers mentally, including:
  - a three-digit number and 1s
  - a three-digit number and 10s
  - a three-digit number and 100s
  - add numbers with up to 3 digits, using formal written methods of columnar addition
  - solve problems, including missing number problems, using number facts, place value, and more complex addition

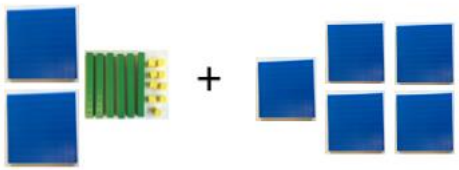
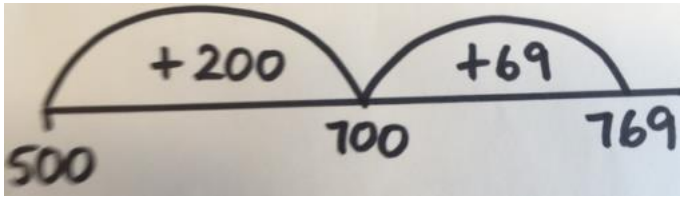
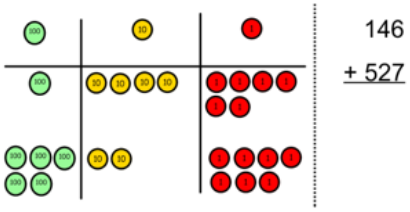
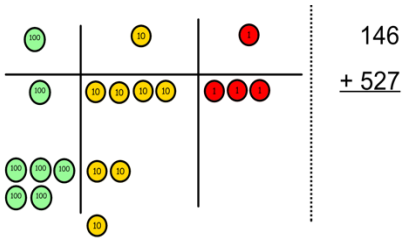
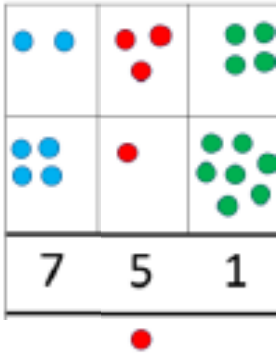
	Concrete	Pictorial	Abstract
Add 2 two-digit numbers- using partitioning (not crossing tens boundary)	Add the 10s and 1s separately.  *5 + 3 = 8* *There are 8 ones in total.* *3 + 2 = 5* *There are 5 tens in total.* *35 + 23 = 58*	Add the 10s and 1s separately. Use a part-whole model to support. 	*11 = 10 + 1* *32 + 10 = 42* *42 + 1 = 43* *32 + 11 = 43*
Add 2 two-digit numbers-			**79 + 63 = 142**

using partitioning (crossing tens boundary)	 		70 + 60 = 130 9 + 3 = 9 + 1 + 2 130 + 12 = 142
Add a three-digit number and 1s (using bonds) Base 10 and place value counters are the most effective manipulatives when adding numbers with up to 3 digits. Ensure children write out their calculation alongside any concrete resources so they can see the links to the written column method. Plain counters on a place value grid can also be used to support learning.			123 + 5 = 128 123 + 5 = 120 + 8

Add a three-digit number and 1s (crossing tens boundary)		  *135 + 7 = 142*	**125 + 8 = 133** 125 + 5 + 3 = 133  *135 + 7 = ?* *135 + 5 + 2 = 142* Ensure that children understand how to add 1s bridging a 100. *198 + 5 = ?* *198 + 2 + 3 = 203*

Add a three-digit number and 10s (using bonds)	  234 + 50 There are 3 tens and 5 tens altogether. 3 + 5 = 8 In total there are 8 tens. 234 + 50 = 284	 250 + 20 =?  5 tens + 3 tens = 8 tens 351 + 30 = 381	**255 + 20 = 275** **255 + 20 = 200 + 70 + 5**

Add a three-digit number and 10s (crossing tens boundary)	 Children to understand the exchange of 10 tens for one hundred. 	  184 + 20 =? 184 + 20 = 204	**278 + 50 = 328** 270 + 50 + 8 = 328  184 + 20 =? I can count in 10s … 194 … 204 184 + 20 = 204 Use number bonds within 20 to support efficient mental calculations. 385 + 50 There are 8 tens and 5 tens. That is 13 tens. 385 + 50 = 300 + 130 + 5 385 + 50 = 435

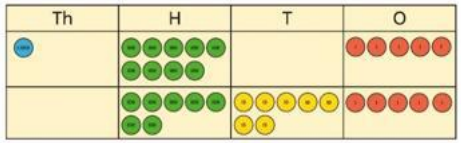
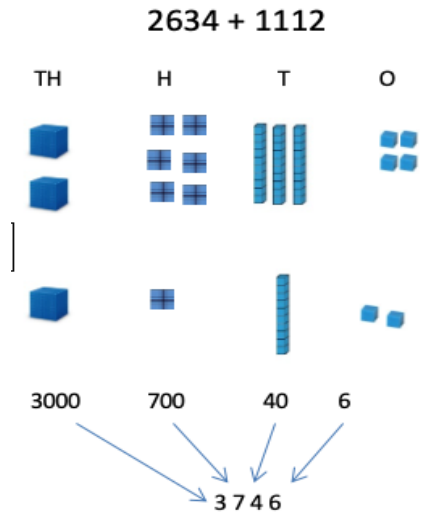
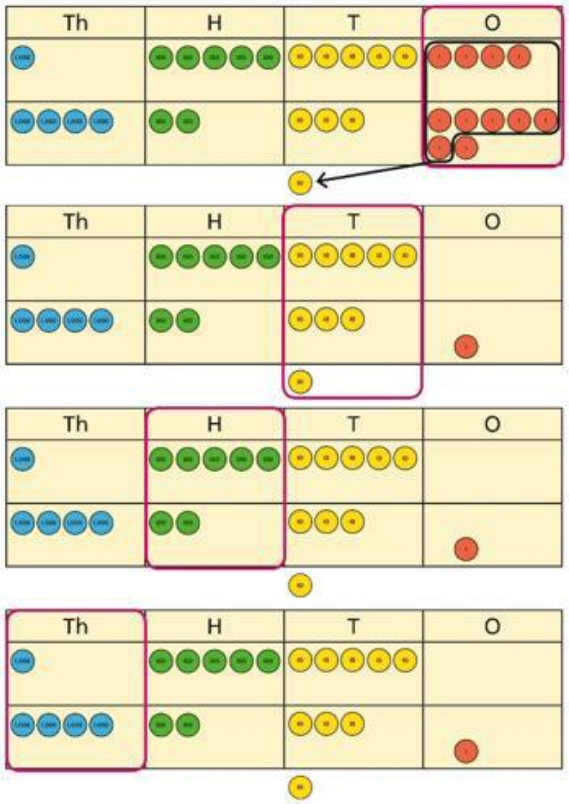
Add a three-digit number and 100s			**269 + 500 = 769** 200 + 500 + 69 = 769
Add numbers with up to 3 digits, using expanding column addition From Year 3, encourage children to use the formal column method when calculating alongside straws, base 10 or place value counters. As numbers become larger, straws become less efficient.	Make both numbers on a place value grid using base ten counters.  Add up the ones and exchange 10 ones for one 10.  Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added. This can also be done with **Base 10** counters to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100.	Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding. 234 + 417 	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. 345 + 186 300 + 40 + 5 + 100 + 80 + 6 400 + 120 + 11 Add these mentally 400 + 120 = 520 + 11 = 531

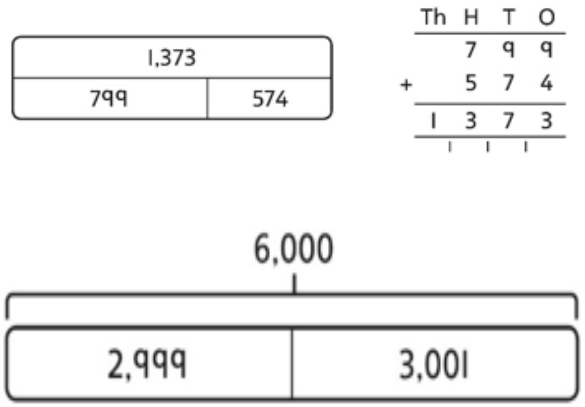
Add numbers with up to 3 digits, using formal written methods of columnar addition (Only when pupil secure in expanded)			H T O 3 4 5 + 1 8 6 5 3 1 1 1

Year 4

Pupils should be taught to:

- add numbers with up to 4 digits using the formal written methods of columnar addition where appropriate
- estimate and use inverse operations to check answers to a calculation
- solve addition two-step problems in contexts, deciding which operations and methods to use and why

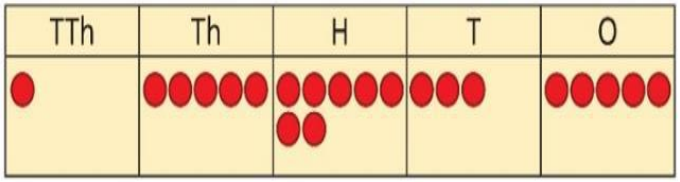
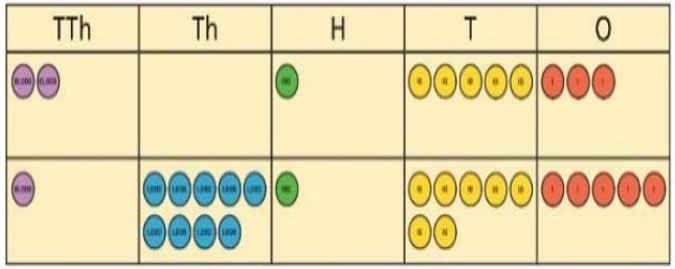
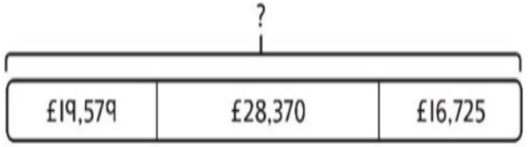
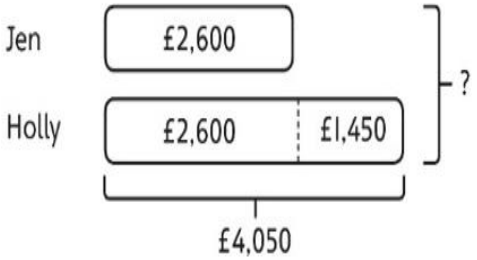
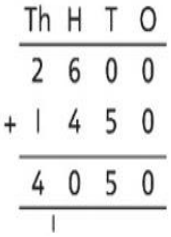
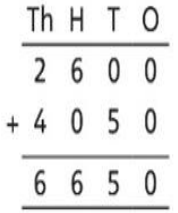
	Concrete	Pictorial	Abstract
Add numbers with up to 4 digits Base 10 and place value counters are the most effective manipulatives when adding numbers with up to 4 digits. Ensure children write out their calculation alongside any concrete resources so they can see the links to the written column method. Plain counters on a place value grid can also be used to support learning.	 		One exchange 1554 + 4237 5791 1 More than one exchange 3545 + 4628 8173 1 1

Representing additions and checking strategies			Use rounding and estimating to check the reasonableness of an addition. **912 + 6,149 =?** *I used rounding to work out that the answer should be approximately 1,000 + 6,000 = 7,000.*
Formal Written Method Column Addition			As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here 72.8 + 54.6 127.4 1 1 £ 2 3 . 5 9 + £ 7 . 5 5 £ 3 1 . 1 4 1 1 1

Year 5

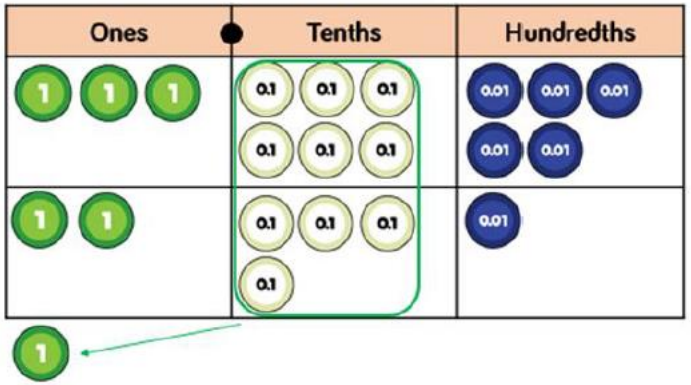
Pupils should be taught to:

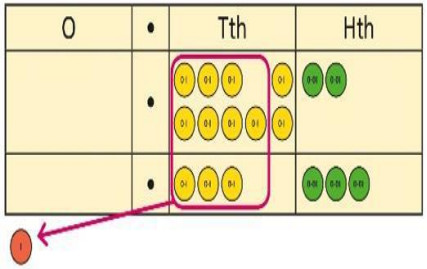
- add whole numbers with more than 4 digits, including using formal written methods (columnar addition)
- add numbers mentally with increasingly large numbers
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

	Concrete	Pictorial	Abstract
Add numbers with more than 4 digits Place value counters or plain counters on a place value grid are the most effective concrete resources when adding numbers with more than 4 digits. At this stage, children should be encouraged to work in the abstract, using the column method to add larger numbers efficiently.	 	   	<u>No carrying</u> TTH TH H T O 3 7 3 4 5 + 1 2 1 2 3 4 9 4 6 8 <u>Carrying</u> TTH TH H T O 4 7 3 4 5 + 7 2 1 8 7 1 1 9 5 3 2 1 1 <u>Missing Numbers</u> (no carrying) TTH TH H T O ? ? 3 4 5 + 1 2 1 ? 3 4 9 4 6 8 (carrying) TTH TH H T O ? 7 3 ? 5 + 7 ? 1 8 ? 1 1 9 5 3 2

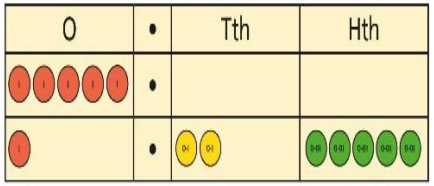
Add decimals with two decimal places, including money

Place value counters and plain counters on a place value grid are the most effective manipulatives when adding decimals with 1, 2 and then 3 decimal places. Ensure children have experience of adding decimals with a variety of decimal places. This includes putting this into context when adding money and other measures.





$$\begin{array}{r} \text{O}\cdot\text{Tth Hth} \\ 0\cdot 9\ 2 \\ +\ 0\cdot 3\ 3 \\ \hline 1\cdot 2\ 5 \\ \hline 1 \end{array}$$



$$\begin{array}{r} \text{O}\cdot\text{Tth Hth} \\ 5\cdot 0\ 0 \\ +\ 1\cdot 2\ 5 \\ \hline 6\cdot 2\ 5 \end{array}$$

Add using a column method, ensuring that children understand the link with place value.

$$\begin{array}{r} \text{O}\cdot\text{Tth Hth} \\ 0\cdot 2\ 3 \\ +\ 0\cdot 4\ 5 \\ \hline 0\cdot 6\ 8 \end{array}$$

Include exchange where required, alongside an understanding of place value.

$$\begin{array}{r} \text{O}\cdot\text{Tth Hth} \\ 0\cdot 9\ 2 \\ +\ 0\cdot 3\ 3 \\ \hline 1\cdot 2\ 5 \\ \hline 1 \end{array}$$

Include additions where the numbers of decimal places are different.

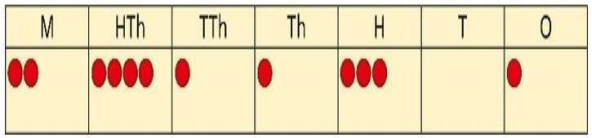
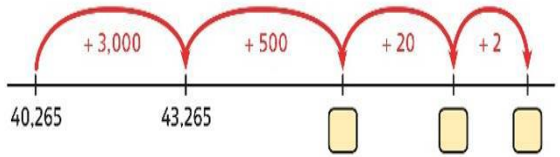
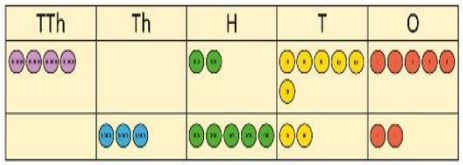
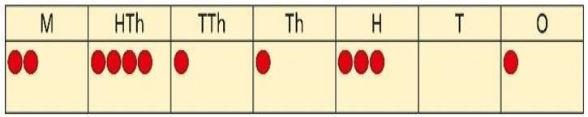
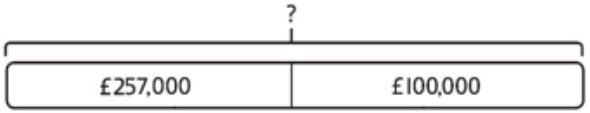
3.4 + 0.65 = ?

$$\begin{array}{r} \text{O}\cdot\text{Tth Hth} \\ 3\cdot 4\ 0 \\ +\ 0\cdot 6\ 5 \\ \hline \end{array}$$

Year 6

Pupils should be taught to perform mental calculations, using increasingly large numbers

- use their knowledge of the order of operations to carry out calculations involving the 4 operations
- solve addition multi-step problems in contexts, deciding which methods to use and why
- solve problems involving addition

	Concrete	Pictorial	Abstract
Add several numbers with increasing complexity		  TTh Th H T O 4 0 2 6 5 + 3 5 2 2	H T O · Tth Hth 1 4 0 · 0 9 + 4 9 · 8 9 1 8 9 · 9 8 1
Selecting mental methods for larger numbers	 2,411,301 + 500,000 =?	257,000 + 99,000 =?  I added 100 thousand then subtracted 1 thousand. 257 thousands + 100 thousands = 357 thousand 257,000 + 100,000 = 357,000 357,000 – 1,000 = 356,000 So, 257,000 + 99,000 = 356,000	195,000 + 6,000 =? 195 + 5 + 1 = 201 195 thousands + 6 thousands = 201 thousands So, 195,000 + 6,000 = 201,000