Addition and Subtraction

Mathematics Calculation Policy

Introduction:

The mathematics curriculum at Sandy Hill has been designed to ensure that children possess the skills and knowledge that will affect them positively in their lives. Concepts have been carefully sequenced to enable learners to make connections, building upon prior knowledge. At the heart of the curriculum, driven throughout each academic year are fundamental fluency/arithmetic skills.

Aims:

- Ensure that every child possesses key fluency skills to enhance their self-confidence and enjoyment of mathematics in order to develop their understanding of the world.
- Develop pupils' reasoning skills using precise mathematical vocabulary
- Build pupils' understanding through applying their skills to problem-solving activities and real-life links.

Rationale:

This calculation policy exists as a direct result of careful collaborative and evidence-based curriculum planning, linked closely with direct experience and knowledge of how children learn best within mathematics. Through the systems we implement, we aim to engineer mathematical success.

As a school, arithmetic is given its own (separate) dedicated practice time within the school day. As an established system within the school, we recognise that children (including those with SEND) benefit from having simple, efficient and effective strategies (procedural knowledge) to help them solve mathematical problems. Coupled with the most vital maths facts (declarative knowledge) that are rehearsed systematically, pupils' working memory is not overloaded, pupils experience success, gaining enjoyment and self-confidence. (OFSTED Research Review Series, May 2021).

This calculation policy aims to identify the key progressions across the school, identifying the images pupils will experience (White Rose linked) and the procedural knowledge required at each stage of the mathematics journey.

Images to Support Mathematical Understanding:

White Rose Is used by the school to inform planning and support with small steps progression. The images below are used to support the teaching and learning of mathematics.

Addition and Subtraction

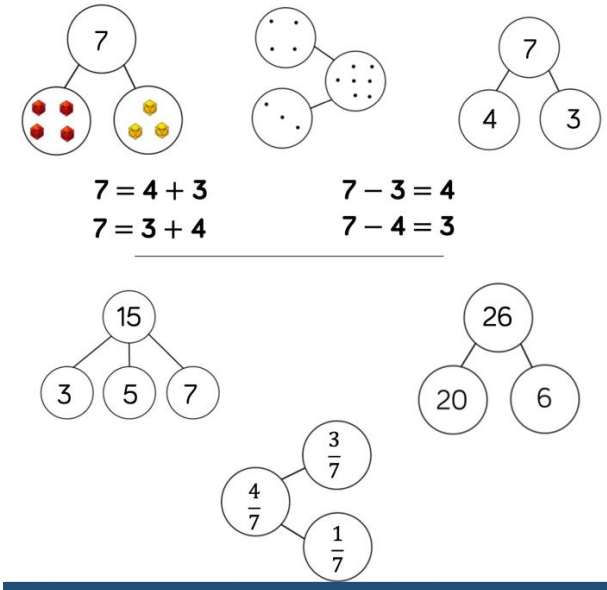
Mathematics Calculation Policy

Contents:

Addition and Subtraction

Mathematics Calculation Policy

Part-Whole Model



Benefits

This part-whole model supports children in their understanding of aggregation and partitioning. Due to its shape, it can be referred to as a cherry part-whole model.

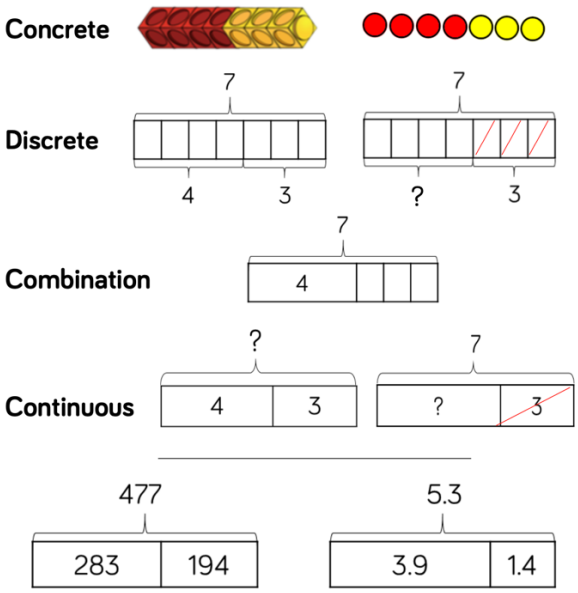
When the parts are complete and the whole is empty, children use aggregation to add the parts together to find the total.

When the whole is complete and at least one of the parts is empty, children use partitioning (a form of subtraction) to find the missing part.

Part-whole models can be used to partition a number into two or more parts, or to help children to partition a number into tens and ones or other place value columns.

In KS2, children can apply their understanding of the part-whole model to add and subtract fractions, decimals and percentages.

Bar Model (single)



Benefits

The single bar model is another type of a part-whole model that can support children in representing calculations to help them unpick the structure.

Cubes and counters can be used in a line as a concrete representation of the bar model.

Discrete bar models are a good starting point with smaller numbers. Each box represents one whole.

The combination bar model can support children to calculate by counting on from the larger number. It is a good stepping stone towards the continuous bar model.

Continuous bar models are useful for a range of values. Each rectangle represents a number. The question mark indicates the value to be found.

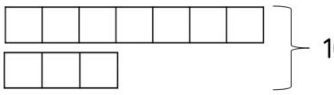
In KS2, children can use bar models to represent larger numbers, decimals and fractions.

Addition and Subtraction

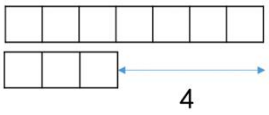
Mathematics Calculation Policy

Bar Model (multiple)

Discrete

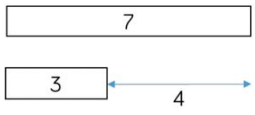


$7 + 3 = 10$

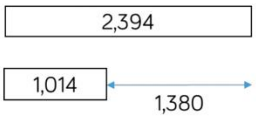


$7 - 3 = 4$

Continuous



$7 - 3 = 4$



$2{,}394 - 1{,}014 = 1{,}380$

Benefits

The multiple bar model is a good way to compare quantities whilst still unpicking the structure.

Two or more bars can be drawn, with a bracket labelling the whole positioned on the right hand side of the bars. Smaller numbers can be represented with a discrete bar model whilst continuous bar models are more effective for larger numbers.

Multiple bar models can also be used to represent the difference in subtraction. An arrow can be used to model the difference.

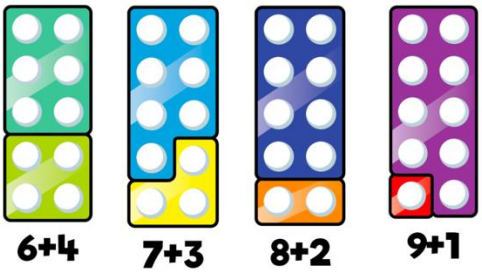
When working with smaller numbers, children can use cubes and a discrete model to find the difference. This supports children to see how counting on can help when finding the difference.

Number Shapes

$7 = 4 + 3$

$7 = 3 + 4$

$7 - 3 = 4$



Benefits

Number shapes can be useful to support children to subitise numbers as well as explore aggregation, partitioning and number bonds.

When adding numbers, children can see how the parts come together making a whole. As children use number shapes more often, they can start to subitise the total due to their familiarity with the shape of each number.

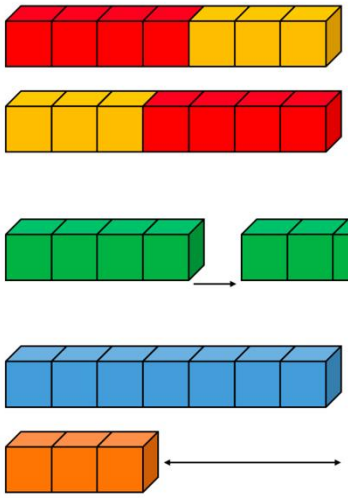
When subtracting numbers, children can start with the whole and then place one of the parts on top of the whole to see what part is missing. Again, children will start to be able to subitise the part that is missing due to their familiarity with the shapes.

Children can also work systematically to find number bonds. As they increase one number by 1, they can see that the other number decreases by 1 to find all the possible number bonds for a number.

Addition and Subtraction

Mathematics Calculation Policy

Cubes



Benefits

Cubes can be useful to support children with the addition and subtraction of one-digit numbers.

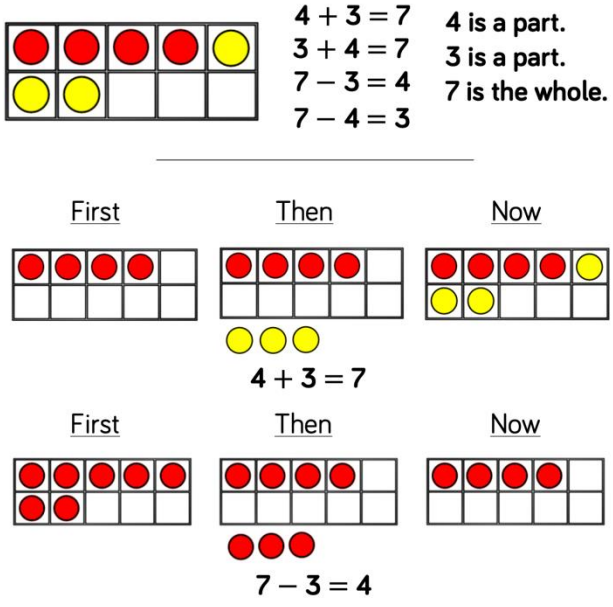
When adding numbers, children can see how the parts come together to make a whole. Children could use two different colours of cubes to represent the numbers before putting them together to create the whole.

When subtracting numbers, children can start with the whole and then remove the number of cubes that they are subtracting in order to find the answer. This model of subtraction is reduction, or take away.

Cubes can also be useful to look at subtraction as difference. Here, both numbers are made and then lined up to find the difference between the numbers.

Cubes are useful when working with smaller numbers but are less efficient with larger numbers as they are difficult to subitise and children may miscount them.

Ten Frames (within 10)



Benefits

When adding and subtracting within 10, the ten frame can support children to understand the different structures of addition and subtraction.

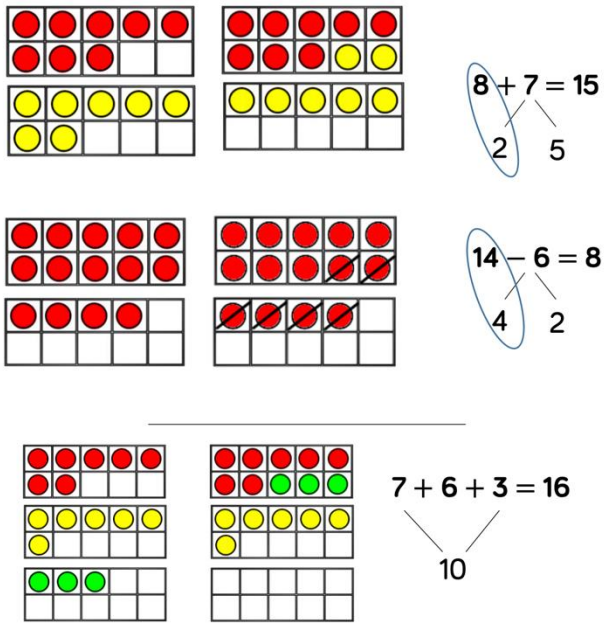
Using the language of parts and wholes represented by objects on the ten frame introduces children to aggregation and partitioning.
Aggregation is a form of addition where parts are combined together to make a whole. Partitioning is a form of subtraction where the whole is split into parts. Using these structures, the ten frame can enable children to find all the number bonds for a number.

Children can also use ten frames to look at augmentation (increasing a number) and take-away (decreasing a number). This can be introduced through a first, then, now structure which shows the change in the number in the 'then' stage. This can be put into a story structure to help children understand the change e.g. First, there were 7 cars. Then, 3 cars left. Now, there are 4 cars.

Addition and Subtraction

Mathematics Calculation Policy

Ten Frames (within 20)



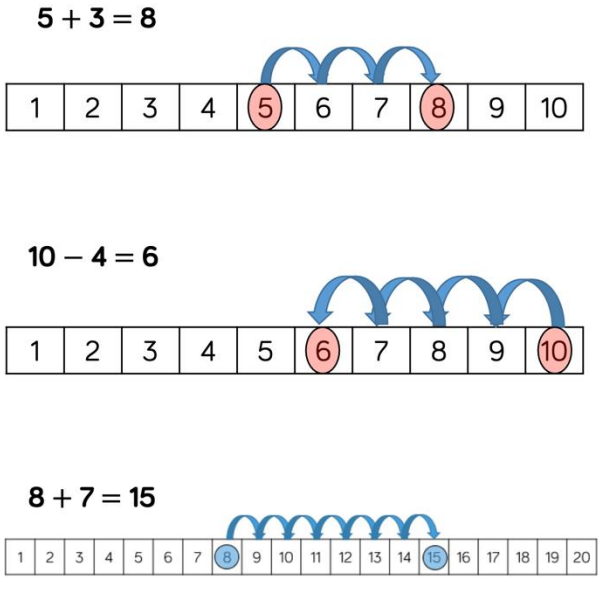
Benefits

When adding two single digits, children can make each number on separate ten frames before moving part of one number to make 10 on one of the ten frames. This supports children to see how they have partitioned one of the numbers to make 10, and makes links to effective mental methods of addition.

When subtracting a one-digit number from a two-digit number, firstly make the larger number on 2 ten frames. Remove the smaller number, thinking carefully about how you have partitioned the number to make 10, this supports mental methods of subtraction.

When adding three single-digit numbers, children can make each number on 3 separate 10 frames before considering which order to add the numbers in. They may be able to find a number bond to 10 which makes the calculation easier. Once again, the ten frames support the link to effective mental methods of addition as well as the importance of commutativity.

Number Tracks



Benefits

Number tracks are useful to support children in their understanding of augmentation and reduction.

When adding, children count on to find the total of the numbers. On a number track, children can place a counter on the starting number and then count on to find the total.

When subtracting, children count back to find their answer. They start at the minuend and then take away the subtrahend to find the difference between the numbers.

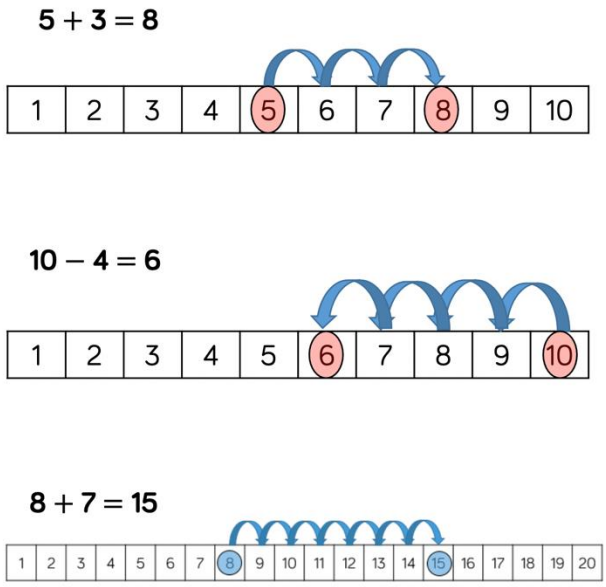
Number tracks can work well alongside ten frames and bead strings which can also model counting on or counting back.

Playing board games can help children to become familiar with the idea of counting on using a number track before they move on to number lines.

Addition and Subtraction

Mathematics Calculation Policy

Number Tracks



Benefits

Number tracks are useful to support children in their understanding of augmentation and reduction.

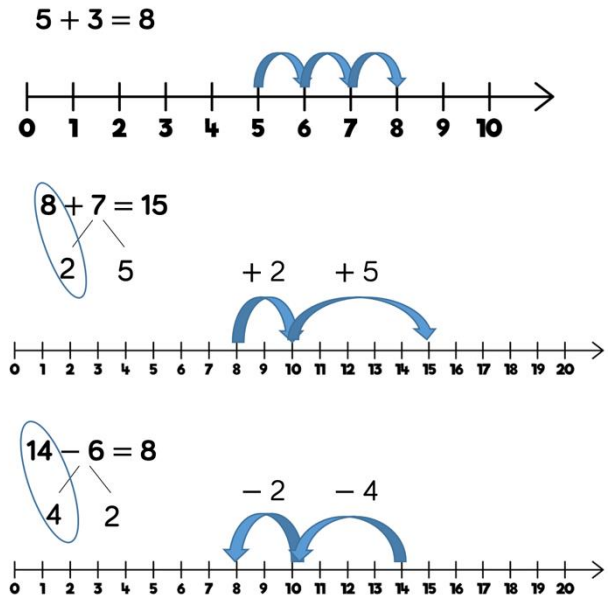
When adding, children count on to find the total of the numbers. On a number track, children can place a counter on the starting number and then count on to find the total.

When subtracting, children count back to find their answer. They start at the minuend and then take away the subtrahend to find the difference between the numbers.

Number tracks can work well alongside ten frames and bead strings which can also model counting on or counting back.

Playing board games can help children to become familiar with the idea of counting on using a number track before they move on to number lines.

Number Lines (labelled)



Benefits

Labelled number lines support children in their understanding of addition and subtraction as augmentation and reduction.

Children can start by counting on or back in ones, up or down the number line. This skill links directly to the use of the number track.

Progressing further, children can add numbers by jumping to the nearest 10 and then jumping to the total. This links to the making 10 method which can also be supported by ten frames. The smaller number is partitioned to support children to make a number bond to 10 and to then add on the remaining part.

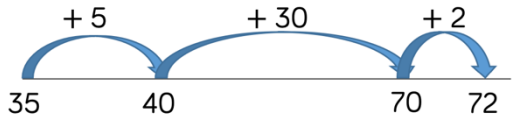
Children can subtract numbers by firstly jumping to the nearest 10. Again, this can be supported by ten frames so children can see how they partition the smaller number into the two separate jumps.

Addition and Subtraction

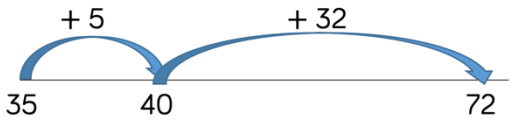
Mathematics Calculation Policy

Number Lines (blank)

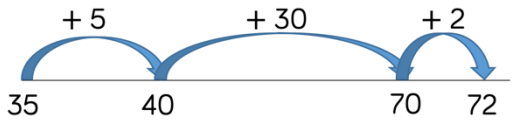
35 + 37 = 72



35 + 37 = 72



72 − 35 = 37



Benefits

Blank number lines provide children with a structure to add and subtract numbers in smaller parts.

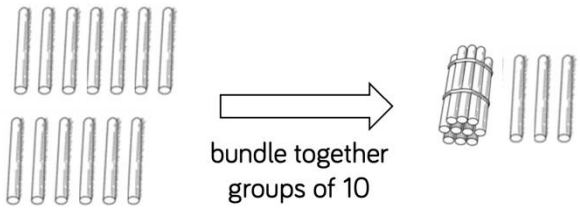
Developing from labelled number lines, children can add by jumping to the nearest 10 and then adding the rest of the number either as a whole or by adding the tens and ones separately.

Children may also count back on a number line to subtract, again by jumping to the nearest 10 and then subtracting the rest of the number.

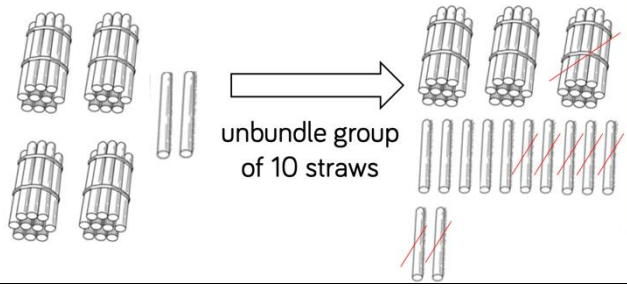
Blank number lines can also be used effectively to help children subtract by finding the difference between numbers. This can be done by starting with the smaller number and then counting on to the larger number. They then add up the parts they have counted on to find the difference between the numbers.

Straws

7 + 6 = 13



42 − 17 = 25



Benefits

Straws are an effective way to support children in their understanding of exchange when adding and subtracting 2-digit numbers.

Children can be introduced to the idea of bundling groups of ten when adding smaller numbers and when representing 2-digit numbers. Use elastic bands or other ties to make bundles of ten straws.

When adding numbers, children bundle a group of 10 straws to represent the exchange from 10 ones to 1 ten. They then add the individual straws (ones) and bundles of straws (tens) to find the total.

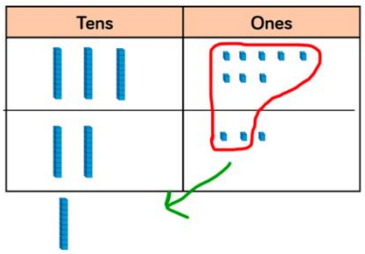
When subtracting numbers, children unbundle a group of 10 straws to represent the exchange from 1 ten to 10 ones.

Straws provide a good stepping stone to adding and subtracting with Base 10/Dienes.

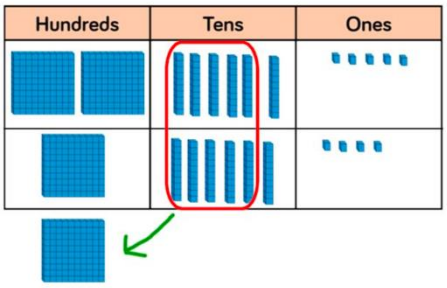
Addition and Subtraction

Mathematics Calculation Policy

Base 10/Dienes (addition)



$$\begin{array}{r} 38 \\ +\ 23 \\ \hline 61 \\ \hline 1 \end{array}$$



$$\begin{array}{r} 265 \\ +\ 164 \\ \hline 429 \\ \hline 1 \end{array}$$

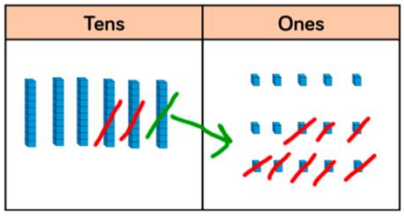
Benefits

Using Base 10 or Dienes is an effective way to support children's understanding of column addition. It is important that children write out their calculations alongside using or drawing Base 10 so they can see the clear links between the written method and the model.

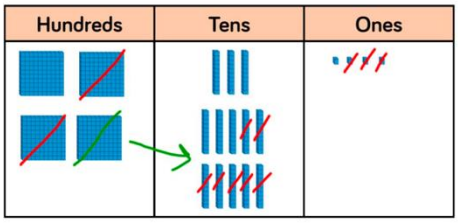
Children should first add without an exchange before moving on to addition with exchange.. The representation becomes less efficient with larger numbers due to the size of Base 10. In this case, place value counters may be the better model to use.

When adding, always start with the smallest place value column. Here are some questions to support children.
How many ones are there altogether?
Can we make an exchange? (Yes or No)
How many do we exchange? (10 ones for 1 ten, show exchanged 10 in tens column by writing 1 in column)
How many ones do we have left? (Write in ones column)
Repeat for each column.

Base 10/Dienes (subtraction)



$$\begin{array}{r} {}^{5}\not{6}\,{}^{1}\not{5} \\ -\ 28 \\ \hline 37 \end{array}$$



$$\begin{array}{r} {}^{3}\not{4}\,{}^{1}\not{3}5 \\ -\ 273 \\ \hline 262 \end{array}$$

Benefits

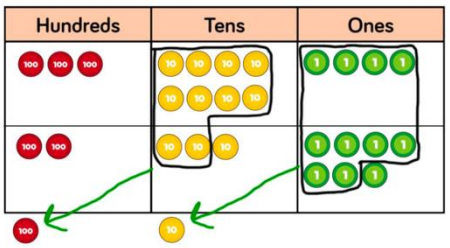
Using Base 10 or Dienes is an effective way to support children's understanding of column subtraction. It is important that children write out their calculations alongside using or drawing Base 10 so they can see the clear links between the written method and the model.

Children should first subtract without an exchange before moving on to subtraction with exchange. When building the model, children should just make the minuend using Base 10, they then subtract the subtrahend. Highlight this difference to addition to avoid errors by making both numbers. Children start with the smallest place value column. When there are not enough ones/tens/hundreds to subtract in a column, children need to move to the column to the left and exchange e.g. exchange 1 ten for 10 ones. They can then subtract efficiently.
This model is efficient with up to 4-digit numbers. Place value counters are more efficient with larger numbers and decimals.

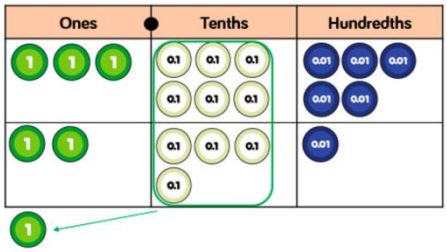
Addition and Subtraction

Mathematics Calculation Policy

Place Value Counters (addition)



$$\begin{array}{r} 384 \\ +\ 237 \\ \hline 621 \\ \hline 1\ 1 \end{array}$$



$$\begin{array}{r} 3.65 \\ +\ 2.41 \\ \hline 6.06 \\ \hline 1 \end{array}$$

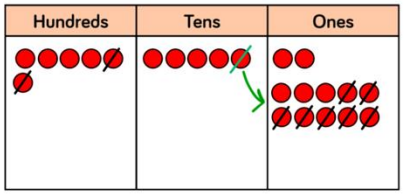
Benefits

Using place value counters is an effective way to support children's understanding of column addition. It is important that children write out their calculations alongside using or drawing counters so they can see the clear links between the written method and the model.

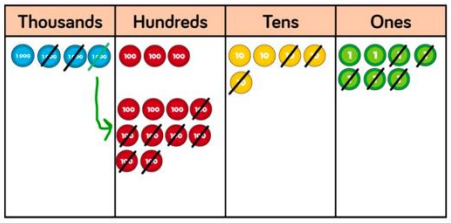
Children should first add without an exchange before moving on to addition with exchange. Different place value counters can be used to represent larger numbers or decimals. If you don't have place value counters, use normal counters on a place value grid to enable children to experience the exchange between columns.

When adding money, children can also use coins to support their understanding. It is important that children consider how the coins link to the written calculation especially when adding decimal amounts.

Place Value Counters (Subtraction)



$$\begin{array}{r} {}^{4}\not{6}\,{}^{1}\not{5}2 \\ -\ 207 \\ \hline 445 \end{array}$$



$$\begin{array}{r} {}^{3}\not{4}\,{}^{1}357 \\ -\ 2735 \\ \hline 1622 \end{array}$$

Benefits

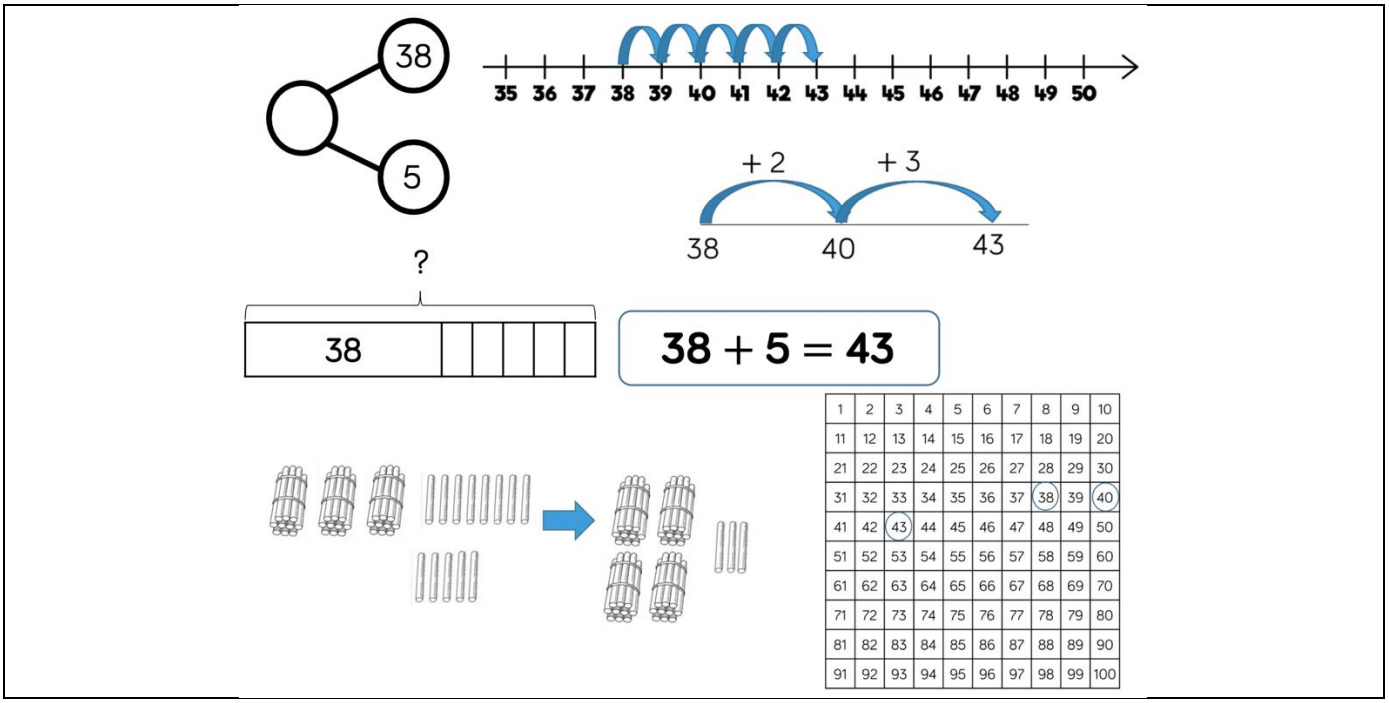
Using place value counters is an effective way to support children's understanding of column subtraction. It is important that children write out their calculations alongside using or drawing counters so they can see the clear links between the written method and the model.

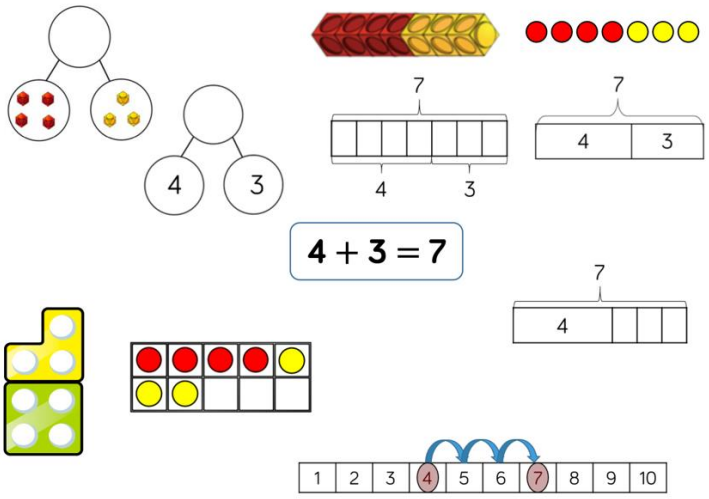
Children should first subtract without an exchange before moving on to subtraction with exchange. If you don't have place value counters, use normal counters on a place value grid to enable children to experience the exchange between columns.

When building the model, children should just make the minuend using counters, they then subtract the subtrahend. Children start with the smallest place value column. When there are not enough ones/tens/hundreds to subtract in a column, children need to move to the column to the left and exchange e.g. exchange 1 ten for 10 ones. They can then subtract efficiently.

Addition and Subtraction

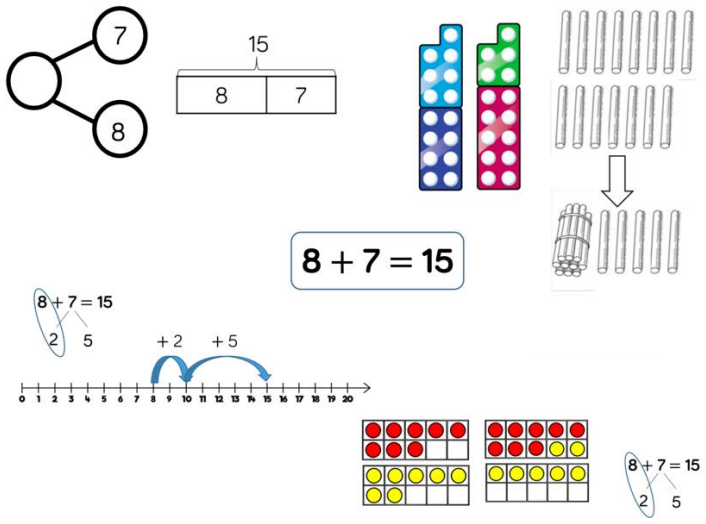
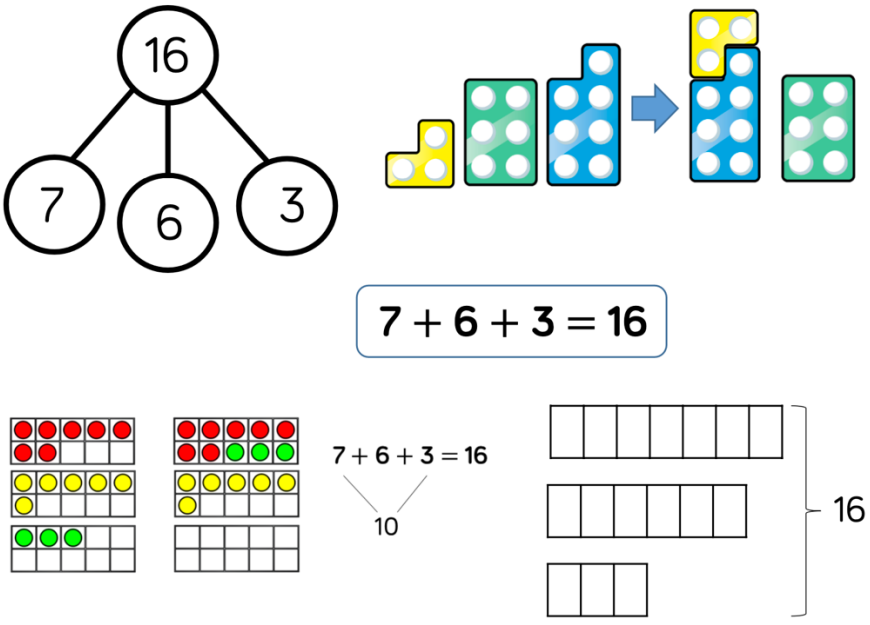
Mathematics Calculation Policy



Addition			
Year Group	**Learning Area**	**Procedural Knowledge**	**Rationale**
Year 1	Add 1 digit numbers within 10		When adding numbers to 10, children can explore both aggregation (counting on) and augmentation (combining). The part-whole model, discrete and continuous bar model, number shapes and ten frame support aggregation. The combination

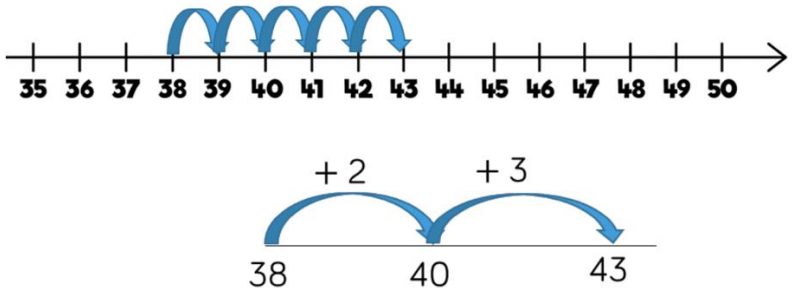
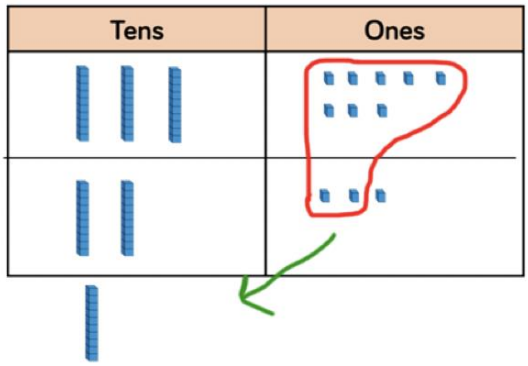
Addition and Subtraction

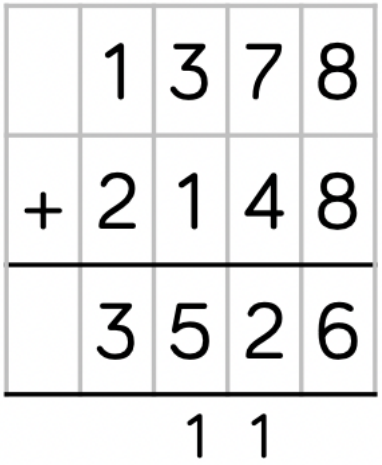
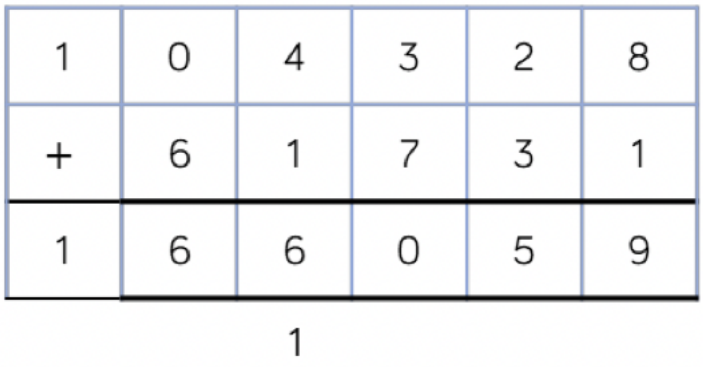
Mathematics Calculation Policy

			bar model, ten frame, bead string and number track all support augmentation.
Year 1 and 2	Add 1 and 2 digit numbers to 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. From Year 2, use different manipulatives can be used to represent this exchange alongside number lines to support children in understanding how to partition their jumps.
Year 2	Add 3 one digit numbers		The most efficient mental approach is to identify numbers that make 10 before adding the remaining digit.

Addition and Subtraction

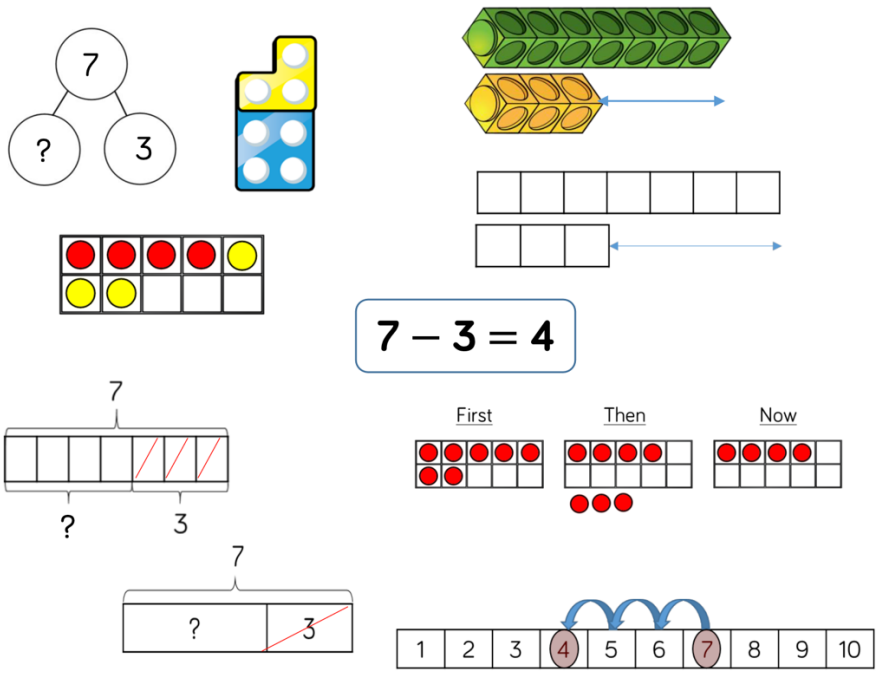
Mathematics Calculation Policy

Year 2/3	Add 1 and 2 digits numbers to 100		When adding single digits to a two-digit number, children should be encouraged to count on from the larger number. They should also apply their knowledge of number bonds to add more efficiently e.g. 8 + 5 = 13 so 38 + 5 = 43.
Year 2/3	Add two 2-digit numbers to 100	 38 + 23 61 1	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 to become more efficient. From Year 3, encourage children to use the formal column method when calculating.
Year 3	Add numbers with up to 3 digits	265 + 164 429 1	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. Children must be able to recognise the place value of the digits in the calculation and the exchanged number.
Year 4	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.
Year 5 and 6	Add 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.

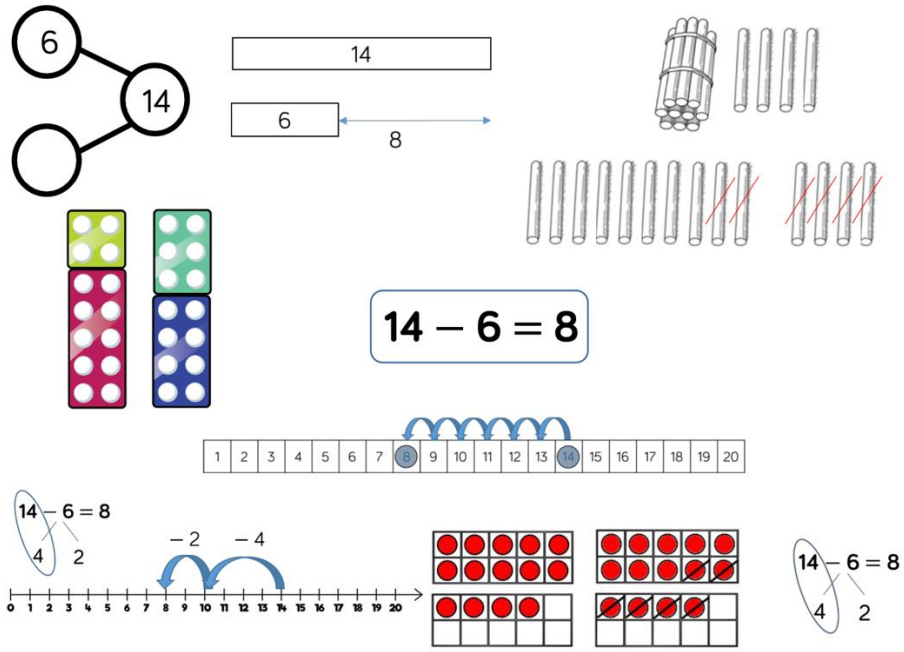
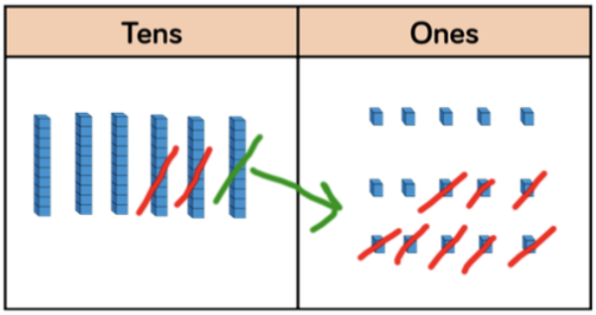
Addition and Subtraction

Mathematics Calculation Policy

Year 5	Add up to 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. Use place holders to support children's understanding of decimal place value and support calculation.
Subtraction			
Year 1	Subtract two 1-digit numbers to 10		Part-whole models, bar models, ten frames and number shapes support partitioning. Ten frames, number tracks, single bar models and bead strings support reduction. Cubes and bar models with two bars can support finding the difference.

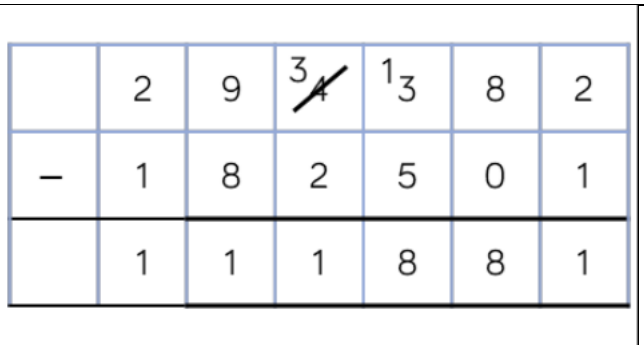
Addition and Subtraction

Mathematics Calculation Policy

Year 1	Subtract 1 and 2-digit numbers to 20		In Year 1, subtracting one-digit numbers that cross 10, is done by counting back, using objects, number tracks and number lines. From Year 2, children should be encouraged to find the number bond to 10 when partitioning the subtracted number. Ten frames, number shapes and number lines are particularly useful for this.
Year 2 and 3	Subtract 1 and 2-digit numbers to 100	 5 1 6 5 − 2 8 3 7	From Year 3, encourage children to use the formal column method when calculating alongside manipulatives and images.
Year 3	Subtract with up to 3-digits	3 1 4 3 5 − 2 7 3 2 6 2	Base 10 and place value counters are the most effective manipulative when subtracting numbers with up to 3 digits. Ensure children write out their calculation

Addition and Subtraction

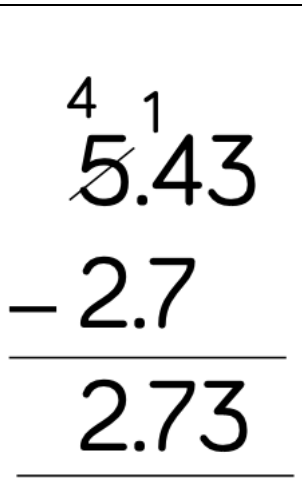
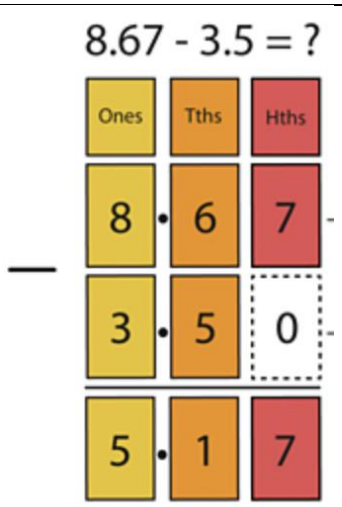
Mathematics Calculation Policy

			alongside any concrete resources so they can see the links to the written column method.
Year 4	Subtract with up to 4-digits	$\begin{array}{r} {}^{3}\cancel{4}^{1}357 \\ -\ 2735 \\ \hline 1622 \\ \hline \end{array}$	Base 10 and place value counters are the most effective manipulatives when subtracting 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.
Year 5 and 6	Subtract with more than 4 digits		At this stage, children should be encouraged to work in the abstract, using column method to subtract larger numbers efficiently.

	2	9	$^{3}\cancel{4}$	$^{1}3$	8	2
–	1	8	2	5	0	1
	1	1	1	8	8	1

Addition and Subtraction

Mathematics Calculation Policy

Year 5 and 6	Subtract with up to 3 decimal places	 	Ensure children have experience of subtracting decimals with a variety of decimal places. This includes putting this into context when subtracting money and other measures. Use place holders to support children's understanding of decimal place value and support calculation.