synergy

MULTI-ACADEMY TRUST

CALCULATION POLICY

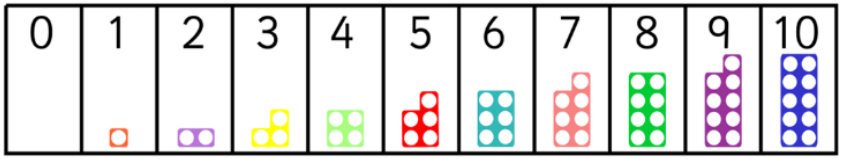
White Rose MATHS

MathsHUBS

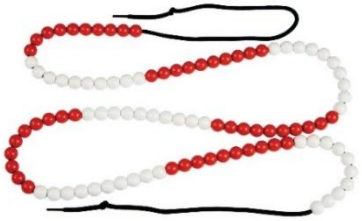
This policy has been created by the Synergy Maths Leads and uses examples from White Rose and Maths Hub with further material added.
It is a working document and will be revised and amended as necessary.
September 2023

RESOURCES

Numicon



Place value counters



Bead string

Multi-link

Dice

Fraction towers

Playing cards

Dominoes

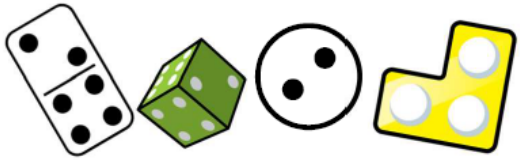
Base ten

Counters

Cuisenaire rods

Reception – Notes and Guidance

Key Language for Teachers



Cardinal - The number that indicates how many there are in a set.

Classification – The identification of an object by specific attributes, such as colour, texture, shape or size.

Conservation (of number) – The recognition that the number stays the same if none have been added or taken away.

Numeral - The written symbol for a number; e.g. 3, 2, 1

Ordinal - A number denoting the position in a sequence e.g. 1st, 2nd, 3rd, etc or page 1, page 2, page 3…

Partition - Separate a set into two or more subsets e.g. Partition a set of socks into plain and patterned.

Subitise - Instantly recognise a small quantity, without having to count how many there are.

Number - Number can be:

- a count of a collection of items e.g. three boxes,
- a measure e.g. of length or weight, or
- a label e.g. the number 17 bus

Quantity - The amount you have of something e.g. a cup of flour, three boxes, half an hour.

The Counting Principles

Following research from Gelman and Gallistel in 1978, it is vital that teachers understand the five counting principles.
(Gelman, R. & Gallistel, C. (1978) The Child's Understanding of Number. Cambridge, MA. Harvard University Press.)

1

The one-one principle. This involves children assigning one number name to each object that is being counted. Children need to ensure that they count each object only once ensuring they have counted every object.

Children will sometimes count objects more than once or miss an object out that needs to be counted. Encourage children to line up objects and touch each one as they count saying one number name per object. This will also help to avoid children counting more quickly than they touch the objects which again shows they have not grasped one-one correspondence.

1 2 3 4 5

The Counting Principles

2

The stable-order principle. Children understand when counting, the numbers have to be said in a certain order.

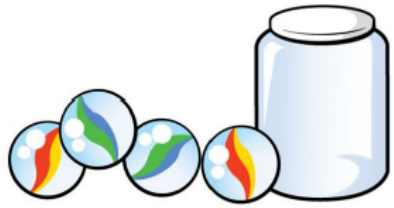
Children need to know all the number names for the amount in the group they are counting. Teachers can therefore encourage children to count aloud to larger numbers without expecting them to count that number of objects immediately.

3

The cardinal principle. Children understand that the number name assigned to the final object in a group is the total number of objects in that group.

In order to grasp this principle, children need to understand the one-one and stable-order principle. From a larger group, children select a given number and count them out. When asked 'how many?', children should be able to recall the final number they said. Children who have not grasped this principle will recount the whole group again.

The Counting Principles



4 **The abstraction principle.** This involves children understanding that anything can be counted including things that cannot be touched including sounds and movements e.g. jumps.

When starting to count, many children rely on touching the objects in order to count accurately. Teachers can encourage abstraction on a daily basis by counting claps or clicks. They can also count imaginary objects in their head to encourage counting on, this involves the children visualising objects.

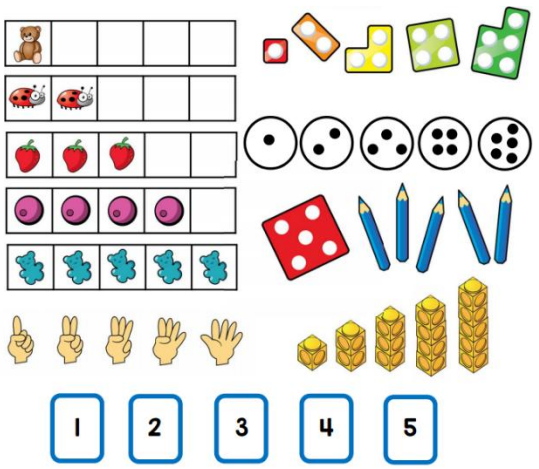
5 **The order-irrelevance principle.** This involves children understanding that the order we count a group of objects is irrelevant. There will still be the same number.

Encourage children to count objects, left to right, right to left, top to bottom and bottom to top. Once children have counted a group, move the objects and ask children how many there are, if they count them all again they have not fully grasped this principle.

Early Years Foundation Stage

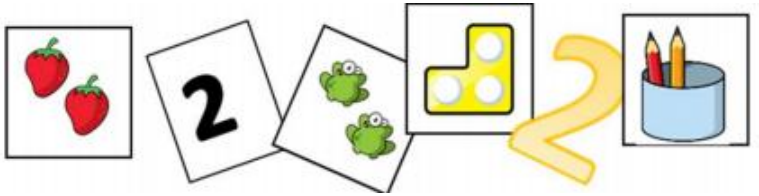
- **Count objects, actions and sounds**
  - Develop the key skills of counting objects including saying the numbers in order and matching one number name to each item.
  - Say how many there are after counting – for example, "…6, 7, 8. There are 8 balls" – to help children appreciate that the last number of the count indicates the total number of the group. This is the cardinal counting principle.
  - Say how many there might be before you count to give a purpose to counting: "I think there are about 8. Shall we count to see?"
  - Count out a smaller number from a larger group: "Please give me seven…" Knowing when to stop shows that children understand the cardinal principle.
  - Build counting into everyday routines such as counting out pieces of fruit.
  - Sing counting songs, number rhymes and read stories that involve counting.
  - Play games which involve counting.

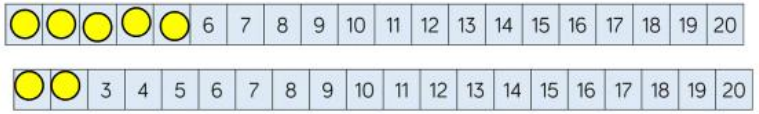
- **Subitise**
  - Show small quantities in familiar patterns (for example, dice) and random arrangements.
  - Play games which involve quickly revealing and hiding numbers of objects.
  - Put objects into five frames and then ten frames to begin to familiarise children with the tens structure of the number system. Prompt children to subitise first when enumerating groups of up to 4 or 5 objects: "I don't think we need to count those. They are in a square shape so there must be 4." Count to check.
  - Encourage children to show a number of fingers 'all at once', without counting.



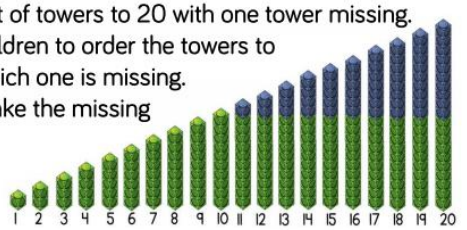
Early Years Foundation Stage

- **Link the number symbol (numeral) with its cardinal number value**
  - Display numerals in order alongside dot quantities or tens frame arrangements.
  - Play card games such as snap or matching pairs with cards where some have numerals, and some have dot arrangements.
  - Discuss the different ways children might record quantities (for example, scores in games), such as tallies, dots and using numeral cards.
- **Count beyond ten**
  - Count verbally beyond 20, pausing at each multiple of 10 to draw out the structure, for instance when playing hide and seek, or to time children getting ready.
  - Provide images such as number tracks, calendars and hundred squares indoors and out, including painted on the ground, so children become familiar with two-digit numbers and can start to spot patterns within them.
- **Compare numbers**
  - Provide collections to compare, starting with a very different number of things.
  - Include more small things and fewer large things, spread them out and bunch them up, to draw attention to the number not the size of things or the space they take up. Include groups where the number of items is the same.
  - Use vocabulary: 'more than', 'less than', 'fewer', 'the same as', 'equal to'. Encourage children to use these words as well.
  - Distribute items evenly, for example: "Put 3 in each bag," or give the same number of pieces of fruit to each child. Make deliberate mistakes to provoke discussion.
  - Tell a story about a character distributing snacks unfairly and invite children to make sure everyone has the same.





Provide a set of towers to 20 with one tower missing.
Ask the children to order the towers to identify which one is missing.
Can they make the missing tower?



Early Years Foundation Stage

- **Understand the 'one more than/one less than' relationship between consecutive numbers**

- Make predictions about what the outcome will be in stories, rhymes and songs if one is added, or if one is taken away.
- Provide 'staircase' patterns which show that the next counting number includes the previous number plus one.

- **Explore the composition of number to 10**

- Focus on composition of 2, 3, 4 and 5 before moving onto larger numbers.
- Provide a range of visual models of numbers: for example, six as double three on dice, or the fingers on one hand and one more, or as four and two with ten frame images.
- Model conceptual subitising: "Well, there are three here and three here, so there must be six."
- Emphasise the parts within the whole: "There were 8 eggs in the incubator. Two have hatched and 6 have not yet hatched."
- Plan games which involve partitioning and recombining sets. For example, throw 5 beanbags, aiming for a hoop. How many go in and how many don't?

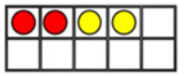
- **Automatically recall number bonds for numbers 0 – 5 and some to 1**

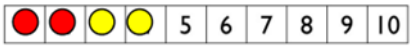
- Have a sustained focus on each number to and within 5.
- Help children to learn number bonds through lots of hands-on experiences of partitioning and combining numbers in different contexts, and seeing subitising patterns.
- Play hiding games with a number of objects in a box, under a cloth or in a tent, etc.: "6 went in the tent and 3 came out. I wonder how many are still in there?"
- Spot and use opportunities for children to apply number bonds: "There are 5 of us but only 2 clipboards. How many more do we need?"
- Place objects into a five frame and talk about how many spaces are filled and unfilled.

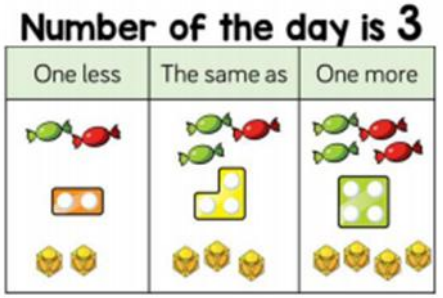
Use stories and number songs which count on and back to introduce the one more and one less patterns. Represent the patterns using bricks or cubes to support the understanding that each number is one more/less than the number before.

Use first, then, now to tell simple maths stories to practise adding more in real life contexts.

First there were 2 people on the bus.
Then 2 more people got on the bus.
Now there are 4 people on the bus.

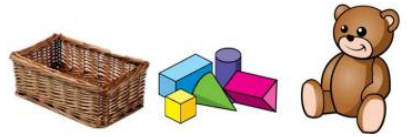


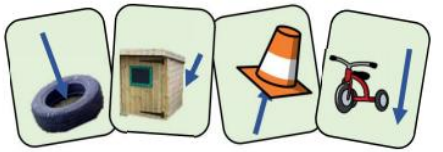




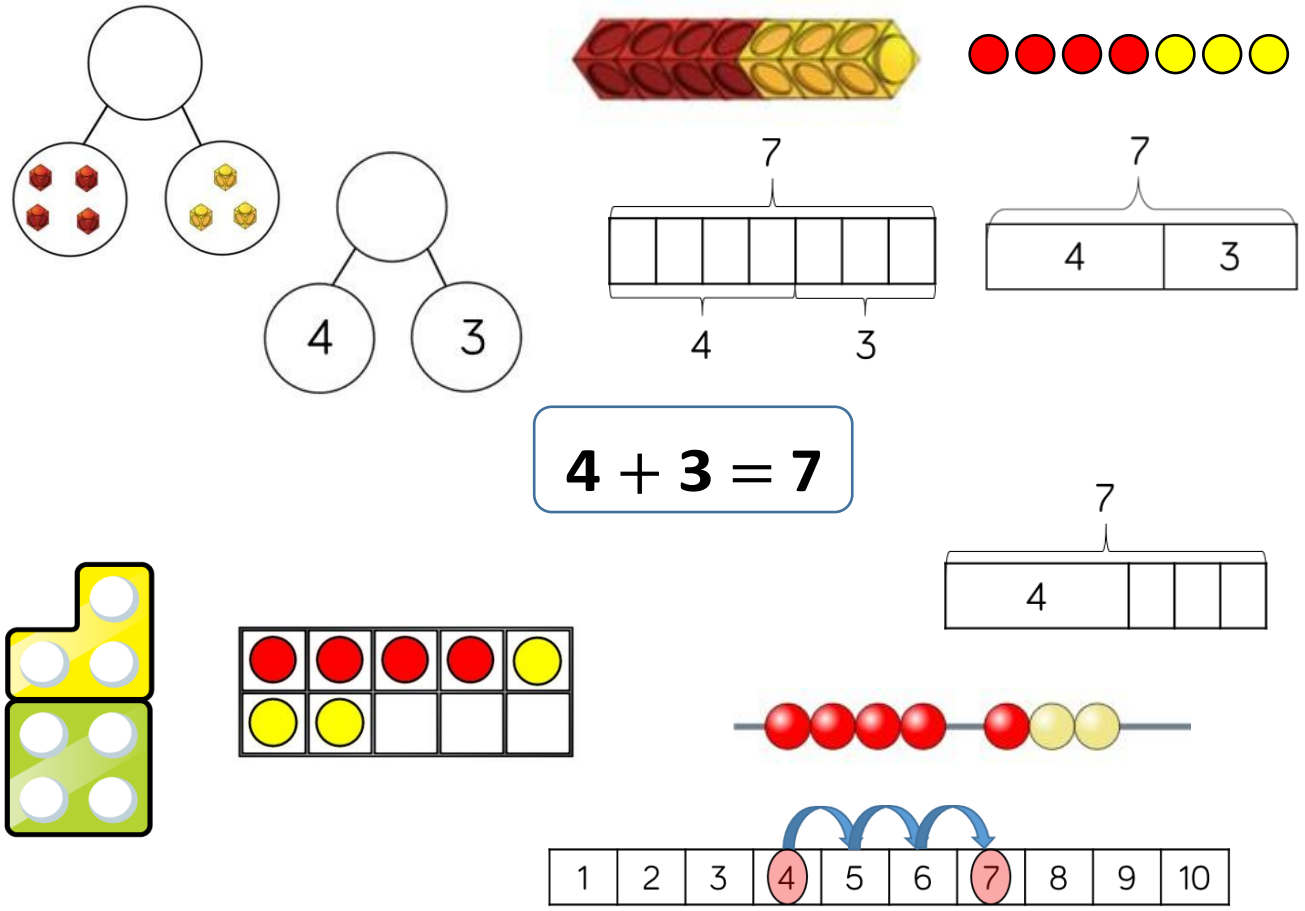
Early Years Foundation Stage

- **Select, rotate and manipulate shapes to develop spatial reasoning skills.**
  - Provide high-quality pattern and building sets, including pattern blocks, tangrams, building blocks and magnetic construction tiles, as well as found materials.
  - Challenge children to copy increasingly complex 2D pictures and patterns with these 3D resources, guided by knowledge of learning trajectories: “I bet you can’t add an arch to that,” or “Maybe tomorrow someone will build a staircase.”
  - Teach children to solve a range of jigsaws of increasing challenge.
- **Compose and decompose shapes so that children recognise a shape can have other shapes within it, just as numbers can.**
  - Investigate how shapes can be combined to make new shapes: for example, two triangles can be put together to make a square. Encourage children to predict what shapes they will make when paper is folded. Wonder aloud how many ways there are to make a hexagon with pattern blocks.
  - Find 2D shapes within 3D shapes, including through printing or shadow play.
- **Continue, copy and create repeating patterns.**
  - Make patterns with varying rules (including AB, ABB and ABBC) and objects and invite children to continue the pattern.
  - Make a deliberate mistake and discuss how to fix it
- **Compare length, weight and capacity.**
  - Model comparative language using ‘than’ and encourage children to use this vocabulary. For example: “This is heavier than that.”
  - Ask children to make and test predictions. “What if we pour the jugful into the teapot? Which holds more?”

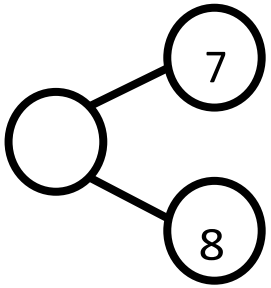


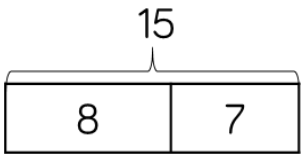


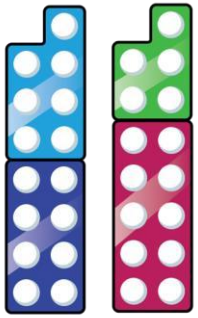
Addition

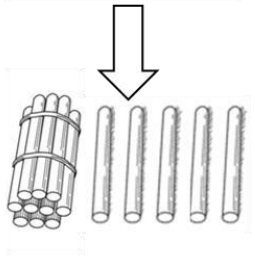
Skill: Add 1-digit numbers within 10	Year 1
	When adding numbers to 10, children can explore both aggregation and augmentation. The part-whole model, discrete and continuous bar model, number shapes and ten frame support aggregation. The combination bar model, ten frame, bead string and number track all support augmentation.

Skill: Add 1 and 2-digit numbers to 20

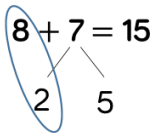


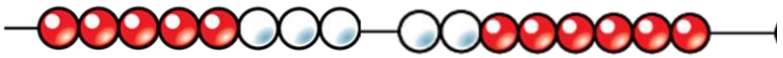


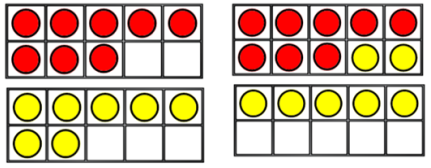


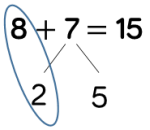


8 + 7 = 15



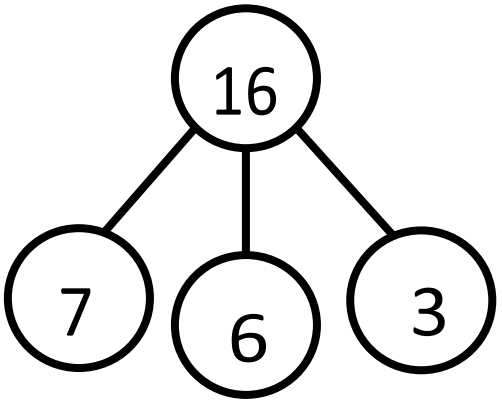
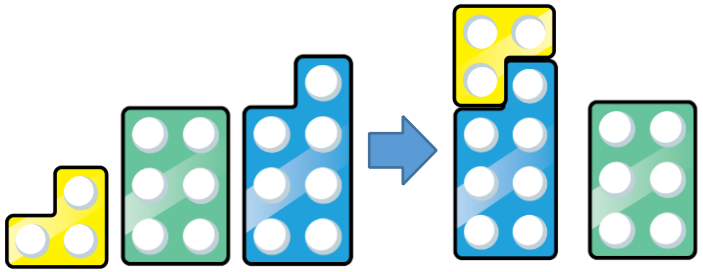
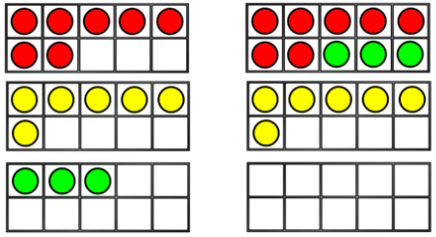
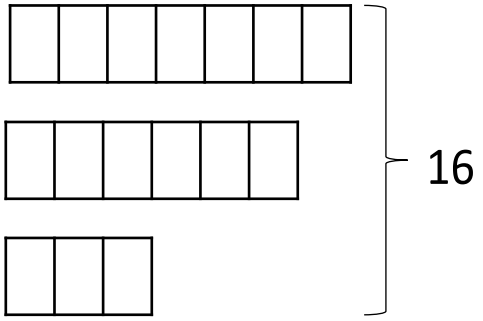




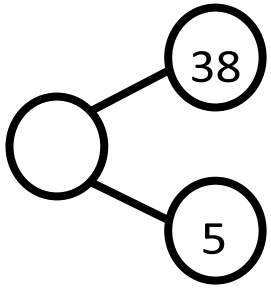


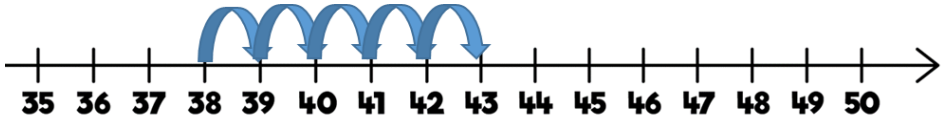
Year 1/2

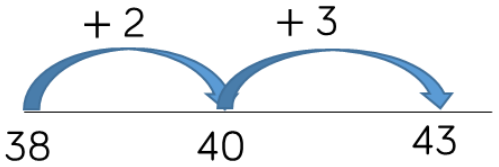
When adding one-digit numbers that cross 10, it is important to highlight the importance of ten ones equalling one ten. In Year 1, this is only done just by counting on. From Year 2, use different manipulatives can be used to represent this exchange alongside number lines to support children in understanding how to partition their jumps.

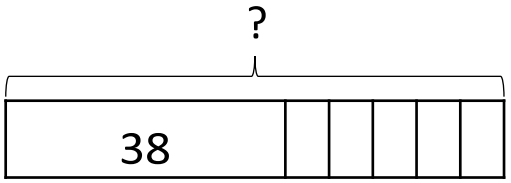
Skill: Add three 1-digit numbers	Year 2
  **7 + 6 + 3 = 16**  7 + 6 + 3 = 16 10 	When adding three 1-digit numbers, children should be encouraged to look for number bonds to 10 or doubles to add the numbers more efficiently. This supports children in their understanding of commutativity. Manipulatives that highlight number bonds to 10 are effective when adding three 1-digit numbers.

Skill: Add 1-digit and 2-digit numbers to 100

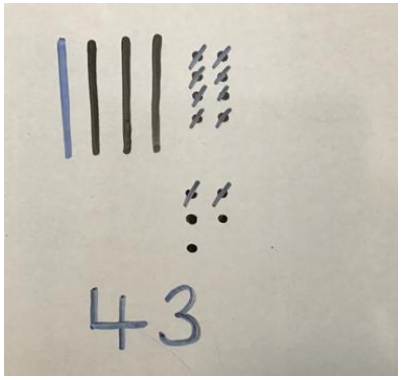








38 + 5 = 43



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

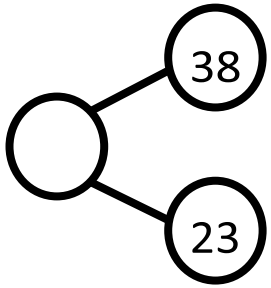
Year 2/3

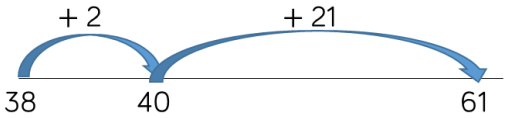
When adding single digits to a two-digit number, children should be encouraged to count on from the larger number.

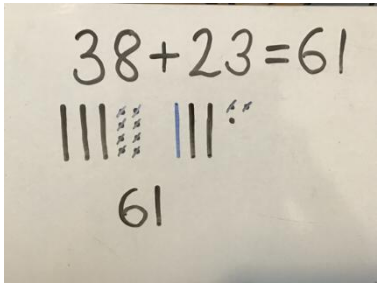
They should also apply their knowledge of number bonds to add more efficiently e.g. 8 + 5 = 13 so 38 + 5 = 43.

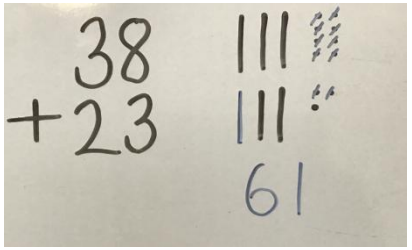
Hundred squares and straws can support children to find the number bond to 10.

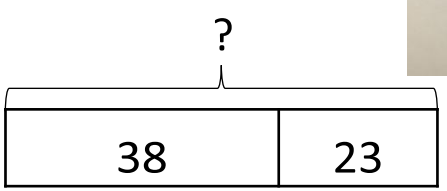
Skill: Add two 2-digit numbers to 100



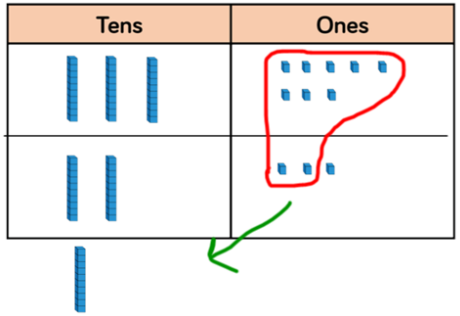




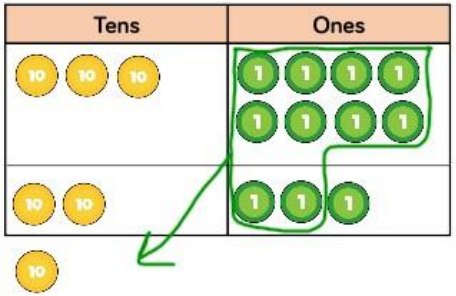




38 + 23 = 61



38
+ 23
61
1

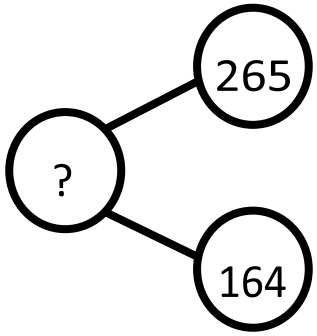


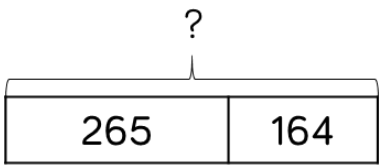
Year 2/3

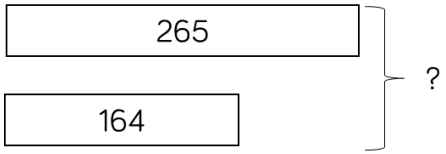
Children can use a blank number line and other representations to count on to find the total. Encourage them to jump to multiples of 10 to become more efficient.

From Year 3, encourage children to use the formal column method when calculating alongside straws, base 10 or place value counters. As numbers become larger, straws become less efficient.

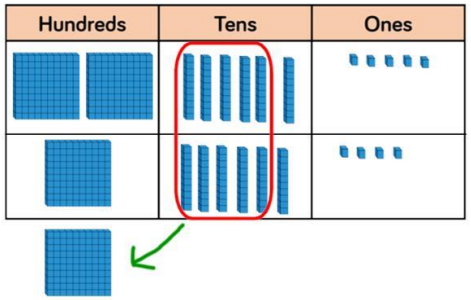
Skill: Add numbers with up to 3 digits



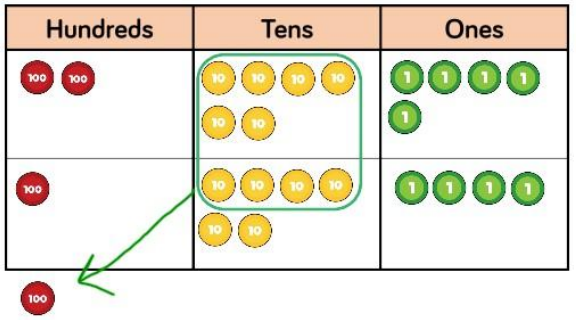




265 + 164 = 429



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



Year 3

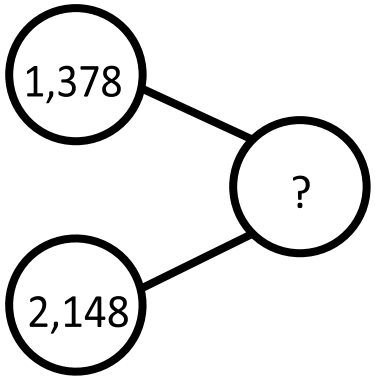
Base 10 and place value counters are the most effective manipulatives when adding numbers with up to 3 digits.

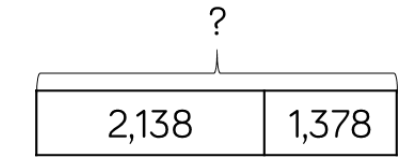
Ensure children write out their calculation alongside any concrete resources so they can see the links to the written column method.

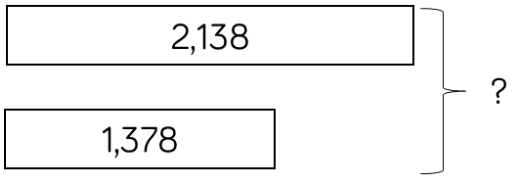
Plain counters on a place value grid can also be used to support learning.

Skill: Add numbers with up to 4 digits

Year 4



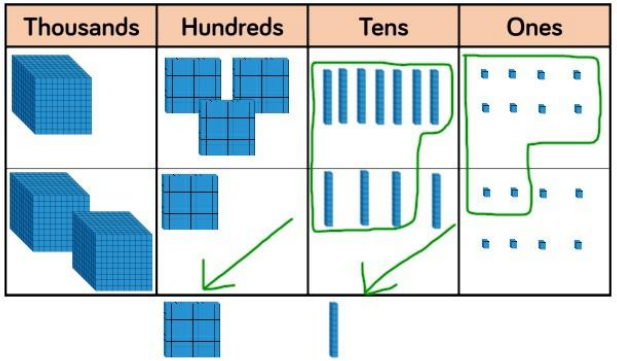


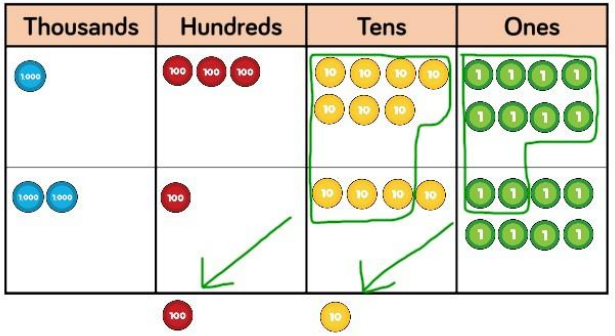


	1	3	7	8
+	2	1	4	8
	3	5	2	6

1 1

1,378 + 2,148 = 3,526



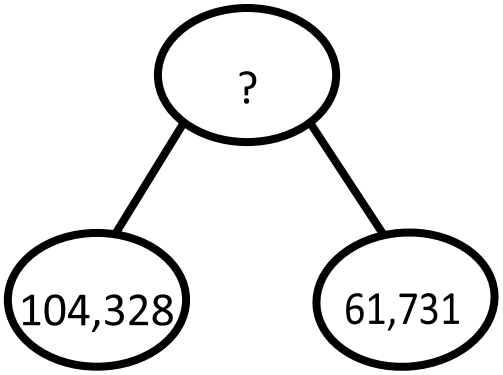


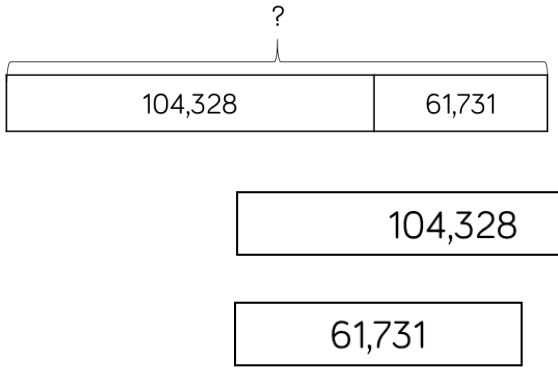
Base 10 and place value counters are the most effective manipulatives when adding numbers with up to 4 digits.

Ensure children write out their calculation alongside any concrete resources so they can see the links to the written column method.

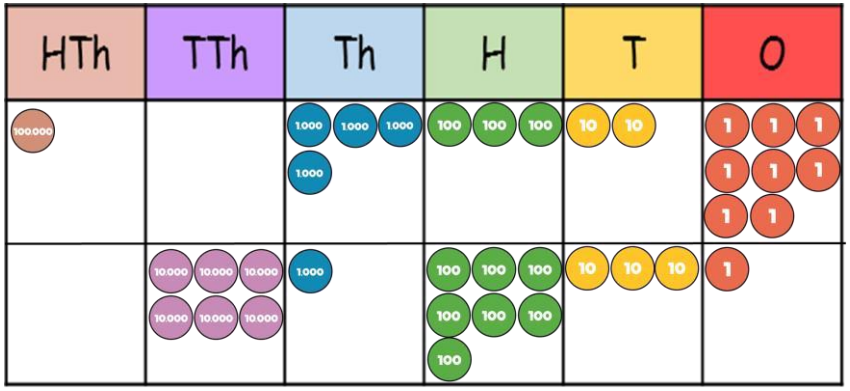
Plain counters on a place value grid can also be used to support learning.

Skill: Add numbers with more than 4 digits





104,328 + 61,731 = 166,059



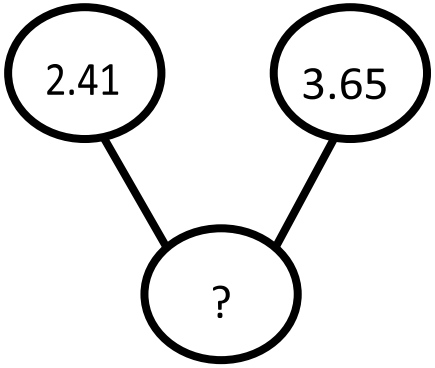
1	0	4	3	2	8
+	6	1	7	3	1
1	6	6	0	5	9

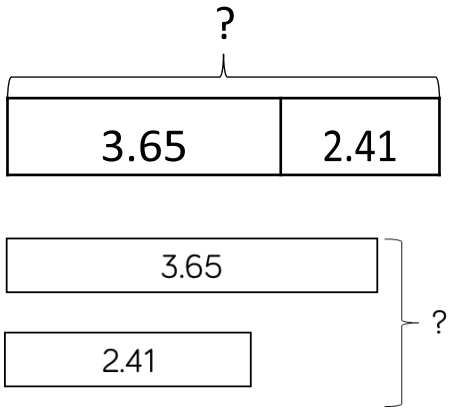
Year 5/6

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.

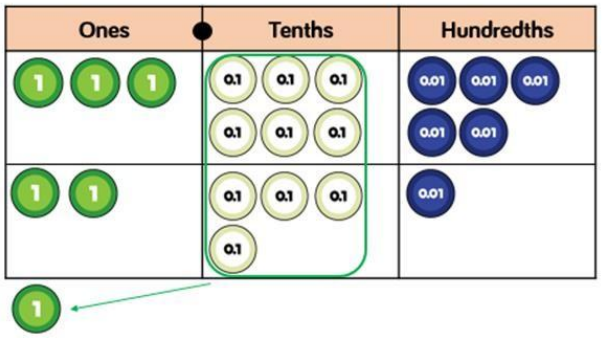
Skill: Add with up to 3 decimal places

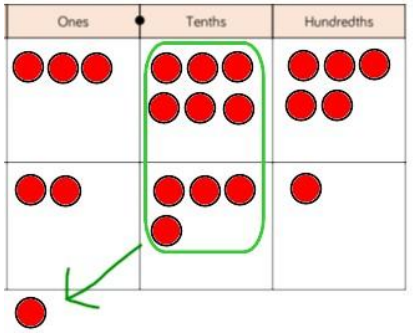




$$\begin{array}{r} 3.65 \\ +\ 2.41 \\ \hline 6.06 \\ \hline 1 \end{array}$$

3.65 + 2.41 = 6.06





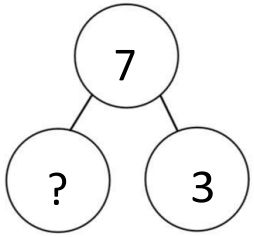
Year 5/6

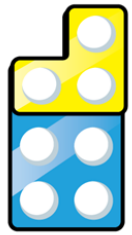
Place value counters and plain counters on a place value grid are the most effective manipulatives when adding decimals with 1, 2 and then 3 decimal places.

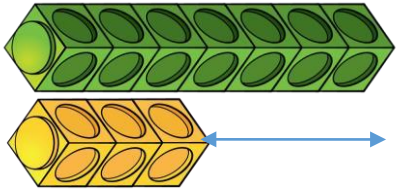
Ensure children have experience of adding decimals with a variety of decimal places. This includes putting this into context when adding money and other measures.

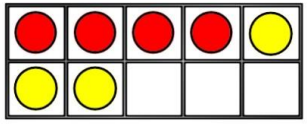
Subtraction

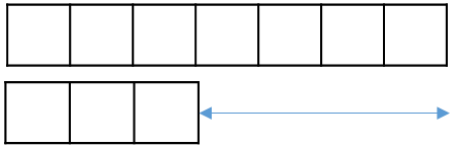
Skill: Subtract 1-digit numbers within 10



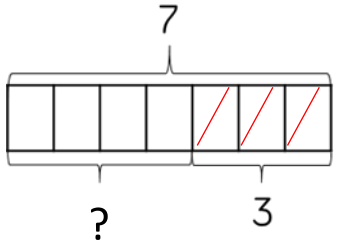


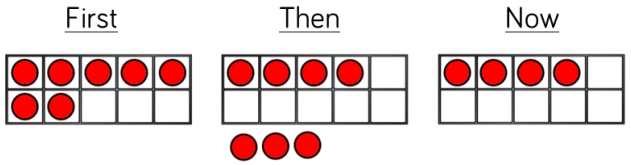


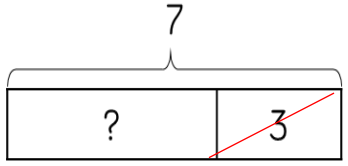


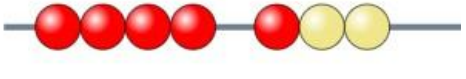


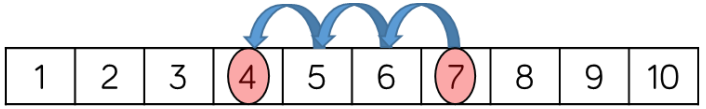
$$7 - 3 = 4$$











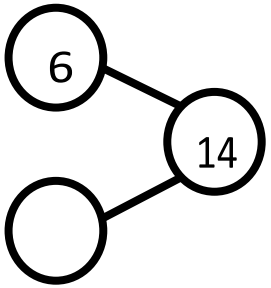
Year 1

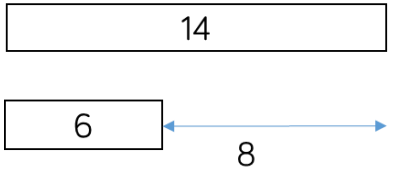
Part-whole models, bar models, ten frames and number shapes support partitioning.

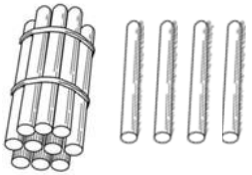
Ten frames, number tracks, single bar models and bead strings support reduction.

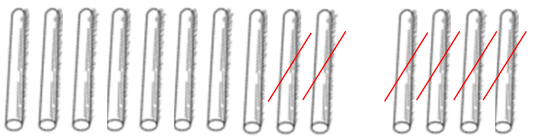
Cubes and bar models with two bars can support finding the difference.

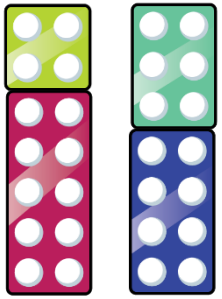
Skill: Subtract 1 and 2-digit numbers to 20



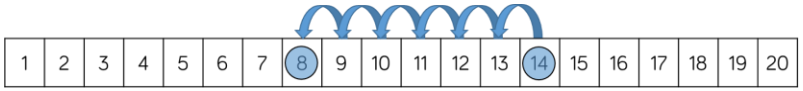


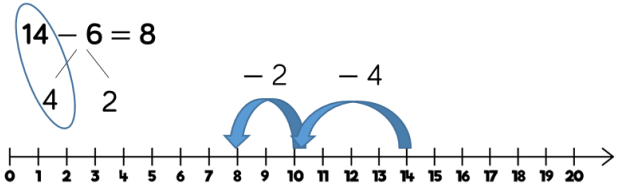


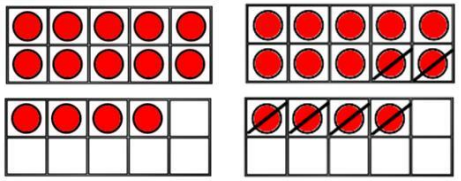


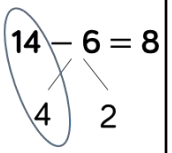


14 − 6 = 8





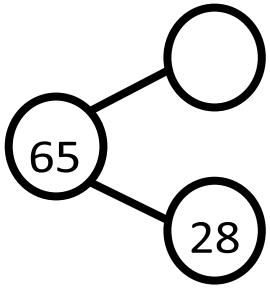


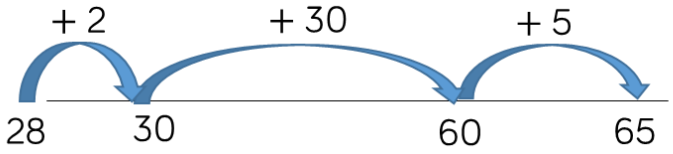


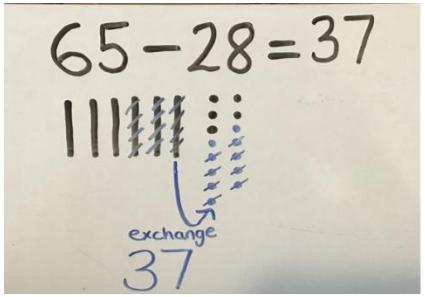
Year 1/2

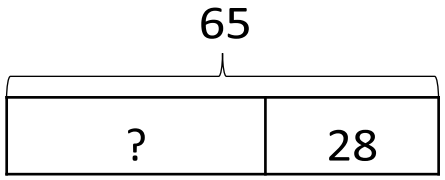
In Year 1, subtracting one-digit numbers that cross 10, is done by counting back, using objects, number tracks and number lines. From Year 2, children should be encouraged to find the number bond to 10 when partitioning the subtracted number. Ten frames, number shapes and number lines are particularly useful for this.

Skill: Subtract 1 and 2-digit numbers to 100

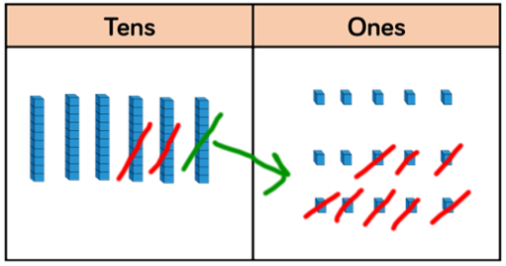




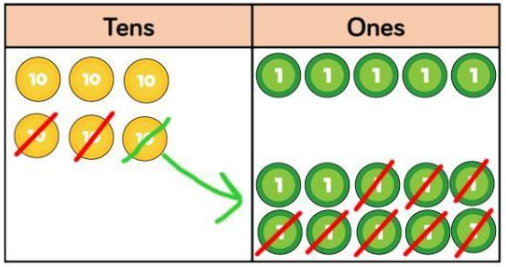




65 − 28 = 37



$$\begin{array}{r} {}^{5}\not{6}\,{}^{1}\not{5} \\ -\ 2\ 8 \\ \hline 3\ 7 \end{array}$$

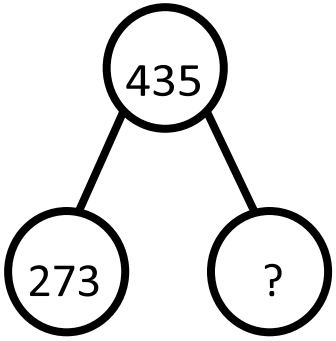


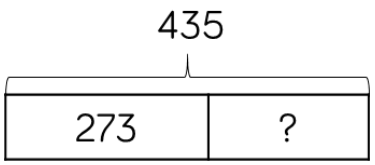
Year 2/3

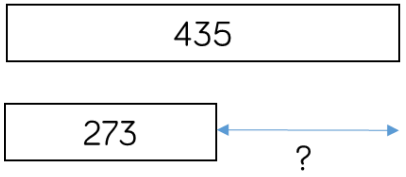
Children can also use a blank number line to count back to find the difference. Encourage them to jump to multiples of 10 to become more efficient.

From Year 3, encourage children to use the formal column method when calculating alongside straws, base 10 or place value counters. As numbers become larger, straws become less efficient.

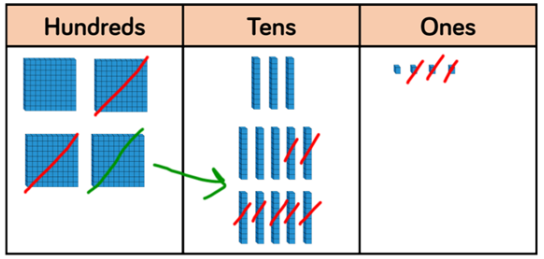
Skill: Subtract numbers with up to 3 digits



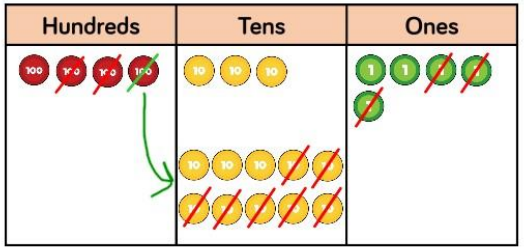




$$435 - 273 = 162$$



$$\begin{array}{r} {}^{3}\not{4}{}^{1}35 \\ -\ 273 \\ \hline 162 \end{array}$$



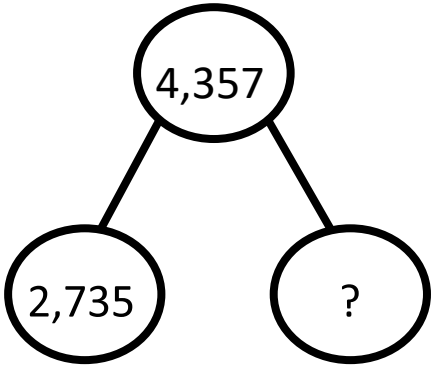
Year 3

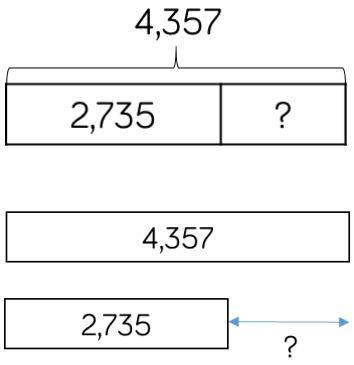
Base 10 and place value counters are the most effective manipulative when subtracting numbers with up to 3 digits.

Ensure children write out their calculation 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.

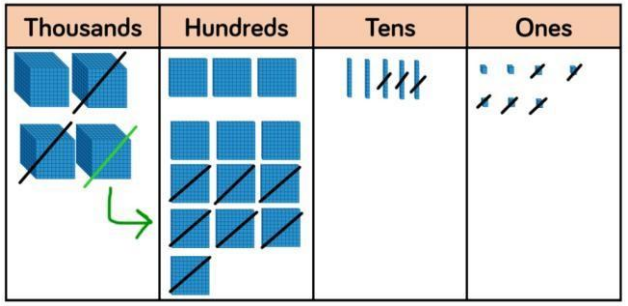
Skill: Subtract numbers with up to 4 digits

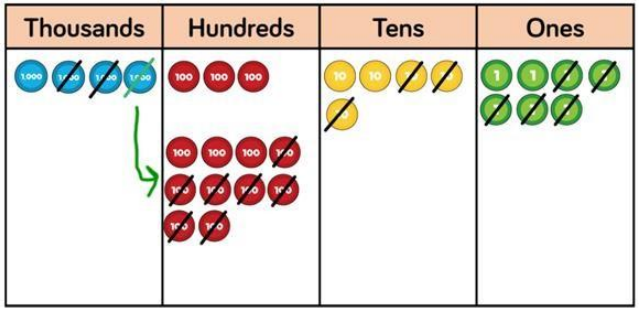




$$\begin{array}{r} {}^{3}\cancel{4}{}^{1}357 \\ -\ 2735 \\ \hline 1622 \end{array}$$

4,357 − 2,735 = 1,622





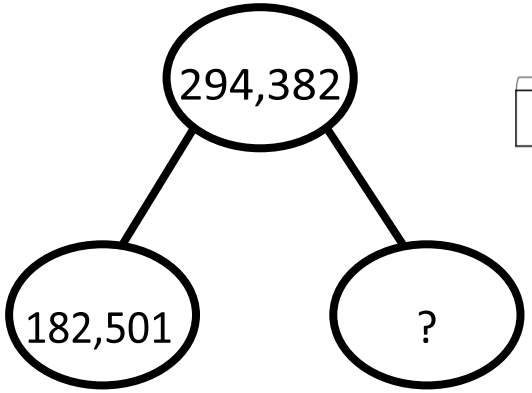
Year 4

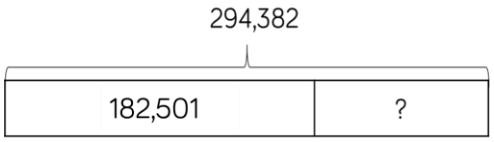
Base 10 and place value counters are the most effective manipulatives when subtracting numbers with up to 4 digits.

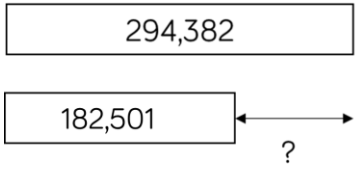
Ensure children write out their calculation alongside any concrete resources so they can see the links to the written column method.

Plain counters on a place value grid can also be used to support learning.

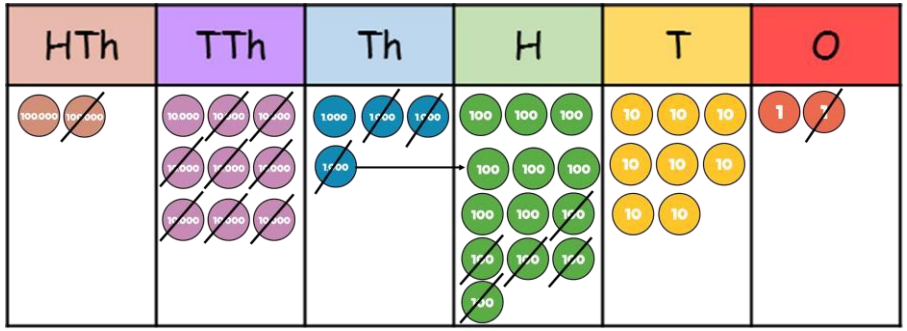
Skill: Subtract numbers with more than 4 digits







294,382 − 182,501 = 111,881



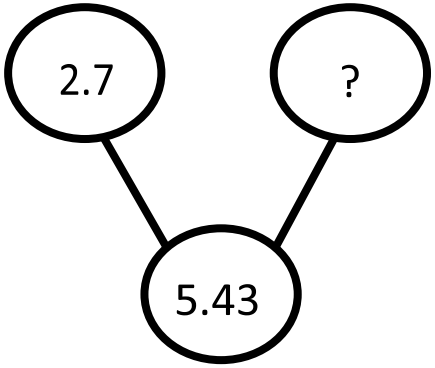
	2	9	$^{3}\cancel{4}$	$^{1}3$	8	2
−	1	8	2	5	0	1
	1	1	1	8	8	1

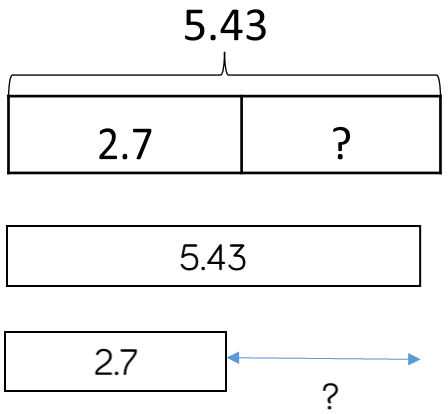
Year 5/6

Place value counters or plain counters on a place value grid are the most effective concrete resource when subtracting numbers 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.

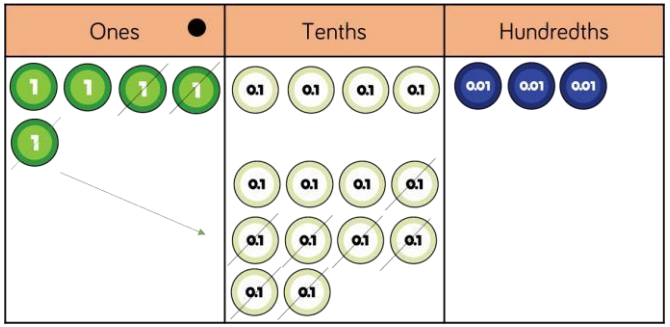
Skill: Subtract with up to 3 decimal places

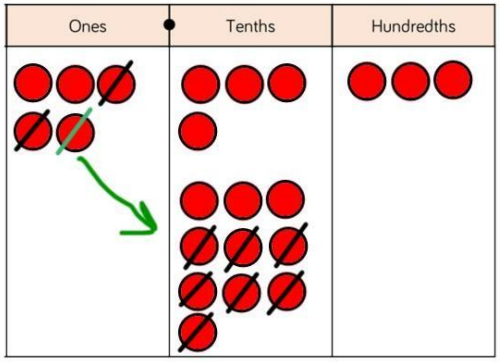




$$\begin{array}{r} {}^{4}\cancel{5}^{1}.43 \\ -\ 2.7 \\ \hline 2.73 \end{array}$$

5.43 − 2.7 = 2.73





Year 5/6

Place value counters and plain counters on a place value grid are the most effective manipulative when subtracting decimals with 1, 2 and then 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.

Glossary

Addend - A number to be added to another.

Aggregation - combining two or more quantities or measures to find a total.

Augmentation - increasing a quantity or measure by another quantity.

Commutative – numbers can be added in any order.

Complement – in addition, a number and its complement make a total e.g. 300 is the complement to 700 to make 1,000

Difference – the numerical difference between two numbers is found by comparing the quantity in each group.

Exchange – Change a number or expression for another of an equal value.

Minuend – A quantity or number from which another is subtracted.

Partitioning– Splitting a number into its component parts.

Reduction – Subtraction as take away.

Subitise – Instantly recognise the number of objects in a small group without needing to count.

Subtrahend - A number to be subtracted from another.

Sum - The result of an addition.

Total – The aggregate or the sum found by addition.