St. John's C. of E.

Primary School

Mathematics Calculation Policy

September 2022

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Fluent computational skills are dependent on accurate and rapid recall of basic number bonds to 20 and times-tables facts. Spending a short time every day on these basic facts quickly leads to improved fluency. This can be done using simple whole class chorus chanting or quick fire recall of facts. This is not meaningless rote learning; rather, this is an important step to developing conceptual understanding through identifying patterns and relationships between the tables (for example, that the products in the 6× table are double the products in the 3× table). This has helped children develop a strong sense of number relationships, an important prerequisite for procedural fluency. It helps children to learn their multiplication tables in this order to provide opportunities to make connections.

In order to be confident at formal calculation methods children need a range of skills and knowledge:

Move between the concrete and the abstract (CPA approach)

Children's conceptual understanding and fluency is strengthened if they experience concrete, visual and abstract representations of a concept during a lesson. Moving between the concrete and the abstract helps children to connect abstract symbols with familiar contexts, thus providing the opportunity to make sense of, and develop fluency in the use of, abstract symbols. For example, in a lesson about addition of fractions children could be asked to draw a picture to represent the sum Alternatively, or in a subsequent lesson, they could be asked to discuss which of three visual images correctly represents the sum, and to explain their reasoning.

Develop children's fluency in mental calculation

Efficiency in calculation requires having a variety of mental strategies. In particular emphasise the importance of 10 and partitioning numbers to bridge through 10. For example: 9 + 6 = 9 + 1 + 5 = 10 + 5 = 15. It can be referred to as "magic 10". It is helpful to make a 10 as this makes the calculation easier.

Develop fluency in the use of formal written methods

Teaching column methods for calculation provides the opportunity to develop both procedural and conceptual fluency. It is important to ensure that children understand the structure of the mathematics presented in algorithms, with a particular emphasis on place value. We often use base ten apparatus and use illustrations in textbooks to support the development of fluency and understanding. Informal methods of recording calculations are an important stage to help children develop fluency with formal methods of recording.

Contextualise the mathematics

A lesson about addition and subtraction could start with this contextual story: "There are 11 people on a bus. At the next stop 4 people get on. At the next stop 6 people get off. How many are now on the bus?"

This helps children develop their understanding of the concepts of addition and subtraction. But during the lesson the teacher should keep returning to the story. For example, if the children are thinking about this calculation 14 – 8 then the teacher should ask the children: "What does the 14 mean? What does the 8 mean?, expecting that children will answer: "There were 14 people on the bus, and 8 is the number who got off."

Then asking the children to interpret the meaning of the terms in a calculation such as 7 + 7 = 14 will give a good assessment of the depth of their conceptual understanding and their ability to link the concrete and abstract representations of mathematics.

Use questioning to develop mathematical reasoning

Teachers' often ask questions in mathematics lessons asked in order to find out whether children can give the right answer to a calculation or a problem. But in order to develop children's conceptual understanding and fluency there needs to be a strong and consistent focus on questioning that encourages and develops their mathematical reasoning.

This can be done simply by asking children to explain how they worked out a calculation or solved a problem, and to compare and contrast different methods that are described. Children quickly come to expect that they need to explain and justify their mathematical reasoning, and they soon start to do so automatically – and enthusiastically. Some calculation strategies are more efficient and it's important that teachers scaffold children's thinking to guide them to the most efficient methods, whilst at the same time valuing their own ideas.

Rich questioning strategies include:

- "What's the same, what's different?"
- "Odd one out"
- "Here's the answer. What could the question have been?"
- Identify the correct question
- True or False
- Greater than, less than or equal to >, <, or =

Expect children to use correct mathematical terminology and to express their reasoning in complete sentences

The quality of children's mathematical reasoning and conceptual understanding is significantly enhanced if they are consistently expected to use correct mathematical terminology (e.g. saying 'digit' rather than 'number') and to explain their mathematical thinking in complete sentences.

Identify difficult points and misconceptions

Misconceptions need to be identified and anticipated when lessons are being designed and these need to be an explicit part of the teaching, rather than the teacher just responding to children's problems if they happen to arise in the lesson. The teacher should be actively seeking to uncover possible misconceptions because if one child has an issue it is likely that others will have a similar problem. Misconceptions also give an opportunity to reinforce that we learn most by working on and through ideas with which we are not fully secure or confident. Discussion about misconceptions can be stimulated by asking children to share thoughts about their own examples when these show errors arising from insufficient understanding.

Mathematical Vocabulary

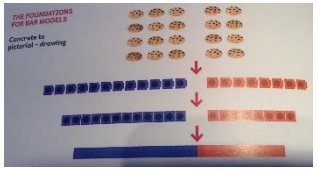
Addition	Subtraction	Multiplication	Division
Add	Take away	Repeated addition	Groups of
Plus	Count back	Times	Into groups of
More	Less	Array	Halve
Altogether	Minus	Multiply	Share
Total	Fewer	Groups of	Equally
Increase	Difference	Double	Into lots of
Make	Count on	Multiplication	Divided by
And	How many more than…	Multiples	Half
Carry	Subtract	Factor	Quarter
Symbol	Decrease	Product	Remainder
Operation	Exchange	Lots of	Factor
Equals	Symbol	Arrays	Divisible
Addend	Operation	Symbol	Divisor
Sum*	Equals	Operation	Dividend
		Equals	Quotient
			Regroup
			Symbol
			Operation
			Equals

* ‘sum’ is a term used for an addition calculation. No other operation uses this term.

The Bar Model Method

The bar model method is a strategy used by children to visualise mathematical concepts and solve problems. The method is a way to represent a situation in a word problem, usually using rectangles.
The bar model is to be used alongside the appropriate calculation/calculations (refer to calculation policy)
Bar model method uses the concrete pictorial and abstract (CPA) sequence when teaching problem solving. The process starts by using real world, tangible representations, before moving onto showing the problem using a pictorial diagram before then introducing the abstract algorithms and notations.

The bar model method is pictorial and it develops from children handling actual objects, to drawing pictures and then drawing boxes to represent objects. Eventually, they will no longer need to draw all the boxes, which represents individual units, instead they just draw one long bar and label it with a number. At this stage the bars do need to be somewhat proportional, so in the example above the purple bar representing 12 cookies is longer than the orange bar representing 8 cookies.



The particular power of the bar modelling pictorial approach is that it is applicable across a large number of topics. Once children have the basics of the approach secured, they can easily extend it across many topics.

A good understanding of the four operations is needed to use bar models. Children need to have strategies to add, subtract multiply and divide for them to use bar models. Bar models don't give you an answer – it gives you an understanding of what to do to get to the answer. The what to do part is where children would normally use the four operations.

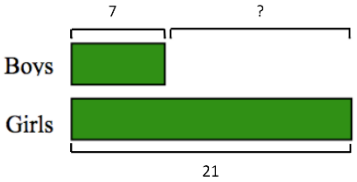
There are two types of bar model:

Part Whole Model:

20 + 5 = 25

a + b = c

Comparison Model:

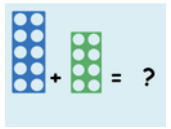
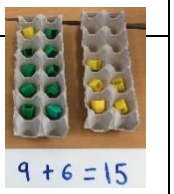
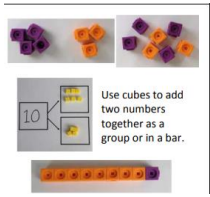
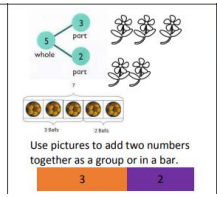
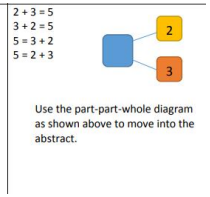
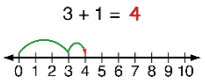
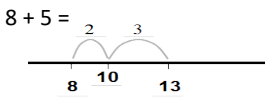


In a cross country race there were 21 girls running and 7 boys. How many more girls were there than boys?

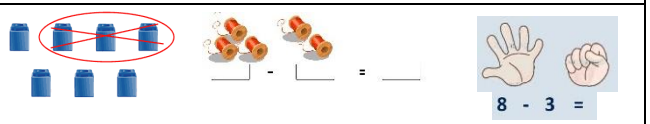
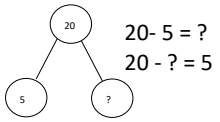
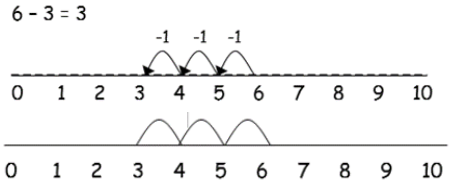
As a school we have decided to write the total above the bar model and the parts underneath. The brackets are to be straight.

Year 1

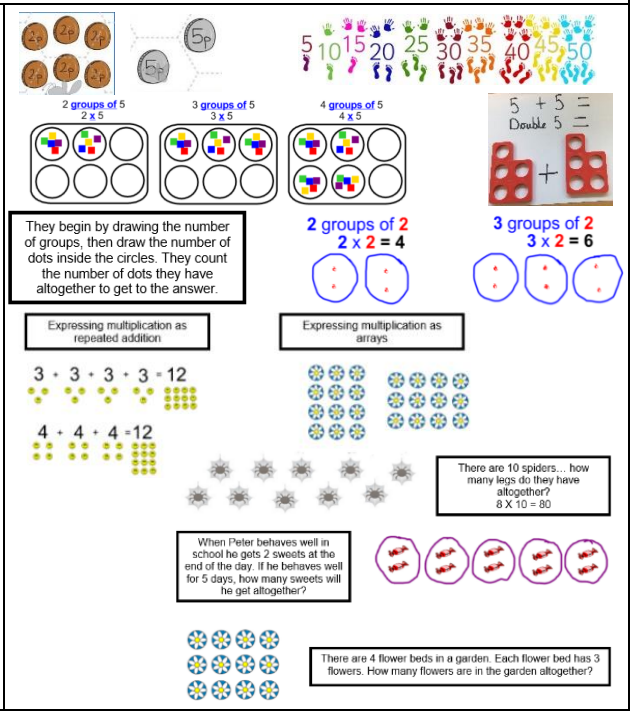
Addition

Year Group	Number Facts Pupils should be taught to:	Written Calculations and Appropriate Models and Images to Support Conceptual Understanding	
1	• Represent and use number bonds and related subtraction facts within 20 (rapid recall) • Children to understand that addition can be done in any order (commutative)	Children are encouraged to count on using practical resources e.g. using fingers, cubes, Numicon, beads to solve addition sentences including missing numbers. Children to record their number sentence. Children to draw pictorially to solve addition problems. Children to use base 10 apparatus (e.g. egg boxes) to solve number facts up to 20 including bridging through10 e.g. 8+4= Children to record their number sentence. Children to use a number line to count on in ones. They also use to bridge through 10 in larger jumps applying knowledge of number facts Children to add by partitioning e.g. 2 + 4 = 6 12+ 4 = 16 Children to solve number sentences involving missing numbers and where the number sentence starts with the answer e.g.15 = 10 + 5	        5 + ☐ = 11 | 8 + ☐ = 12

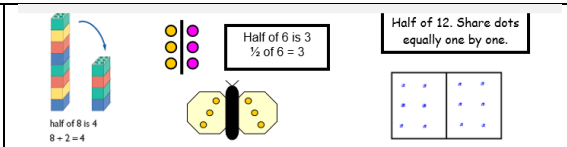
Subtraction

Year Group	Number Facts Pupils should be taught to:	Written Calculations and Appropriate Models and Images to Support Conceptual Understanding	
1	• Represent and use number bonds and related subtraction facts within 20 (rapid recall) • Understand that subtraction must have the largest number first	Children are encouraged to count back using practical resources e.g. using fingers, cubes, Numicon, beads to solve subtraction sentences including missing number. Children to draw pictorially to solve subtraction problems. Children to subtract using a number line starting with the largest number and counting back in ones (subtracting a one digit number) The number line should also be used to show that 6 – 3 means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart. Children to use base 10 apparatus e.g. egg boxes to bridge through 10. Children to also show on a number line. Children to use their knowledge of place value to partition a number to subtract 1 digit from 2 digit.	  20- 5 = ? 20 - ? = 5 20 - □ = 10  16 – 4 = 6 – 4 = 2 so 16 – 4 = 12

Multiplication

Year Group	Number Facts Pupils should be taught to:	Written Calculations and Appropriate Models and Images to Support Conceptual Understanding	
1	• Children count in steps of 2, 5 and 10	Children to use numicon and other appropriate resources to count in 2s, 5s and 10s Children to use laminated sheets with circles (groups) on them, children group objects using the correct mathematical vocabulary. Children to begin to use jottings of simple multiplication with the associated vocabulary. Children to use numicon, cubes, beads, and any other appropriate apparatus. Children are exposed to the different ways in which multiplication can be expressed using the concrete materials and linking it to real life situations. They <u>begin</u> to understand that repeated addition can also be expressed as multiplication using concrete materials. Children begin to commit multiples of 2, 5, 10 to memory and use these facts to solve problems Children will draw their own arrays using dots to represent objects.	

Division

Year Group	Number Facts Pupils should be taught to:	Written Calculations and Appropriate Models and Images to Support Conceptual Understanding	
1	• Children count in steps of 2, 5 and 10	Children to use Numicon, cubes, beads, and any other appropriate apparatus to share amounts within 20. They will then be able to group within 20. Children to share objects practically	

		Children use grouping to solve problems involving division. With the help of laminated sheets children place the given number of objects into groups using the correct mathematical vocabulary. Grouping with the use of jottings. Children first draw the total number of items using dots, then put circles around the given number of dots. They count the number of groups to obtain an answer. Children will draw their own arrays using dots to represent objects.