Moorside
Primary School

Calculation Policy

MOORSIDE PRIMARY SCHOOL

PURPOSE, VISION & VALUES

Our Purpose
Moorside Primary is a school at the heart of our diverse community in the West End of Newcastle.
We pride ourselves in being a caring school community where everyone is welcome.
We strive to deliver an outstanding education for all our children.
We help everyone to become caring and active citizens
We encourage everyone to thrive and achieve their full potential.

Our Vision
We want everyone in our school to work together to make us as good as any school can be.
We want to create new opportunities for everyone to succeed.
We want to create a culture which broadens all of our horizons.
We want everyone to be able to tackle the challenges we will face in an ever changing world.
We want all of our children to effectively engage with each other and with our community.

Our values
We all believe that
Our local community deserves a school they can be proud of.
We are a caring community where everyone is welcome.
We all value, respect and support each other.
Our community has the right to be safe and healthy.
Our children should have the chance to enjoy and be enthused by their time in our school.

We all work together to make sure that
Everyone always tries their best and take pride in all that they do.
Everyone demonstrates good manners at all times.
Everyone respects each other and show consideration.
Everyone respects and cares for our environment and resources.
Everyone celebrates each other’s successes and achievements.

Introduction

Concrete, Pictorial and Abstract approach

The **Concrete Pictorial Abstract** (CPA) approach is a method of learning that uses physical and visual aids to build a child's understanding of abstract topics.

Concrete

As part of the CPA approach, new concepts are introduced through the use of physical objects or practical equipment. These can be physically handled, enabling children to explore different mathematical concepts. These are sometimes referred to as maths manipulatives and can include mathematical resources such as: base ten, numicon or place value counters.

All children, regardless of ability, benefit from the use of practical resources in ensuring understanding goes beyond the learning of a procedure.

Practical resources promote reasoning and discussion, enabling children to understand, articulate and explain a concept. Teachers are also able to observe the children to gain a greater understanding of where misconceptions lie and to establish the depth of their understanding.

Pictorial

Once children are confident with a concept using concrete resources, they progress to drawing pictorial representations or quick sketches of the objects. By doing this, they are no longer manipulating the physical resources, but still benefit from the visual support the resources provide. A variety of different pictorial representations can be used such as: number lines, part- part whole models or base ten jottings.

Abstract

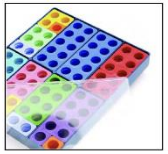
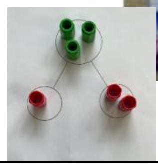
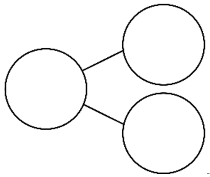
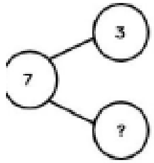
Once children have a secure understanding of the concept through the use of concrete resources and visual images, they are then able to move on to the abstract method. To be able to access this stage effectively, children need access to the previous two stages alongside it. Examples of abstract methods are: column addition/subtraction, short multiplication/division.

For the most effective learning to take place, children need to constantly go back and forth between each of the stages. This ensures concepts are reinforced and understood.

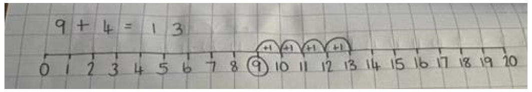
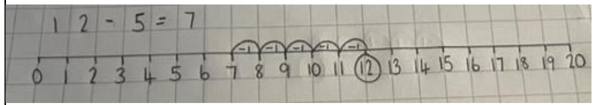
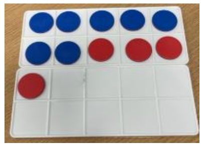
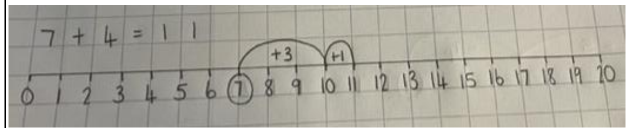
When concrete resources, pictorial representations and abstract recordings are all used within the same activity, it ensures children are able to make strong links between each stage.

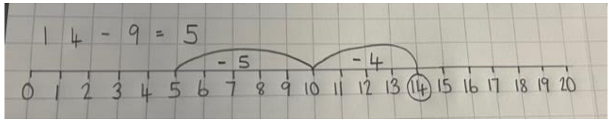
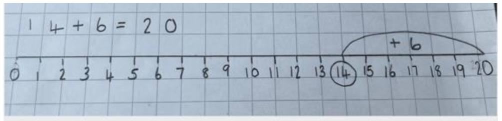
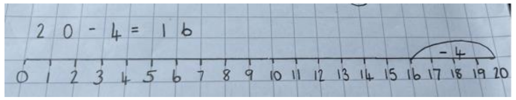
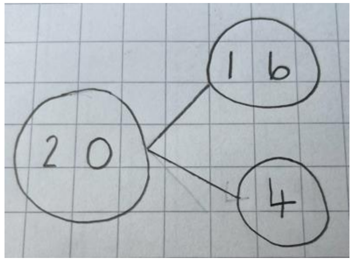
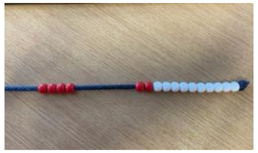
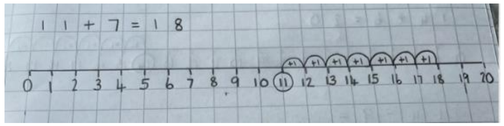
Reception – Number

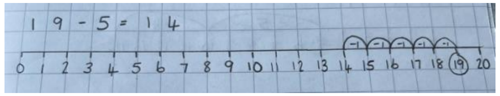
Guidance from [Improving Mathematics in the Early Years and Key Stage 1 – Guidance Report,](#) suggests ‘manipulatives and representations can be powerful tools for supporting young children to engage with ideas across many areas of mathematics. It is important that children have opportunities to engage in both free and structured play with manipulatives.’

Learning Intentions	Concrete	Pictorial	Abstract	Vocabulary Possible question stems
Count objects, actions and sounds. Subitise. Link the number symbol (numeral) with its cardinal number value. Count beyond ten. Compare numbers. Understand the ‘one more than/one less than’ relationship between consecutive numbers. Explore the composition of numbers to ten. Automatically recall number bonds for numbers 0-5 and some to 10.	Use of indoor and outdoor learning environments for children to be modelled counting, grouping, regrouping. Use of daily routines and counting games/songs, where children are actively involved. Use specific maths resources such as: counters, numicon, Rekenreks to model and explore the relationships between numbers.    Use visual mathematical aids such as: ten frames, part-part whole mats using physical objects that can be manipulated.  	Groups of pictures so children are able to count the total. Use of number tracks/number lines to count, compare numbers, understand the concept of one more than/one less than.  Use of visual part- part whole diagrams and ten frames to add pictures or numbers to. 	The use of key vocabulary, children should be modelled verbally explaining their mathematical concepts. When counting on, children should be encouraged to start with the largest number. Introduce to children who are ready, symbols and number sentences. Provide opportunities for children to identify missing numbers. 	zero number one, two, three … to twenty and beyond teen numbers, eleven, twelve … twenty none is the same as more, less odd, even few pattern add more altogether total double take away count, count (up) to, count on (from, to) count back (from, to) How many …? How many more to make? How many are left?

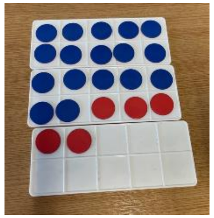
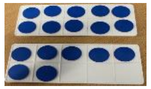
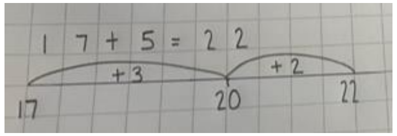
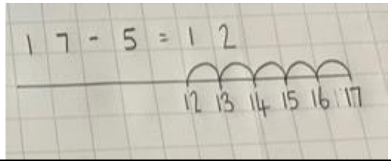
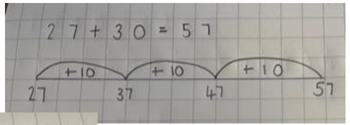
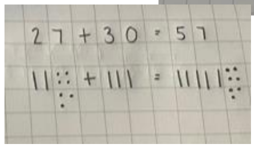
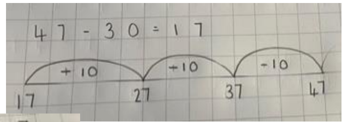
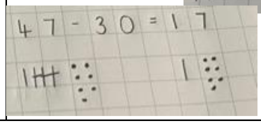
<u>Year 1 Addition and Subtraction</u>

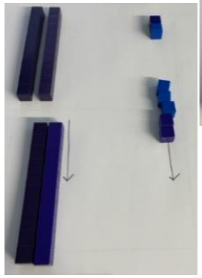
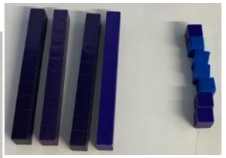
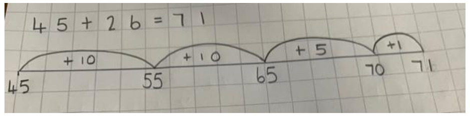
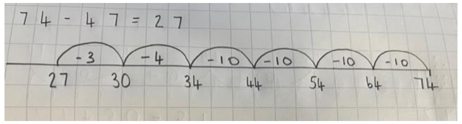
Learning Intention	Concrete	Pictorial	Abstract	Vocabulary Possible question stems
Count on from the larger number. Count back.	Start with the larger number on the bead string and then count on the smaller number one by one to find the answer.  Move the beads away from the group counting backwards.	Start with the larger number on the number line and count on in ones or in one jump to find the answer. 9 + 4 = 11  12 – 5 = 7  Count back in ones using a number line. Children need to be modelled the process and layout of counting the jumps forwards and backwards.	Place the larger number in your head and count on the smaller number to find the answer. Place the number (12) in your head. Count back (5). What number do we get?	counting count on count up add ones larger number smaller number equals How many more ….? What number are we starting with? How many do we need to add on/count on from? How many are left? How many have gone?
Regrouping to make 10.	Using ten frames or bead strings, start with the larger number and use the smaller number to make ten and then add remaining number. 7 + 4 = 11 	Use a number line to regroup or partition the smaller number . 7 + 4 = 11 	7 + 4 = 11 If I am at seven, how many more do I need to make 10? How many more do I add on now? 14 – 9 = 5 How many do we need to subtract from 14 to get 10? (4) How many more do we need to subtract to make the total 9? (5)	add regroup partition larger number smaller number How many more do I need to make 10? How many more do I add on now?

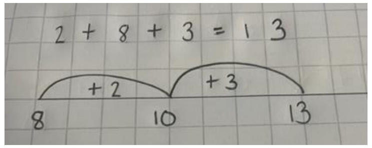
	Using bead strings or ten frames, make the larger number. Model the process of partitioning the smaller number to make 10 and then subtract the remaining number  14 – 9 = Make 14 on the tens frame or bead string. Subtract 4 to get back to the number 10. Model to children how many more we need to subtract to make the total 9. This would be another 5.	Use a number line to regroup or partition the smaller number to subtract from the larger number. 14 – 9 = 5 		How many do we need to subtract from 14 to get 10? (4) How many more do we need to subtract to make the total 9? (5)
Represent and use number bonds and related subtractions facts within 20	Partition a number physically using bead strings or rekenreks. 20 – 14 = 6 	Use a number line to represent number bonds and related subtraction facts within 20. 14 + 6 = 20  20 – 4 = 16 	Use the part whole diagram to move children to thinking more abstract. 	number forwards backwards count up count on count back pattern pairs add subtract What number needs to be added to 12 to make ….? How many jumps do we need to count back to get from 20 to … ?
Add and subtract one-digit and two-digit numbers to 20, including zero	Use of bead strings or rekenrek to add and subtract numbers. 12 + 4 = 16 	Use a number line to add and subtract one digit and two-digit numbers to 20, including zero. 11 + 7 = 18 	Children to visualise mentally to add and subtract numbers to 20. 11 + 7 = 18 In number sentences like these, their knowledge of	number forwards backwards count up count on count back pattern pairs

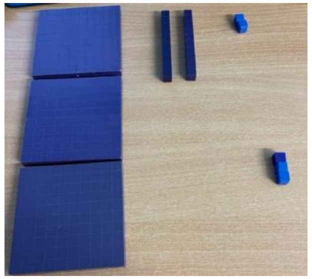
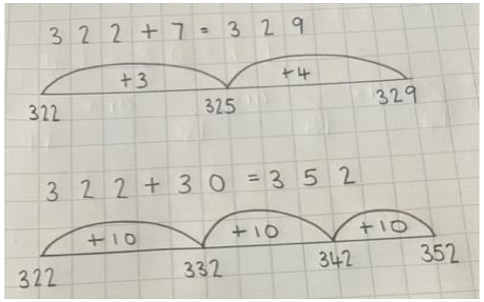
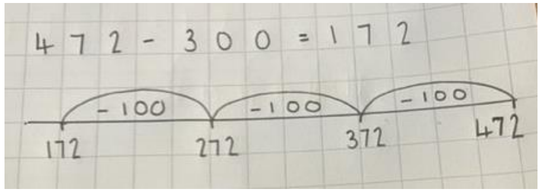
		19 – 5 = 14 	place value will help with this abstract process.	add subtract How many jumps? How many do we need to count on/count back ….? What number do we start with? If we are subtracting, will be the answer be larger or smaller?

Year 2 Addition and Subtraction

Learning Intention	Concrete	Pictorial	Abstract	Vocabulary Possible question stems
Add and subtract numbers; a two – digit number and ones	Use ten frames to make 10 and explore the pattern. 17 + 5 = 22  17 – 5 = 12  	Use a number line to model process of adding ones to a two-digit number. 17 + 5 = 22  17 – 5 = 12 	Children to use knowledge of composition of number to add ones to a two digit number. **17 + 5 =** 17 + 3 = 20 20 + 2 = 22	addition add total subtraction subtract pattern ten frames number lines How many do we add/subtract to get to the next ten? How many do we have left to add/subtract?
Add and subtract numbers; a two-digit number and tens	Use base 10 manipulatives to identify that the ones digit does not change. 27 + 10 =  47 - 10 =  *Ones should be lined up to help build understanding that 10 ones = 1 ten.	Use a number line or base 10 jottings to model the process of adding tens to a two-digit number. 27 + 30 =   47 – 30 =  	Children to use knowledge of composition of number to add and subtract tens from a two digit number. **27 + 30 =** 27 + 10 = 37 27 + 20 = 47 27 + 30 = 57 **47 – 30 =** 47 – 10 = 37 47 – 20 = 27 47 – 30 = 17	addition add total subtraction subtract groups of tens pattern tens number lines tens ones What happens to the tens digit when we add/subtract …..? What happens to the ones digit when we add/subtract tens?

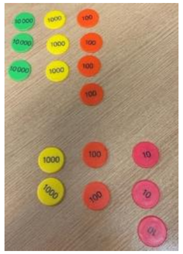
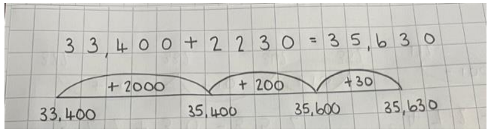
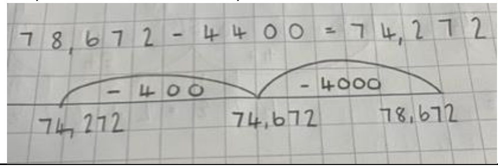
Add and subtract numbers; two, two digit numbers –	Model using base 10 manipulatives. 46 + 24 = 70  47 – 25 = 22  *When the ones equal 10 or more, children should be modelled lining the ones up as a ten and the remaining ones being visible. This is to support the concept of regrouping. *When subtracting, children should be modelled with numbers that do not require regrouping.	Use a number line and bridging ten where necessary. 45 + 26 = 71  74 – 47 = 27  *Children need to be modelled the use of a number line to bridge ten.	Children to use knowledge of composition of number to add two digit numbers **45 + 26 =** 45 + 20 = 65 65 + 5 = 70 70 + 1 = 71 **74 – 47 =** 74 – 40 = 34 34 – 4 = 30 30 – 3 = 27	addition add total subtraction subtract tens ones How many tens are we adding/subtracting? How any ones are we adding/subtracting?

Adding three one- digit numbers	Model using base 10 or bead strings the process of adding three one digit numbers. Start with the biggest number. 2 + 8 + 3 = 13 	Use a number line to add three one-digit numbers. Bridge ten where neccesary. Start with the biggest number. 	Children to use knowledge of composition of numbers to add three one-digit numbers.	addition add total base 10 tens ones

Year 3 Addition and Subtraction				
Learning Intention	**Concrete**	**Pictorial**	**Abstract**	**Vocabulary Possible question stems**
Add and subtract numbers mentally; A three digit number and ones A three digit number and tens A three digit number and hundreds	Model process using base 10 manipulatives. If children are secure with the use of base 10 manipulatives and are able to understand a more abstract manipulative, introduce place value counters. Children will need modelling the process of partitioning to make 10. 322 + 3 = 325 	Use a number line to add/subtract ones/tens and hundreds to a three digit number. Model using partititioning. 322 + 7 = 329  472 – 300 = 172 	Children to use knowledge of composition of numbers to add/subtract ones/tens and hundreds to a three digit number.	add subtract ones tens hundreds partition How many ones are we adding/subtracting? How many tens are we adding/subtracting? How many hundreds are we adding/subtracting?
Add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction.	Children to be introduced to a formal written method when they are secure with their place value knowledge of three digit numbers. Through the use of base 10 manipulatives and/or place value	Use of jottings or a place value grid to support transition from concrete manipulatives to a more formal written method. (See appendix 1)	Children to be modelled process of a formal written method (column addition/ subtraction) for the different stages. (See appendix 1).	add subtract ones tens hundreds partition regrouping carrying over

It should be introduced gradually and in the following order. Children should only move on to the next stage, once they are secure using a concrete, pictorial and abstract method. (See appendix 1)	counters, children will need modelling the process of regrouping (exchanging and carrying over – See appendix 1)			exchanging columns In the ones column, we have 4 + 7. If the answer is 11, where do we put the ones and what do we need to do with the tens? In the tens column, we have 50 – 70. Can we do this? What do we need to do, to make sure we have enough tens to subtract from?

Year 4 Addition and Subtraction				
Learning Intention	**Concrete**	**Pictorial**	**Abstract**	**Vocabulary Possible question stems**
Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate. It should be introduced and built upon the children's starting points. Children should only move on to the next stage, once they are secure using a concrete, pictorial and abstract method. (See appendix 1)	Children to use the column method with numbers they have a secure understanding of its place value. (See appendix 1) Through the use of base 10 manipulatives and/or place value counters, children will need modelling the process of regrouping (exchanging and carrying over)	Use of jottings or a place value grid to support transition from concrete manipulatives to a more formal written method. (See appendix 1)	Children to be modelled process of a formal written method (column addition/ subtraction) for the different stages. (See appendix 1).	add subtract ones tens hundreds partition regrouping carrying over exchanging columns In the tens column, we have 50 – 70. Can we do this? What do we need to do, to make sure we have enough tens to subtract from? In the hundreds column, we have a zero? Where do we regroup/exchange from?

Year 5/6 Addition and Subtraction				
Learning Intention	**Concrete**	**Pictorial**	**Abstract**	**Vocabulary** **Possible question stems**
Add and subtract numbers mentally with increasingly large numbers. Children to work with numbers they have a secure understanding of its place value.	Model process using base 10 manipulatives. If children are secure with the use of base 10 manipulatives and are able to understand a more abstract manipulative introduce place value counters. 33,400 + 2230 = 35,630 	Use a number line to add/subtract. Model using partititioning. 33,400 + 2230 = 35,630  78,672 – 4400 = 74,272  	Children to use knowledge of composition of numbers to add and subtract mentally. *With larger numbers, this process can be difficult. Model a pictorial method where possible.	add subtract ones tens hundreds thousands ten thousands hundred thousands partition How many ones are we adding/subtracting? How many tens are we adding/subtracting? How many hundreds are we adding/subtracting? How many thousands are we adding/subtracting? How many ten thousands are we adding?
Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)	Children to use the column method with numbers they have a secure understanding of its place value. Through the use of place value counters, children will need modelling the process of regrouping (exchanging and carrying over)	Use of jottings or a place value grid to support transition from concrete manipulatives to a more formal written method. (See appendix 1)	Children to be modelled process of a formal written method (column addition/ subtraction) for the different stages. (See appendix 1).	add subtract ones tens hundreds thousands ten thousands hundred thousands partition column In the tens column, we have 50 – 70. Can we do this? What do we need to do, to make sure we have enough tens to subtract from? In the hundreds column, we have a zero? Where do we regroup/exchange from?

Appendix 1 - formal written method for column addition and subtraction

The use of column addition and subtraction is a formal written method (FWM). It should be introduced when the children have a secure understanding of the place value of the numbers they will be adding/subtracting.

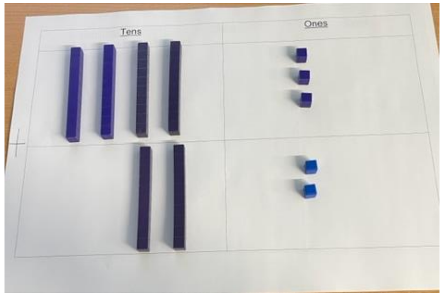
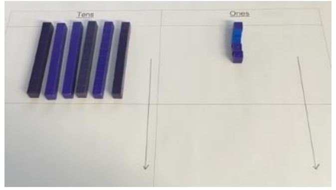
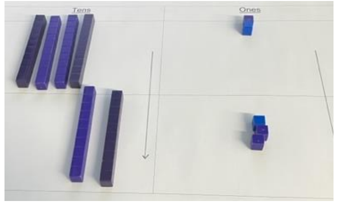
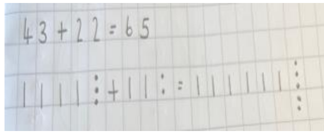
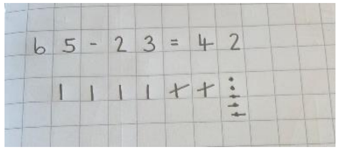
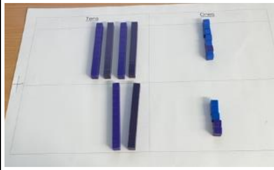
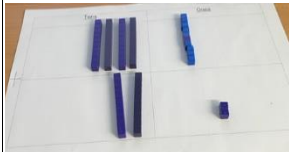
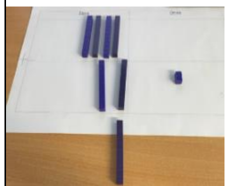
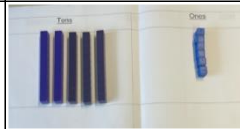
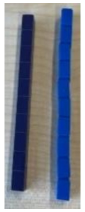
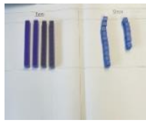
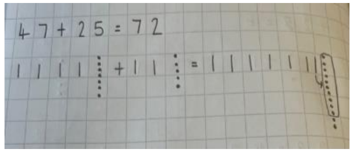
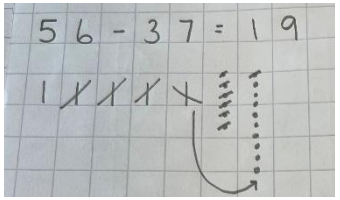
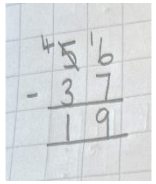
It should be introduced using concrete manipulatives first and in the following order:

- FWM of 2 digit +/- no regrouping
- FWM of 2 digit +/- (carrying over from ones to tens and exchanging from tens to ones)
- FWM of 3 digit no regrouping
- FWM of 3 digit 1 regrouping (carrying over from ones to tens and exchanging from tens to ones)
- FWM of 3 digit 1 regrouping (carrying over from tens to hundreds and exchanging from hundreds to tens)
- FWM of 3 digit where regrouping (carrying over/ exchanging) could be in either columns
- FWM of 3 digit number with 2 regroupings (carrying over/exchanging)
- FWM of 3 digit number with exchanging through a zero as a place value holder.
- FWM of 4 digit number no regrouping
- FWM of 4 digit 1 regrouping (carrying over from ones to tens and exchanging from tens to ones)
- FWM of 4 digit 1 regrouping (carrying over from tens to hundreds and exchanging from hundreds to tens)
- FWM of 4 digit where regrouping (carrying over/ exchanging) could be in either columns
- FWM of 4 digit number with 2 or more regroupings (carrying over/exchanging)
- FWM of 4 digit number with exchanging through 1 or more zero as a place value holder.

Each process of column addition and subtraction should be modelled using a concrete, pictorial and abstract method.

When staff are modelling the process of the formal written method using concrete manipulatives, they should also model the abstract method alongside. Through the use of key vocabulary and sentence stems such as “fives ones subtract 3 ones equals 2 ones” will help children see the process clearer.

Examples of regrouping (carrying over and exchanging)

Learning Intention	Concrete		Pictorial	Abstract	Vocabulary Possible question stems
	Addition	**Subtraction**			
FWM of 2 digit +/- no regrouping		 	  	4 3 + 2 2 6 5 6 5 - 2 3 4 2	Column addition Column subtraction Ones Tens What does the digit 3 represent? What does the digit 2 represent? *"We add the ones.3 ones add 5 ones is equal to 8 ones."* *"Five ones subtract three ones equals two ones."*
FWM of 2 digit +/- (carrying over from ones to tens and exchanging from tens to ones)	 Children to use base 10 to represent numbers. (47 + 25)  Children to be modelled adding the ones together to create ten first.  Children to then be modelled regrouping ten ones for one ten and moving the ten to the tens column – underneath the answer box.	 56 – 37 = *What is six ones subtract 7 ones*? This calculation cannot be done without going into negative numbers. Children should discuss this using base 10 ones to show there is only 6.  Children should be modelled the process of regrouping one ten for ten ones to move to the ones column. Now the calculation can be done because it is now sixteen ones subtract seven. Once the ones column has been subtracted, the children should be modelled subtracting the tens column.	  	4 7 + 2 5 7 2 1 	Column addition Column subtraction Ones Tens Which calculation requires regrouping? What is six ones subtract 7 ones *"Seven ones add five ones is equal to twelve ones"* *"Twelve ones is equal to one ten and two ones."* *"Four tens subtract three tens equals one ten".*

Useful documents from NCETM website: NCETM 1.20 Algorithms: Column Addition and NCETM 1.21 Algorithms: Column Subtraction