Lenham Primary School

Take Pride; Be Proud

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Calculation Policy

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Calculation Policy

Aims of the policy:

- To ensure consistency and progression in our approach to calculation and enable a smooth transition between year groups and phases.
- To ensure that children develop an efficient, reliable, formal written method of calculation for all operations.
- To ensure that children can use these methods accurately with confidence and understanding
- To ensure pupils understand important concepts and make connections within mathematics.
- To ensure pupils show high levels of fluency in performing written and mental calculations.
- To ensure that pupils are ready for the next stage of learning and have been given strong foundations in mental methods, the use of practical equipemtn , allowed to explore jottings in a range of forms and then move onto more formal recording using a strong knowledge of place value, number lines labelled or blank, partitioning before eventually using compact written methods.
- To ensure that pupils are competent in fluency, reasoning and problem solving and can make informed and appropriate choices about the methods they wish to use (mental or written) to solve mathematical problems efficiently and effectively.

Introduction:

The 2014 National Curriculum provides a structured and systematic approach to the teaching of calculation. The aim is for mental calculations and written procedures to be performed efficiently, fluently, and accurately with understanding. Procedures and understanding are to be developed in tandem. End of key stage expectations are explicit in the programme of study.

At Lenham Primary School, we have a consistent approach to the teaching of written calculation methods in order to ensure continuity and progression across the school.

Age related expectations:

This calculation policy is organised according to age appropriate expectations as set out in the National Curriculum 2014, **however it may be more appropriate for pupils to work** at a lower stage, if necessary, until they are secure enough to move on.

Providing a context for calculation:

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods. It is also important for children to be confident to use mental and written strategies to explain their thinking**.** This must be a priority within calculation lessons**.** Written methods need to be viewed as tools to enable children to solve problems and record their thinking in an organised way.

Aims:

Children should be able to use an efficient method, mental or written appropriate to the given task, with understanding. By the end of year 6, children will have been taught, and be secure with, a compact standard method for each operation.

To develop efficient written calculation strategies children need:

- Secure mental methods which are developed from early years
- A solid understanding of the number system
- Practical hands on experience including a range of manipulatives
- Visual models and images including number lines and arrays
- Experience of expanded methods to develop understanding and avoid rote learning
- Secure understanding of each stage before moving onto the next.

Before carrying out a calculation, children will be encouraged to consider:

- Can I do it in my head? (using rounding, adjustment)
- The size of an approximate answer (estimation)
- Could I use jottings to keep track of the calculation?
- Do I need to use an expanded or compact written method?

Pre requisite skills for written calculations

Addition and subtraction:

- Do they know all the addition and subtraction facts for all numbers to 20?
- Do they understand place value and can they partition and then re-partition numbers?
- Can they add three single digit numbers mentally?
- Can they add and subtract any pair of two digit numbers mentally?
- Can they explain their mental strategies orally and record them using informal jottings?

Multiplication and Division:

- Do they know the 2, 5 and 10 times tables and corresponding division facts?
- Do they know the result of multiplying by 1 and 0?
- Do they understand 0 as a place holder?
- Can they multiply two and three digit numbers by 10 and 100?
- Can they double and halve two digit numbers mentally?
- Can they use multiplication and division facts they know to derive mentally other multiplication and division facts that they do not know?
- Can they explain their mental strategies orally and record them using informal jottings?

These lists are not exhaustive but are a guide for the teacher as they structure the move from informal to formal methods of calculation. It is vitally important that children's mental methods of calculation continued to be practised and secured alongside their learning and use of an efficient written method for each operation.

A pathway to teaching calculation methods:

Expanded methods should be viewed as steps towards a standard method and not as methods in themselves.
Before beginning to record in a more refined written format children must have had significant practical work reinforced with appropriate manipulative, models and images.
Teachers will guide pupils to refine their written methods of recording by modelling and asking questions such as "What is the same? What's different?"
Learning will be planned to ensure pupil are encouraged to use and apply what they have learnt to problem solving tasks.

The pathway shown below is for ***guidance.*** As children move along the pathway it is vital that they practice, reinforce, consolidate, use and apply it to mathematical learning and NOT simply move onto the next step.

	EYFS/Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	Combining two parts to make a whole: part whole model Starting at the bigger number and counting on – using cubes Regrouping to make 10 using ten frame	Adding three single digits Use of Base 10 to combine two numbers	Column method – regrouping Using place value counters (up to 3 digits)	Column method – regrouping. Using place value counters (up to 4 digits)	Column method – regrouping Use of place value counters for adding decimals	Column method – regrouping. Abstract methods. Place value counters to be used for adding decimal numbers.
Subtraction	Take away ones Counting back Find the difference Part whole model Make 10 using the ten frame	Counting back Find the difference Part whole model Make 10 Use Base 10	Column method with regrouping. (up to 3 digits using place value counters)	Column method with regrouping (up to 4 digits)	Column method with regrouping. Abstract for whole numbers. Start with place value counters for decimals – with the same amount of decimal places.	Column method with regrouping. Abstract methods. Place value counters for decimals – with different amounts of decimal places.
Multiplication	Recognising and making equal groups. Doubling. Counting in multiples. Use cubes, Numicon and other objects in the classroom.	Arrays – showing commutative multiplication.	Arrays 2 digit x 1 digit using base 10	Column multiplication – introduced with place value counters. (2 and 3 digit multiplied by 1 digit)	Column multiplication Abstract only but might need a repeat of year 4 first (up to 4 digit numbers multiplied by 1 or 2 digits)	Column multiplication Abstract methods (multi-digit up to 4 digits by a 2 digit number)

Division	Sharing objects into groups. Division as grouping e.g. I have 12 sweets and put them in groups of 3, how many groups? Use cubes and draw round 3 cubes at a time.	Division as grouping. Division within arrays – linking to multiplication Repeated subtraction	Division with a remainder – using lolly sticks, times table facts and repeated subtraction. 2 digit divided by 1 digit using Base 10 or place value counters.	Division with a remainder Short division (up to 3 digits by 1 digit – concrete and pictorial)	Short division (up to 4 digits by a 1 digit number including remainders)	Short division Long division with place value counters (up to 4 digits by a 2 digit number) Children should exchange into the tenths and hundredths column too.

PLEASE look at the LIVE padlet which explains our Maths Knowledge Organiser @ Lenham Primary

https://padlet.com/lculver4/rcur7eys6cqqgrbo

Below is a photo of the padlet.

As a separate document there is a PDF of the padlet which can be downloaded.

Maths Knowledge Organiser @ Lenham Primary

Language

Addend
A number to be added to another

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

Array
An ordered collection of counters, cubes or other items in rows and columns

Augmentation
Increasing a quantity or measure by another quantity

Commutative
numbers can be added or multiplied in any order

Complement
In addition a number and its complement make a total e.g. 3(8) is the complement to 7(4) to make 10(0)

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

Dividend
In division, the number that is divided.

Divisor
In division, the number by which another is divided

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

Factor
A number that multiplies with another to make a product

Minuend
A quantity or number from which another is subtracted

Multiplicand
In multiplication, a number to be multiplied by another

Partitioning
Splitting a number into its component parts

Product
The result of multiplying one number by another

Quotient
The result of division

Reduction
Subtraction as take away

Remainder
The amount left over after a division when the divisor is not a factor of the dividend

Scaling
Enlarging or reducing a number by a given amount, called the scale factor

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

Representations and Manipulatives

Part-Part-Whole

The **part-whole model** supports children to their understanding of aggregation and partitioning.

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 are empty), children use partitioning to find the missing part.

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

Bar model (single)

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 like access 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 continuous **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.

Discrete

Bonds

Continuous

Comparison

Comparison

Bar Model (multiple)

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 fixed 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.

Bonds

Continuous

Comparison

Bar Model (Multiplication and Division)

Children can use the **single bar model** to represent multiplication as repeated addition. They could use counters, cubes or dots within the **bar model** to support calculations before moving on to placing digits into the **bar model** to represent the multiplication.

Division can be represented by showing the total of the **bar model** and then dividing the **bar model** into equal groups.

It is important when solving word problems that the **bar model** represents the problem.

Sometimes, children may look at scaling problems. In this case, more than one **bar model** is useful to represent this type of problem e.g. There are 3 girls in a group. There are 5 times more boys than girls. How many boys are there? The multiple **bar model** provides an opportunity to compare the groups.

Number Shapes

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 also 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.

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.

Number Shapes (Multiplication and Division)

Number shapes support children's understanding of multiplication as repeated addition.

Children can build multiplications in a row using the **number shapes**. When solving odd numbers, encourage children to interlock the shapes so there are no gaps in the one. They can then use the term **number shapes** along with the other necessary shapes over the top of the no to check the total. Using the **number shapes** in multiplication can support children in discovering patterns of multiplication e.g. odd x odd = even, odd x even = odd, even x even = even.

When dividing, **number shapes** support children's understanding of division as grouping. Children make the number they are dividing and then place the **number shape** they are dividing by over the top of the number to find how many groups of the number there are altogether e.g. There are 5 groups of 3 in 15.

Cubes

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

Addition

YEAR 1

Skill: Add 1 digit numbers within 10

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 will support augmentation.

YEAR 2

Skill: Add three 1-digit numbers

When adding three 1-digit numbers, children should be encouraged to look for number bonds to 10 or doubles to add the numbers more efficiently.

This supports children in their understanding of commutativity.

Manipulatives that highlight number bonds to 10 are effective when adding three 1-digit numbers.

YEAR 1/2

Skill: 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.

Different manipulatives can be used to represent this exchange. Ten-frame resources alongside number lines to support children in understanding how to partition their jumps.

YEAR 2/3

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

When adding one-digit 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 eleven can support children to find the number bond to 10.

YEAR 2/3

Skill: Add two 2-digit numbers to 100

At this stage, encourage children to use formal column method when calculating alongside straws, base 10 or place value counters. As numbers become larger, straws become less efficient.

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

YEAR 3

Skill: Add numbers with up to 3 digits

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.

YEAR 4

Skill: Add numbers with up to 4 digits

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

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

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

YEAR 5/6

Skill: Add numbers with more than 4 digits

Place value counters or plain counters on a place value grid are the most effective concrete resources when adding numbers with more than 4 digits.

At this stage, children should be encouraged to work in the abstract, using the column method to add larger numbers effectively.

YEAR 5

Skill: Add with up to 3 decimal places

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

YEAR 1

Skill: Subtract 1-digit numbers within 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.

YEAR 1/2

Skill: Subtract 1 and 2-digit numbers to 20

When subtracting one-digit numbers that cross 10, it is important to highlight the importance of ten ones equalling one ten.

Children should be encouraged to find the number bond to 10 when partitioning the subtrahend number. Ten frames, number shapes and number lines are particularly useful for this.

YEAR 2

Skill: Subtract 1 and 2-digit numbers to 100

At this stage encourage children to use formal column method when calculating alongside straws, base 10 or place value counters. As numbers become larger, straws become less efficient.

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

YEAR 3

Skill: Subtract numbers with up to 4 digits

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 method.

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

YEAR 4

Skill: Subtract numbers with up to 4 digits

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 method.

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

YEAR 5/6

Skill: Subtract numbers with more than 4 digits

Place value counters or plain counters on a place value grid are the most effective concrete resources 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.

Number Shapes (Multiplication and Division)

Number shapes support children's understanding of multiplication as repeated addition.

Children can build multiplications in a row using the number shapes. When using odd numbers, encourage children to interlock the shapes so there are no gaps in the one. They can then use the term **number shapes** along with the other necessary shapes over the top of the no to check the total. Using the number shapes in multiplication can support children in discovering patterns of multiplication e.g. odd x odd = even, odd x even = odd, even x even = even.

YEAR 5

Skill: 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.

Times Tables

YEAR 2

Skill: 2 times table

Encourage daily counting in multiples both forwards and backwards. This can be supported using a number line or a hundred square.

Look for patterns in the two times table, using concrete manipulatives to support. Notice how all the numbers are even and there is a pattern in the ones.

Use different models to develop fluency.

YEAR 2

Skill: 5 times table

Encourage daily counting in multiples both forwards and backwards. This can be supported using a number line or a hundred square.

Look for patterns in the five times table, using concrete manipulatives to support. Notice how all the numbers are odd, even pattern.

YEAR 2

Skill: 10 times table

Encourage daily counting in multiples both forwards and backwards. This can be supported using a number line or a hundred square.

Look for patterns in the ten times table, using concrete manipulatives to support. Notice the pattern in the digits - the ones are always 0, and the tens increase by 1 each time.

YEAR 3

Skill: 3 times tables

Encourage daily counting in multiples both forwards and backward. This can be supported using a number line or a hundred square.

Look for patterns in the three times table, using concrete manipulatives to support. Notice the odd, even, odd, even pattern using number shapes to support. Highlight the pattern in the ones using a hundred square.

YEAR 3

Skill: 4 times table

Encourage daily counting in multiples, supported by a number line or a hundred square. Look for patterns in the four times table, using manipulatives to support. Make links to the 2 times table, seeing how each multiple is double the twos. Notice the pattern in the ones within each group of five multiples. Highlight that all the multiples are even using number shapes to support.

YEAR 4

Skill: 6 times table

Encourage daily counting in multiples, supported by a number line or a hundred square. Look for patterns in the six times table, using manipulatives to support. Make links to the 3 times table, seeing how each multiple is double the threes. Notice the pattern in the ones within each group of five multiples.

YEAR 4

Skill: 9 times table

Encourage daily counting multiples both forwards and backwards. This can be supported using a number line or a hundred square. Look for patterns in the nine times table, using concrete manipulatives to support. Notice the pattern in the tens and ones using the hundred square to support as well as noting the odd, even pattern within the multiples.

YEAR 4

Skill: 7 times table

Encourage daily counting in multiples both forwards and backwards, supported by a number line or a hundred square. The seven times table can be trickier to learn due to the lack of obvious pattern in the numbers, however they already know several facts due to commutativity. Children can still see the odd, even pattern in the multiples using number shapes to support.

YEAR 4

Skill: 11 times table

Encourage daily counting in multiples both forwards and backwards. This can be supported using a number line or a hundred square.

Look for patterns in the eleven times table, using concrete manipulatives to support. Notice the pattern in the tens and ones using the hundred square to support. Also consider the pattern after crossing 100.

YEAR 4

Skill: 12 times table

Multiplication

YEAR 1/2

Skill: Solve 1-step problems using multiplication

Children represent multiplication as repeated addition in many different ways.

In Year 1, children use concrete and pictorial representations to solve problems. They are not expected to record multiplication formally.

In Year 2, children are introduced to the multiplication symbol.

YEAR 3/4

Skill: Multiply 2-digit numbers by 1-digit numbers

Teachers may decide to first look at the expanded column method before moving on to the short multiplication method.

The place value counters should be used to support the understanding of the method rather than supporting the multiplication, as children should use times table knowledge.

YEAR 3/4

Skill: Multiply 3-digit numbers by 1-digit numbers

When moving to 3-digit by 1-digit multiplication, encourage children to move towards the short, formal written method. Base 10 and place value counters continue to support the understanding of the written method. Lots of exchanges needed in the questions and move children away from resources when multiplying larger numbers.

YEAR 5

Skill: Multiply 4-digit numbers by 1-digit numbers

When multiplying 4-digit numbers, place value counters are the best manipulative to use to support children in their understanding of the formal written method. If children are multiplying larger numbers and struggling with their times tables, encourage the use of multiplication grids so children can focus on the use of the written method.

YEAR 5

Skill: Multiply 2-digit numbers by 2-digit numbers

When multiplying a multi-digit number by 2-digits, use the area model to help understand the size of the numbers they are using. This links to finding the area of a rectangle by finding the space covered by the Base 10. The grid method matches the area model as an initial written method before moving on to the formal written multiplication method.

YEAR 5

Skill: Multiply 3-digit numbers by 2-digit numbers

Children can continue to use the area model when multiplying 3-digits by 2-digits. Place value counters become more efficient to use but Base 10 can be used to highlight the size of numbers. Encourage children to move towards the formal written method, seeing the links with the grid method.

YEAR 5/6

Skill: Multiply 4-digit numbers by 2-digit numbers

When multiplying 4-digits by 2-digits, children should be confident in the written method.

If they are still struggling with times tables, provide multiplication grids to support when they are focusing on the use of the method.

Consider where exchanged digits are placed and make sure this is consistent.

Division

YEAR 1/2

Skill: Solve 1-step problems using multiplication (sharing)

Children solve problems by sharing amounts into equal groups.

In Year 1, children use concrete and pictorial representations to solve problems. They are not expected to record division formally.

In Year 2, children are introduced to the division symbol.

YEAR 1/2

Skill: Solve 1-step problems using division (grouping)

Children solve problems by grouping and counting the number of groups. Grouping encourages children to count in multiples and links to repeated subtraction on a number line. They can use concrete representations in fixed groups such as number shapes which helps to show the link between multiplication and division.

YEAR 1/2

Skill: Divide 2-digits by 1-digit (sharing with no exchange)

When dividing larger numbers, children can use manipulatives that allow them to partition into tens and ones.

Straws, Base 10 and place value counters can all be used to share into equal groups.

Pictorial/ve models can provide children with a clear written method that matches the concrete representation.

Flexible partitioning on a part-whole model supports this method.

YEAR 3/4

Skill: Divide 2-digits by 1-digit (sharing with exchange)

When dividing numbers involving an exchange, children can use Base 10 and place value counters to exchange one ten for ten ones. Children should start with the equipment outside the place-value grid before sharing the tens and ones equally between the rows.

Flexible partitioning on a part-whole model supports this method.

YEAR 4/5

Skill: Divide 3-digits by 1-digit (grouping)

When using the short division method, children use grouping. Starting with the largest place value, they group by the divisor.

Language is important here. Children should consider 'How many groups of 4 tens can we make?' and 'How many groups of 4 ones can we make?'

Remainders can also be seen as they are left ungrouped.

YEAR 4

Skill: Divide 3-digits by 1-digit (sharing)

Children can continue to use place value counters to share 3-digit numbers into equal groups. Children should start with the equipment outside the place-value grid before sharing the hundreds, tens and ones equally between the rows. This method can also help to highlight remainders.

Flexible partitioning on a part-whole model supports this method.

YEAR 5

Skill: Divide 3-digits by 1-digit (grouping)

Children can continue to use grouping to support their understanding of short division when dividing a 3-digit number by a 1-digit number.

Place value counters or plain counters can be used on a place value grid to support this understanding. Children can also draw their own counters and group them through a more pictorial method.

Children should be encouraged to move away from the pictorial when dividing numbers with multiple exchanges.

YEAR 5

Skill: Divide 4-digits by 1-digit (grouping)

Place value counters or plain counters can be used on a place value grid to support children to divide 4-digits by 1-digit. Children can also draw their own counters and group them through a more pictorial method.

Children should be encouraged to move away from the pictorial when dividing numbers with multiple exchanges.

YEAR 6

Skill: Divide multi-digits by 2-digits (short division)

When children begin to divide up to 4-digits by 2-digits, written methods become the most accurate as concrete and pictorial representations become less effective. Children can write out multiples to support their calculations with larger remainders. Children will also solve problems with remainders where the quotient can be rounded as appropriate.

YEAR 6

Skill: Divide multi-digits by 2-digits (long division)

Children can also divide by 2-digit numbers using long division.

Children can write out multiples to support their calculations with larger remainders.

Children will also solve problems with remainders where the quotient can be rounded as appropriate.