West Park CE Primary School

Policy for written calculations - Mathematics

Date: June 2024

Document Summary

This document sets out progression from mental methods through to standard formal written calculations.

The concrete, pictorial and abstract approach is applied in every classroom, so that children can fully understand the foundational Maths of the methods used.
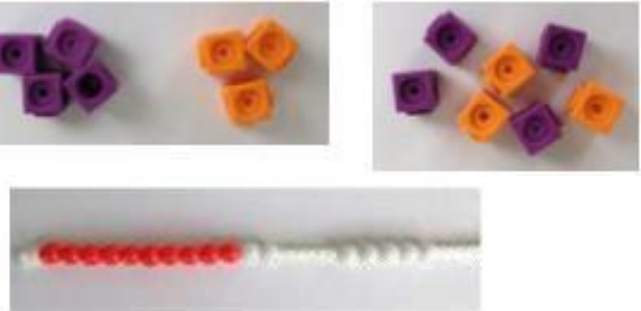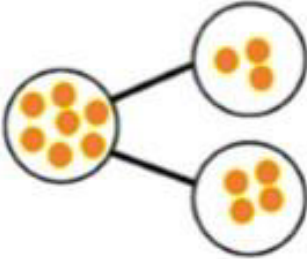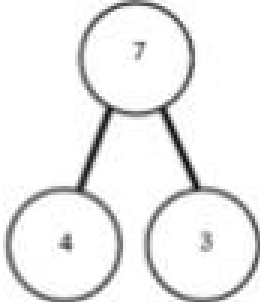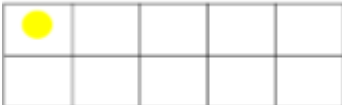
Specific Mathematical vocabulary is used and applied by all staff and children across the school, to ensure a consistent understanding that can be built on year-on-year.

At West Park, we believe children should be able to access a range of representations and methods in order to calculate. For example: part-whole models, bar models and place value charts.

	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 Regrouping to make 10	Adding three single digits Exchanging/regrouping	Column method-exchanging/regrouping (up to 3 digits)	Column method-exchanging/regrouping (up to 4 digits)	Column method-exchanging/regrouping (with more than 4 digits) (Decimals-with the same amount of decimal places)	Column method-exchanging/regrouping (with more than 4 digits) (Decimals-with the same amount of decimal places)
Subtraction	Taking away ones Counting back Find the difference Part whole model Make 10	Counting back Find the difference Part whole model Exchanging/regrouping	Column method-exchanging/regrouping (up to 3 digits)	Column method-exchanging/regrouping (up to 4 digits)	Column method-exchanging/regrouping (with more than 4 digits) (Decimals-with the same amount of decimal places)	Column method-exchanging/regrouping (with more than 4 digits) (Decimals-with the same amount of decimal places)
Multiplication	Doubling Counting in multiples Arrays (with support)	Doubling Counting in multiples Repeated addition Arrays showing commutative multiplication	Counting in multiples Repeated addition Arrays showing commutative multiplication Grid method	Column multiplication (2 and 3 digit multiplied by 1 digit)	Column multiplication (up to 4 digit multiplied by 1 or 2 digits)	Column multiplication (up to 4 digit multiplied by 2 digits)
Division	Sharing objects into groups Division as grouping	Division as grouping and sharing Division within arrays	Division within arrays Division with a remainder Short division (2 digits by 1 digit-concrete and pictorial)	Division within arrays 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 interpret remainders appropriately for the context)	Short division Long division (up to 4 digits by a 2 digit number-interpret remainders as whole numbers, fractions or round)

CALCULATION GUIDANCE: Addition

Key Vocabulary for addition: sum, total, add, plus, altogether, total, number bonds, column addition method, more than, 'is equal to', 'is the same as'.

Concrete	Pictorial	Abstract
Combining two parts to make a whole EG using: cubes, objects, bead strings, counters etc.	**Children to represent the concrete resources, using drawings.** EG using: part-whole models	**4 + 3 = 7** (four is a part, 3 is a part and the whole is seven.)
Starting at the bigger number and counting on. **Regrouping to make 10.** **Adding 3 single digits**	**Drawing number line or tens frame**	**Writing and completing a number sentence, in a range of formats** 6 + 5 = 11 6 + □ = 11 6 + 5 = 5 + □ 6 + 5 = □ + 4

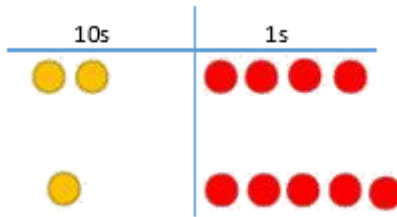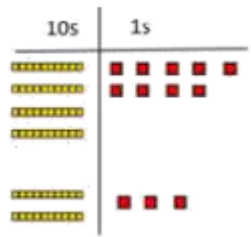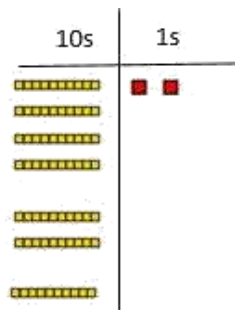|		
EG. Using 10s frame or number lines.		
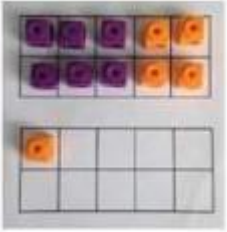
Column method with regrouping
 	
Add together the ones first, then add the tens. Use Base 10 blocks first before moving onto place value counters.
24 + 15 =
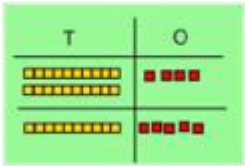 	
44 + 15 =
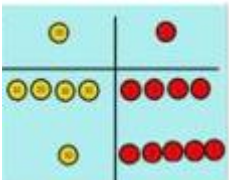 	
	After physically using the base 10 blocks and place value counters, children can draw the counters to help them solve additions
	
		24 + 15 = 39
		
		   24
		+ 15
		   39

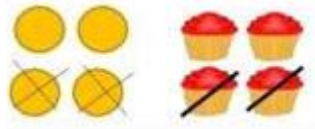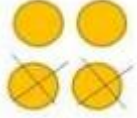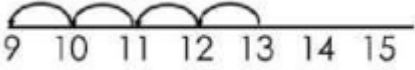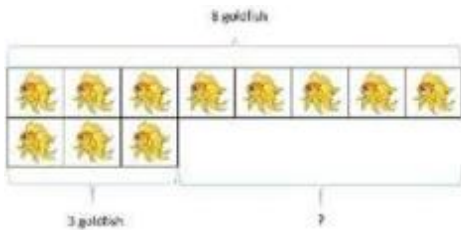| Column method with regrouping	Using place value counters, children can draw the counters to help them solve additions.	From Year 3 onwards, children to use compact method:
Make both numbers on a place value grid. Add up the ones and exchange 10 ones for 1 ten.		49 + 23 72 1 146 + 527 673 1 As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here. From Year 5, consolidate understanding using numbers with more than 4 digits and extend by adding numbers with up to 3 decimal places.

CALCULATION GUIDANCE: Subtraction

Concrete	Pictorial	Abstract
Taking away ones Use physical objects, counters cubes etc. to show how objects can be taken away. 4 – 2 = 2	Cross out drawn objects to show what has been taken away. 4 – 2 = 2	4 – 2 = 2
Counting back Make the larger number in your subtraction. Move the items as you count backwards in ones. For example, this could be done on a Reckenrek or using objects or counters.	Count back on a number line or number track. 9 10 11 12 13 14 15 Start at the bigger number and count back the smaller number, showing the jumps on the number line.	Put 13 in your head, count back 4. What number are you at?
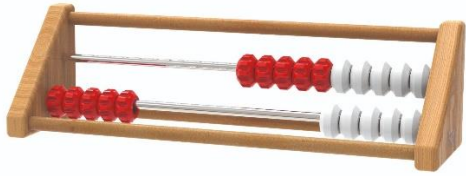
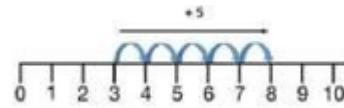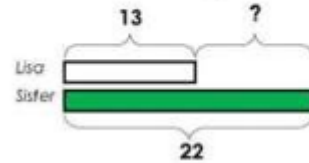|		
Find the Difference Compare amounts and objects to find the difference. Use cubes to build towers or make bars to find the difference. Use basic bar models with items to find the difference.	 Count on to find the difference. Draw bars to find the difference between 2 numbers.	Hannah has 8 goldfish. Helen has 3 goldfish. Find the difference between the number of goldfish the girls have.
Column method without regrouping 75 – 42 = 33	Draw the Base 10 or place value counters alongside the written calculation to help show working.	This will lead to clear written column subtraction (compact method).
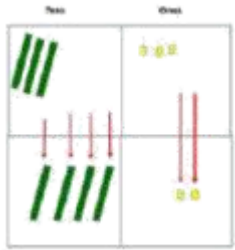
Use Base 10 to make bigger number then take the smaller number away.

Show how you partition numbers to subtract.

Again make the larger number first.
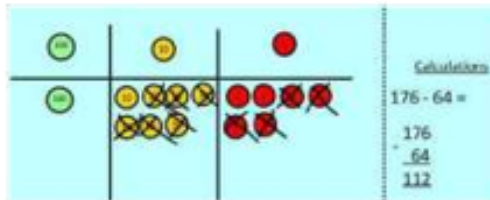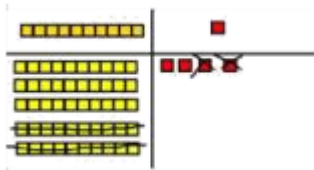
| **Column method with regrouping (sometimes known as exchanging)**

Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. | Draw the counters onto a place value grid and show that you have subtracted by crossing the counters out as well as clearly showing the exchanges you make.

When confident, children can find their own way to record the exchange/regrouping. | Children can start their formal written method (compact) by partitioning the number into clear place value columns. |

Make the larger number with the place value counters

234
- 88
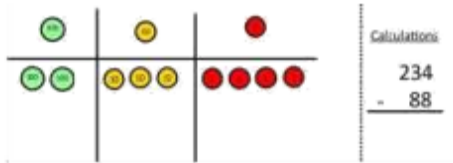
Start with the ones, can I take away 8 from 4 easily? I need to exchange 1 of my tens for 10 ones.
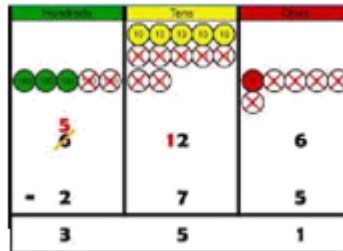

234
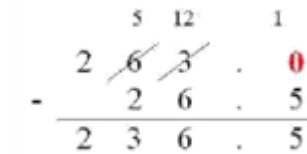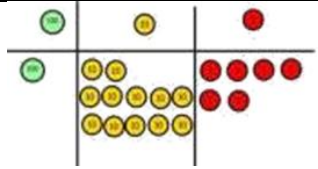- 88
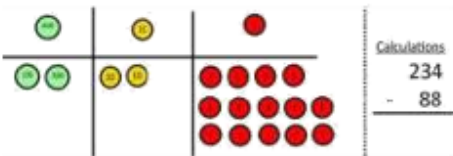
Now I can subtract my ones.

234
- 88
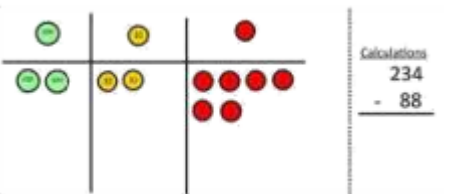
Now look at the tens, can I take away 8 tens easily? I need to exchange 1 hundred for 10 tens.

Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.

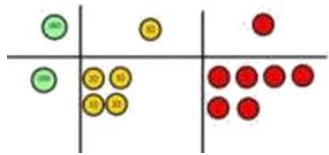This will lead to an understanding of subtracting any number, including decimals.

Calculations
```
  234
-  88
```

Now I can take away 8 tens and complete my subtraction.

Calculations
```
 ¹2̷3̷4
-   88
  146
```

Show children how concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.

CALCULATION GUIDANCE: Multiplication

Concrete	Pictorial	Abstract
Doubling Multilink Counting objects 	Drawing pictures and using images of doubles.	Using symbols, numerals and their names 2 + 2 = 4 4 + 4 = 8
Counting in multiples using repeated addition	There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there? 	Write repeated addition sentences to describe objects and pictures.

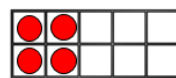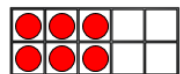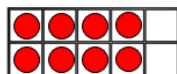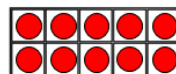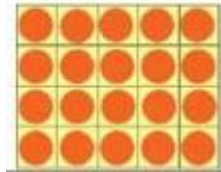|		
  Use different objects to add equal groups.	$2 + 2 + 2 = 6$ $5 + 5 + 5 = 15$ Using tens frames: How many counters? 0 2 4 6 8 10	$2 + 2 + 2 = 6$
Arrays Create arrays using counters/cubes to show multiplication sentences.	Draw arrays in different rotations to find **commutative** multiplication sentences. $4 \times 2 = 8$ $2 \times 4 = 8$	Use an array to write multiplication sentences and reinforce repeated addition.

|		
	$2 \times 4 = 8$ $4 \times 2 = 8$ Link arrays to area of rectangles. 	 $5 + 5 + 5 = 15$ $3 + 3 + 3 + 3 + 3 = 15$ $5 \times 3 = 15$ $3 \times 5 = 15$
Grid Method Show the link with arrays to first introduce the grid method. 4 rows of 10 4 rows of 3 Move on to using Base 10 to move towards a more compact method.	Children can represent the work they have done with place value counters in a way that they understand.	Start with multiplying by one digit numbers and showing the clear addition alongside the grid. | $\times$	30	5
7	210	35 | $210 + 35 = 245$ Move forward, multiply by a 2 digit number showing the different rows within the grid method.

4 rows of 13

Move on to place value counters to show how we are finding groups of a number. We are multiplying by 4 so we need 4 rows.
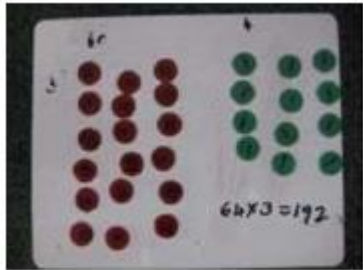
Fill each row with 126.

Calculations
4 x 126
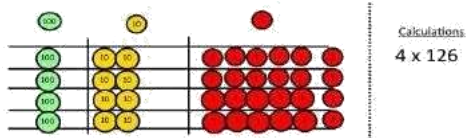
Add up each column, starting with the ones making any exchanges needed.
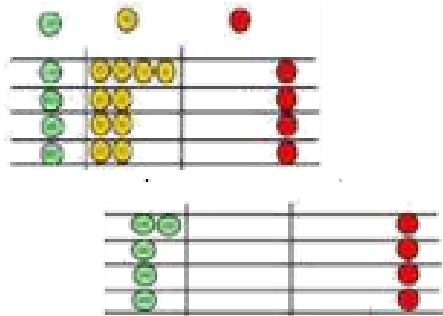
4 x 126 = 504

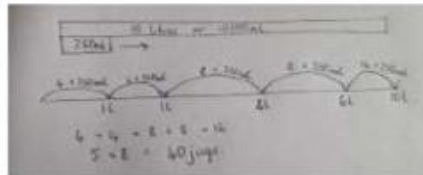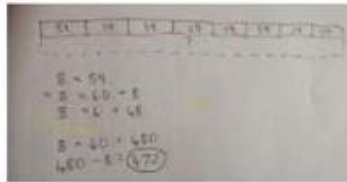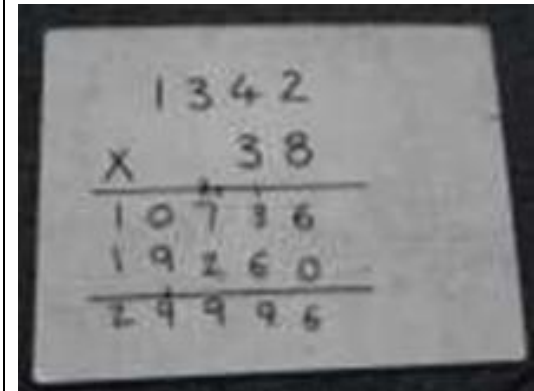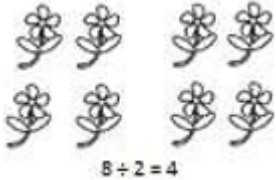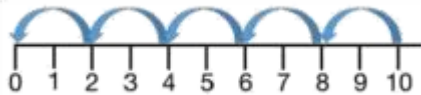|		
Column method for multiplication (compact method) Children can continue to be supported by place value counters at the stage of multiplication. It is important at this stage that they always multiply the ones first and note down their answer followed by the tens, which they note below.	Children can draw counters similarly to concrete stage. Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods. 	***Short multiplication:*** *2/3/4-digit number x 1-digit number* ***Long multiplication:*** *2/3/4 digit number x 2-digit number (second stage of multiplying)* Reminding the children about lining up their numbers clearly in columns. For long multiplication, children must remember to insert a place holder before their second stage of multiplying.

CALCULATION GUIDANCE: Division

Concrete	Pictorial	Abstract
Sharing and grouping I have 8 cubes, can you share them equally between two people? Divide quantities into equal groups.	Children use pictures or shapes to share quantities. 8 ÷ 2 = 4 Use a number line to show jumps in groups. The number of jumps equals the number of groups. Think of the bar as a whole. Split it into the number of groups you are dividing by and how many would be within each group.	EG. Share 8 buns between two people, using the division symbol. 8 ÷ 2 = 4 Divide 10 into 5 groups. How many are in each group? 10 ÷ 5 = 2

Use cubes, counters, objects or place value counters to aid understanding. 	 $10 \div 5 = ?$ $5 \times ? = 10$	
Division with arrays Link division to multiplication by creating an array and thinking about the number sentences that can be created. E.g. $15 \div 3 = 15$ $5 \times 3 = 15$ $15 \div 5 = 3$ $3 \times 5 = 15$ 	 Draw an array and use lines to split the array into groups to make multiplication and division sentences.	Find the inverse of multiplication and division sentences by creating four linking number sentences. $3 \times 5 = 15$ $5 \times 3 = 15$ $15 \div 5 = 3$ $15 \div 3 = 15$
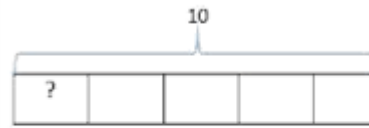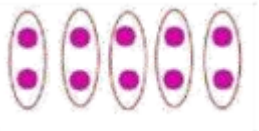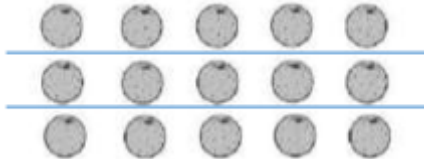
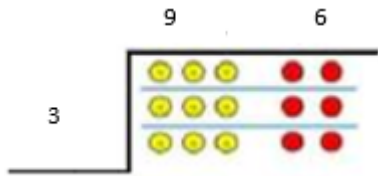| **Short Division (used for dividing by a 1-digit or 2-digit number less than 20)**

Use place value counters to divide using the short division method alongside.
96 ÷ 3 =

9   6
3

42 ÷ 3 =
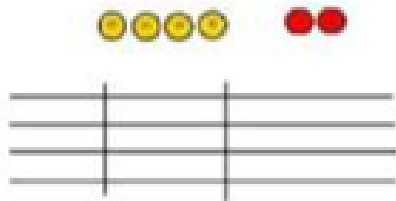
Start with the biggest place value. We are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over. | Pupils can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.
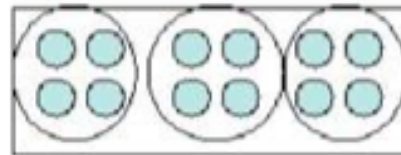
Encourage them to move towards counting in multiples to divide more efficiently. | Begin with divisions that divide equally with no final remainder.

2   1   8
3
4   8   7   2 |
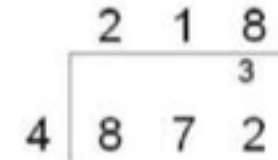
We exchange this ten for 10 ones and then share the ones equally among groups.
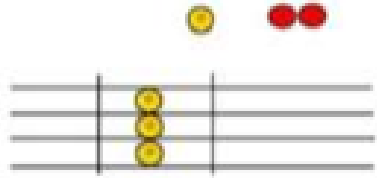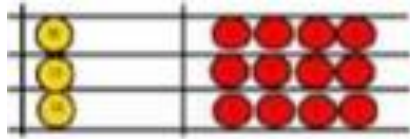
We look at how many are in each group.

| **Division, leading into short division, with remainders expressed as whole numbers**

14 ÷ 3 =
Divide objects between groups and see how much is left over. | Jump forward in equal jumps on a number line then see how many more you need to find a remainder.
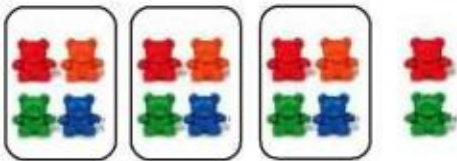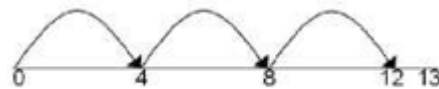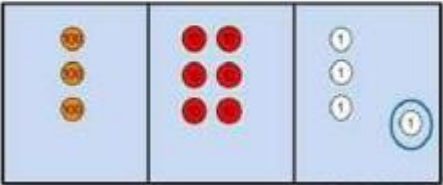
Draw dots and group them to divide an amount and clearly show a remainder. | Move onto division with a remainder. Once children understand remainders, begin to express as a fraction or decimal according to context.

8 6 r 2
3
5 | 4 3 2 |

$364 \div 3 =$ $\begin{array}{r} 121 \text{ rem } 1 \\ 3 \overline{\smash{\big)}\, 364} \end{array}$ 	remainder 2	$\begin{array}{r} 1 \ 8 \ 6 \ 1/5 \\ 5 \overline{\smash{\big)}\, 9\,^43\,^31} \end{array}$ $\begin{array}{r} 1 \ 4 \ . \ 6 \\ {}^{16} \quad {}^{21} \\ 3 \ 5 \overline{\smash{\big)}\, 5\ 1\ 1\ .\ 0} \end{array}$
Long division (used to divide by a 2-digit number)		Using knowledge of column subtraction and multiplication tables to solve more complex divisions. Children to use multiplication strategies to work out times tables for trickier numbers. EG. 43 times tables – add 40 and add 3.

		Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds.

$$\begin{array}{r} 0 \\ 12\overline{\smash{)}2544} \end{array}$$

Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds.

$$\begin{array}{r} 02 \\ 12\overline{\smash{)}2544} \\ \underline{24} \\ 1 \end{array}$$

Step two- How many groups of 12 can I make with 25 hundreds? The 24 shows the hundreds we have grouped. The one is how many hundreds we have left.

$$\begin{array}{r} 021 \\ 12\overline{\smash{)}2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 2 \end{array}$$

Exchange the one hundred for 10 tens. How many groups of 12 can I make with 14 tens?
The 14 shows how many tens I have, the 12 is how many I grouped and the 2 is how many tens I have left.

$$\begin{array}{r} 0212 \\ 12\overline{\smash{)}2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$$

Exchange the 2 tens for 20 ones. The 24 is how many ones I have grouped and the 0 is what I have left.

		Handy videos to help explain how to divide using long division: Long division but with a 1-digit divisor to begin with: https://www.youtube.com/watch?v=LGqBQrUYua4 Long division with 2-digit divisors (more similar to how the children use this method in school): https://www.youtube.com/watch?v=HdU_rf7eMTI Please note: there are multiple long division methods. At West Park, we use the 'drag down' method of long division, as shown in these videos and the examples.