Brough Primary School



Calculation Policy

(Multiplication and division)

Policy Date	February 2022
Policy Review Date	February 2024
Lead Person	Mrs. Wilson

This policy has been largely adapted from the White Rose Maths Hub Calculation Policy (2020 version) and EYFS framework (2021 version) with further material added. It is a working document and will be revised and amended as necessary.

Rationale of Calculation policy

- Lays out the expectations for both mental and written calculations for addition and subtraction and has been created to support the teaching of a mastery approach to mathematics.
- Underpinned by the use of of the different models and representations that can be used to support the teaching of different concept.
- Based on the idea that mathematical understanding is developed through use of representations that are first of all concrete (e.g. counters and multilink cubes), and then pictorial (e.g part whole) to then facilitate abstract working (e.g. formal written methods).
- Each operation is broken down into skills. Each of the skills has dedicated pages showing the different models and representatives that could be used to effectively teach that concept.
- A glossary of terms is also at the end of the calculation policy to support understanding of the key language used to teach the addition and subtraction. This should also be read in conjunction with the vocabulary document.

An overview of the different models and images used to support the teaching of

multiplication and division at Brough Primary School.

- Bar models.
- Numicon.
- Bead strings.
- Number tracks.
- Number lines.
- Base 10.
- Place value counters.







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E	1	2	3	4	5	6	7	8	9	10	11	12
è.	2	4	6	8	10	12	14	16	18	20	22	24
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4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
1	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

1	Times Tables				
1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1 2 3 1 2 3 3 2 4 4 2 3 5 2 6 4 2 13 7 2 12 6 2 12 6 2 12 6 2 10 6 2 10 10 2 23 11 2 24	1 3 4 3 2 1 8 8 8 2 3 6 6 3 9 4 2 12 12 12 12 12 12 12 12 12 12 12 12 12 13 13 13 13 13 12 12 12 3 36 10 11 12 12 3 36 10 11 12 13 12 13 12 13 12 14 12 13 12 14 12 14 12 14 12 14<	$\begin{array}{c} \textbf{41} \\ \textbf{1} \times \textbf{4} \times \textbf{4} \\ \textbf{2} \times \textbf{4} \times \textbf{5} \\ \textbf{3} \times \textbf{4} \times \textbf{12} \\ \textbf{4} \times \textbf{4} \times \textbf{12} \\ \textbf{4} \times \textbf{4} \times \textbf{12} \\ \textbf{5} \times \textbf{4} \times \textbf{20} \\ \textbf{6} \times \textbf{4} \times \textbf{20} \\ \textbf{6} \times \textbf{4} \times \textbf{20} \\ \textbf{7} \times \textbf{4} \times \textbf{32} \\ \textbf{8} \times \textbf{4} \times \textbf{32} \\ \textbf{10} \times \textbf{4} \times \textbf{40} \\ \textbf{11} \times \textbf{4} \times \textbf{44} \\ \textbf{12} \times \textbf{4} \times \textbf{48} \end{array}$		
1 • 5 • 5 2 • 5 • 10 3 • 5 • 15 4 • 5 • 20 5 • 5 • 25 6 • 5 • 35 8 • 5 • 36 9 • 5 • 40 9 • 5 • 45 10 • 5 • 30 11 • 5 • 55 11 • 5 • 55 11 • 5 • 55 11 • 5 • 56 11	1 0 6 2 0 12 3 0 15 4 0 24 5 0 35 6 0 36 7 0 34 9 0 34 10 0 36 11 0 60 12 0 72	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1		
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Year	skills	How - representations and models	Additional guidance
2	Recall and use multiplication and division facts for 2-times table.	Bar models, Numicon, counters, ten frames, bead strings, number lines, everyday objects.	Encourage daily counting in multiples, both forwards and backwards. Look for patterns in two times table using concrete manipulatives to support. Notice all numbers are even and there is a pattern in the ones. Use different models to develop fluency.

Year	skills	How - representations and models	Additional guidance
2 2 1 1 2 2 3 3 3 3 4 1 4 2 3 3 3 3 4 1 4 2 4 1 4 2 4 1 4 4 4 4 4 4 4 4 4 4 4 4 4	Recall and use multiplication and division facts for 5-times table	As previous.	Encourage daily counting in multiples, both forwards and backwards. Look for patterns in five times table using concrete manipulatives to support. Notice the pattern in the ones as well as highlighting the odd, even, odd, even pattern.

Year	skills	How representation model	- ons and Is	Additional guidance
2	Recall and use multiplication and division facts for 10-times table	As previ	ous	Encourage daily counting in multiples, both forwards and backwards. Look for patterns in tens times table using concrete manipulatives
	1 2 3 4 11 12 13 14 21 22 23 24 31 32 33 34 41 42 43 44 51 52 53 54 61 62 63 64 71 72 73 74 81 82 83 84 91 92 93 94	5 6 7 8 9 10 15 16 17 18 19 20 25 26 27 28 29 30 35 36 37 38 39 40 45 46 47 48 49 50 55 56 57 58 59 60 55 66 67 68 69 70 75 76 77 78 79 30 35 86 87 88 89 30 36 96 97 98 99 60		to support. Notice the pattern in the digits - the ones are always 0 and the tens increase by 1 ten each time.

Year	skills	How - representations and models	Additional guidance
3 1 2 1 2 1 2 1 2 1 2 22 31 32 41 42	Recall and use multiplication a division facts for 3-times table	and le Hundred square, Numicon, counters, bead strings, number lines, everyday objects	Encourage daily counting in multiples, both forwards and backwards. Look for patterns in three times table using concrete manipulatives to support. Notice the odd, even, odd, even pattern. Highlight the pattern in the ones using a hundred square.

Year	skills	How - representations and models	Additional guidance
3	Recall and use multiplication and division facts for 4-times table	Hundred square, Numicon, counters, bead strings, number lines, everyday objects.	Encourage daily counting in multiples, both forwards and backwards. Look for patterns in four times table
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		to support. Make links to the 2 time table, see how each multiple is double the twos. Notice the pattern in the ones within each group of five multiples.

Year	skills	How - representations and models	Additional guidance
3	Recall and use multiplication and division facts for 8 times table Image: style="text-align: center;">Image: style="text-alig	Hundred square, bead strings, number tracks, everyday objects, Numicon.	Encourage daily counting in multiples, both forwards and backwards. Look for patterns in eight times table using manipulatives to support. Make links to the 4 time table, see how each multiple is double the four. Notice the pattern in the ones within each group of five multiples. Highlight that all multiples are even using Numicon to support.

Year	skills	How - representations and models	Additional guidance
4	Recall and use multiplication and division facts for 6-times table Image: constraint of the state of the stat	Hundred square, bead strings, number lines, Numicon 17 8 9 10 17 19 20 27 28 29 60 37 38 39 40 47 60 57 58 59 60 50<	Encourage daily counting in multiples, both forwards and backwards. Look for patterns in six times table using manipulatives to support. Make links to the 3 time table, see how each multiple is double the threes. Notice the pattern in the ones within each group of five multiples. Highlight that all the multiples are even
			using Numicon to support.

Year	skills	How - representations and models	Additional guidance
4	Recall and use multiplication and division facts for 9-times table Image: style="text-align: center;">	As previous	Encourage daily counting in multiples, both forwards and backwards. Look for patterns in nine times table using manipulatives to support. Notice the patterns in the tens and ones using a hundred square as well as noting the odd, even pattern within the multiples.

Year	skills	How - representations and models	Additional guidance
4	Recall and use multiplication and division facts for 7-times table 12 3 14 21 28 35 49 56 63 70	Hundred square, bead strings, number lines, Numicon.	Encourage daily counting in multiples. both forwards and backwards. Look for patterns in six times tables, using manipulatives to support See the odd, even pattern in the multiples, using Numicon to support.

Year		skills						How - representations and models			Add	itional g	Juidance)								
4		Rec div	all a visio	nd u n fa	use r cts f	nultiı or 11	olicat time	tion es ta	abl	nd e		F c	lur ou	dre 10, nte	ed : , pla ers,	sq aco nu	uare, e valı ımbe	Base ue r lines	Ei cour bo	ncourage nting in r th forwar backwa	e daily nultiples, rds and rds.	ļ
	11 77	22 88	33 99	44 110	55	66 132 • 1 • 1 • 1		1 2 12 12 13 12 14 132 15 52 15 52 16 62 71 72 31 82 91 92	3 13 23 43 53 63 73 83 93	4 14 24 34 54 64 74 84 94	5 15 25 35 3 45 45 45 45 45 45 45 45 45 45	6 7 16 1 26 2 36 3 46 4 56 5 56 5 56 5 56 5 56 5 56 9	7 8 7 18 7 28 7 28 7 38 7 48 7 58 7 58 7 68 7 68 7 68 7 98	9 19 29 39 49 59 69 79 89 89 00	10 20 40 50 60 70 80 90 100				Loc ele using Noti the using	k for pat ven time manipu suppo ce the p tens an a hundr	tterns in s table, latives to rt. attern in d ones, ed squar	C
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Year		skills									How - representations and models			- ions Is	s and	Additional guidance		
4	F	Recal divis	l and ion f	l use acts	multiplic for 12-tin	cati nes	ion s ta	ar Ibl	nd e		B co	as un	e 1 ter:	0, s, r	pla าun	nbe	value r lines	Encourage daily counting in multiples, both forwards and backwards.
12	24	36	48	60]	11	2	3 13	4	5	6 16	7	8	9 19	10 20			Look for patterns in
72	84	96	108	120	1	21	22	23	2	25	26	27	28	29	30			twelve times table,
132	144					31	32	33	34	35	30	37	38	39	40			using manipulatives to
						51	42 52	53	54	45 55	40 56	57	58	49 59	60			support
		()	יעי		$\overline{\mathbf{O}}$	61	62	63	64	65	66	67	68	69	70			Make links to the 6
		(יעי			71	0	73	74	75	76	77	78	79	80			
				6		81	82	83	94	85	86	97	88	89	100			times table, seeing
							1.52	1.55	54	35	\bigcirc	31	50	55				how each multiple is
	₽ 	 - 2 24	+ 36	+	+ + + 60 72 8	4	+	+ 10:	8 1:	- 20	+	2 74	 + 1+		•			doubles the sixes. Notice the pattern in the ones within each group of five multiples.



Year	White Rose scheme of learning	Skills- ELG	Skills- EYFS framework
EYFS	Find my pattern	Explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally.	Multiplication and Division Step 3 I use grouping and sharing in play and practical contexts (e.g giving out grapes at snack time.)

Year	skills	How - representations and models	Additional guidance
1 and 2	Solve one-step problems with multiplication.	Bar model, Numicon, counters, ten frames bead strings, number lines.	Represent multiplication as repeated addition in many different ways. Y1 - use concrete and pictorial representations. Not expected to record multiplication formally. Y2- introduce to the multiplication symbol.

Year	skills	How - representations and models	Additional guidance
3 and 4	Multiply 2-digit by 1-digit numbers	Place value counters, Base 10, short written method.	Place value counters used to support understanding of the method rather than the multiplication.
4	Multiply 3-digit by 1-digit numbers $ \begin{array}{c} \hline $	As above	Base 10 and place value counters continue to support the understanding of the written method. Limit the number of exchanges and move children away from resources when multiplying larger numbers.

Year		S	kills	5			How - a	representations nd models	Additional guidance
5	Multiply 4	-digit	by 1	-di	git	numbers	Place short	value counters, written method.	Place value counters are the best manipulative to support with understanding the formal written method. Encourage use of multiplication grids if multiplying larger numbers and struggling
			Th	н	т	0			
			1	8	2	6			
		×				3			
			5	4	7	8			
			2		1				

Year	skills	How - representations and models	Additional guidance
5	Multiply 2 digit by 2 digit numbers	As previous plus area and grid method.	Look at grid method as an initial written method before moving onto formal written multiplication method.
5	Multiply 2-digit by 3-digit numbers	As above	Continue using area model with place value counters to highlight the size of numbers. Encourage to move towards formal written method seeing the links with the grid method.

Year	skills						How - representations and models	Additional guidance
5 and 6	Multiply 2-dig	git b	y 4-	digi	it nu	ımber	Formal written method.	Children should be confident with the written method.
		TTh	Th	н	т	0		grids if struggling with
			2	7	3	9		times tables.
		×			2	8		Consider where
		22	1 5	9 3	1 7	2		places and make this
		5 1	4	7	8	0		consistent.
		7	6	6	9	2		
	2.739 × 28 =	76.6	592	1				

Division- overview of skills in different year groups



Division - overview of skills in different year groups.

Year	skills	How - representations and models	Additional guidance
1 and 2	Solve one-step problems with division (sharing)	Bar model, real life objects, arrays, counters.	 Y1 - use concrete and pictorial representations. Not expected to record division formally. Y2 - introduce to the division symbol.
1 and 2	Solve one-step problems with division (grouping)	As above plus Numicon, bead strings, ten frames, number lines.	Grouping encourages the link to repeated subtraction on a number line.

Division - overview of skills in different year groups.

Year	skills	How - representations and models	Additional guidance
3	Divide 2-digits by 1 digit (no exchange, sharing)	Base 10, bar model, place value counters, part-whole model.	Use manipulatives that allow them to partition into tens and ones, when dividing larger numbers.
Tens			
40	48 ÷ 2 = 24 8 + 2		

Division - overview of skills in different year groups.

Year	skills	How - representations and models	Additional guidance
3 and 4	Divide 2-digits by 1 digit (sharing with exchange)	As previous	Use Base 10 and place value counters to exchange one ten for ten ones. Flexible partitioning in a part-whole model support this method.
3 and 4	Divide 2-digits by 1 digit (sharing with remainders)	Base 10, bar model, place value counters, part-whole model.	As above.
	53 + 4 = 13 rl	1	1

Year	skills	How - representations and models	Additional guidance
4 and 5	Divide 2-digits by 1 digit (grouping)	Place value counters, place value grid, written short division.	Language is important here e.g How many groups of 4 ones can we make?
4	Divide 3-digits by 1 digit (sharing with exchange)	Base 10, bar model, place value counters, part-whole model.	Continue to use place value counters to share into equal groups.
4 and 5	Divide 3-digits by 1 digit (grouping)	Place value counters, place value grid, written short division.	Place value counters on a place value grid can be used to understanding. Can draw own counters and group them for a more pictorial method.

Year	skills	How - representations and models	Additional guidance
5	Divide 4-digits by 1 digit (grouping)	Place value counters, place value grid, written short division.	Should be encouraged to move away from concrete and pictorial when dividing numbers with multiple exchanges.
6	Divide multi-digits by 2-digit (short division)	Written short division, list of multiples.	Can write out multiples to support their calculations.
6	Divide multi-digits by 2-digit (long division)	As above	As above for multiples. Can leave as a remainder or convert it into a fraction - depends on context of question.

The benefit of each of the different models and representatives used to teach multiplication and division at Brough Primary School.



Bar Model







Benefits

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 calculation 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



 $5 \times 4 = 20$ $4 \times 5 = 20$



 $18 \div 3 = 6$

Benefits

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 row. They can then use the tens number shapes along with other necessary shapes over the top of the row to check the total. Using the number shapes in multiplication can support children in discovering patterns of multiplication e.g. odd × odd = even, odd × even = odd, even × 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 6 groups of 3 in 18.

Bead Strings

 $5 \times 3 = 15$ $3 \times 5 = 15$ $15 \div 3 = 5$

 $5 \times 3 = 15$ $3 \times 5 = 15$ $15 \div 5 = 3$

$$4 \times 5 = 20$$

 $5 \times 4 = 20$
 $20 \div 4 = 5$

Benefits

Bead strings to 100 can support children in their understanding of multiplication as repeated addition. Children can build the multiplication using the beads. The colour of beads supports children in seeing how many groups of 10 they have, to calculate the total more efficiently.

Encourage children to count in multiples as they build the number e.g. 4, 8, 12, 16, 20.

Children can also use the bead string to count forwards and backwards in multiples, moving the beads as they count.

When dividing, children build the number they are dividing and then group the beads into the number they are dividing by e.g. 20 divided by 4 – Make 20 and then group the beads into groups of four. Count how many groups you have made to find the answer.

Number Tracks





 $6 \times 3 = 18$ $3 \times 6 = 18$



18 ÷ 3 = 6

Benefits

Number tracks are useful to support children to count in multiples, forwards and backwards. Moving counters or cubes along the number track can support children to keep track of their counting. Translucent counters help children to see the number they have landed on whilst counting.

When multiplying, children place their counter on 0 to start and then count on to find the product of the numbers.

When dividing, children place their counter on the number they are dividing and the count back in jumps of the number they are dividing by until they reach 0. Children record how many jumps they have made to find the answer to the division.

Number tracks can be useful with smaller multiples but when reaching larger numbers they can become less efficient.

Number Lines (labelled)





 $4 \times 5 = 20$ $5 \times 4 = 20$



 $20 \div 4 = 5$

Benefits

Labelled number lines are useful to support children to count in multiples, forwards and backwards as well as calculating single-digit multiplications.

When multiplying, children start at 0 and then count on to find the product of the numbers.

When dividing, start at the number they are dividing and the count back in jumps of the number they are dividing by until they reach 0.

Children record how many jumps they have made to find the answer to the division.

Labelled number lines can be useful with smaller multiples, however they become inefficient as numbers become larger due to the required size of the number line.

Number Lines (blank)



Benefits

Children can use blank number lines to represent scaling as multiplication or division.

Blank number lines with intervals can support children to represent scaling accurately. Children can label intervals with multiples to calculate scaling problems.

Blank number lines without intervals can also be used for children to represent scaling.

Base 10/Dienes (multiplication)



Benefits

Using Base 10 or Dienes is an effective way to support children's understanding of column multiplication. It is important that children write out their calculation alongside the equipment so they can see how the concrete and written representations match.

As numbers become larger in multiplication or the amounts of groups becomes higher, Base 10 / Dienes becomes less efficient due to the amount of equipment and number of exchanges needed.

Base 10 also supports the area model of multiplication well. Children use the equipment to build the number in a rectangular shape which they then find the area of by calculating the total value of the pieces This area model can be linked to the grid method or the formal column method of multiplying 2-digits by 2-digits.

Base 10/Dienes (division)

$$68 \div 2 = 34$$

Tens	Ones
11	

$$72 \div 3 = 24$$



Benefits

Using Base 10 or Dienes is an effective way to support children's understanding of division.

When numbers become larger, it can be an effective way to move children from representing numbers as ones towards representing them as tens and ones in order to divide. Children can then share the Base 10/ Dienes between different groups e.g. by drawing circles or by rows on a place value grid.

When they are sharing, children start with the larger place value and work from left to right. If there are any left in a column, they exchange e.g. one ten for ten ones. When recording, encourage children to use the partwhole model so they can consider how the number has been partitioned in order to divide. This will support them with mental methods.

Place Value Counters (multiplication)



34		
×	5	
170		
1	2	



		44
į	×	32
		8
		80
		120
ł	12	200
	14	108
	1	

Benefits

Using place value counters is an effective way to support children's understanding of column multiplication. It is important that children write out their calculation alongside the equipment so they can see how the concrete and written match.

As numbers become larger in multiplication or the amounts of groups becomes higher, Base 10 / Dienes becomes less efficient due to the amount of equipment and number of exchanges needed The counters should be used to support the understanding of the written method rather than support the arithmetic.

Place value counters also support the area model of multiplication well. Children can see how to multiply 2-digit numbers by 2-digit numbers.

Place Value Counters (division)







1223 489

Benefits

Using place value counters is an effective way to support children's understanding of division.

When working with smaller numbers, children can use place value counters to share between groups. They start by sharing the larger place value column and work from left to right. If there are any counters left over once they have been shared, they exchange the counter e.g. exchange one ten for ten ones. This method can be linked to the part-whole model to support children to show their thinking.

Place value counters also support children's understanding of short division by grouping the counters rather than sharing them. Children work from left to right through the place value columns and group the counters in the number they are dividing by. If there are any counters left over after they have been grouped, they exchange the counter e.g. exchange one hundred for ten tens.

Glossary

Array – An ordered collection of counters, cubes or other item in rows and columns.

Commutative – Numbers can be multiplied in any order.

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.

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 a division

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