Numeracy/ Calculations Policy

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Policy and Culture of Numeracy at Brettenham

Brettenham Primary School is committed to improving numeracy outcomes for children by focusing heavily on the concrete, pictorial, abstract (CPA) approach, alongside daily revision of mental arithmetic skills. A large percentage of children at Brettenham are registered as having English as an additional language, therefore, with a strong understanding of number work as a foundation, they have a better grasp of the theory of mathematics, which subsequently supports their reasoning skills.

When teaching Numeracy, the pedagogy of the methods is essential. Both the teachers and the children need to demonstrate understanding of a method by constant articulation of the steps. Children should be constantly questioned verbally as to why they have elected to make a choice or what the next step of the method is. Children must be proficient in explaining their reasoning.

Implementation of the Policy

Each teacher has a commitment to moving children on to the next level as and when they are ready. We have to foster a culture of having high expectations, pushing each child to achieving their full potential. Consistency in approach throughout the school is the key to success.

How Stages Develop

The methods in this document rely on each other to a degree, and also place a great emphasis on the children understanding place value. As children move from one stage to another, the focus moves from:

1) Concrete understanding using manipulatives
2) Pictorial representations of concepts where appropriate
3) Abstract written methods
4) Speed, fluency and efficiency

All stages of the calculation policy should work alongside the development of reasoning skills and articulation of understanding. Pupils should be using mathematical language when using calculations to solve problems, make generalisations, find patterns and explain their ideas. Once a child has fully understood the concept taught, they should move on to mastery challenges (justify, prove, investigate questions), enabling them to develop a deep knowledge of mathematics.

Mixed starters

At Brettenham, we have found that constant retrieval is the key to success. If children do not regularly use a skill, they lose it. Therefore, every lesson begins with a mixed set of starter questions which recap previously learnt skills. This is also useful for AfL, as it enables teachers to quickly identify any areas of mathematics which may need to be revisited.

Counting

EYFS

Practical Maths

Nursery

- Take part in finger rhymes with numbers.
- Combine objects like stacking blocks and cups. Put objects inside others and take them out again.

- React to changes of amount in a group of up to three items.
- Compare amounts, saying 'lots', 'more' or 'same'.
- Develop counting-like behaviour, such as making sounds, pointing or saying some numbers in sequence.
- Count in everyday contexts

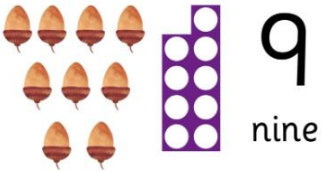
- Develop fast recognition of up to 3 objects, without having to count them individually (subitising)

- Recite numbers past 5
- Say one number for each item in order: 1,2,3,4,5
- Know that the last number reached when counting a small set of objects tell you how many there are in total

- Show 'finger numbers' up to 5
- Link numerals and amounts showing the right number of objects to match the numeral up to 5.
- Experiment with own symbols and marks as well as numerals
- Solve real world maths problems with numbers up to 5
- Compare quantities 'more than' and 'less than'

Reception

- Count objects, actions and sounds
- Subitise numbers up to 5
- Link the number symbol with its cardinal number value



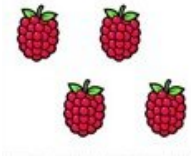
- Count beyond ten
- Compare numbers
- Explore the composition of numbers to 10
- Verbally count beyond 20, recognising the pattern of the counting system
- Explore and represent patterns within numbers to 10, including evens and odds, double facts and how quantities can be distributed equally.

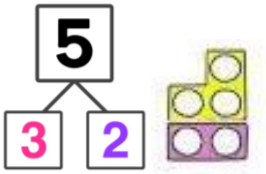
Addition

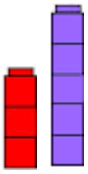
EYFS

Practical Maths

- Understand the 'one more than/one less than' using objects.
- Automatically recall number bonds for numbers 0-5 and some to 10.
- Compare quantities up to 10 in different contexts, recognising when one quantity is greater than, less than or the same as the other quantity



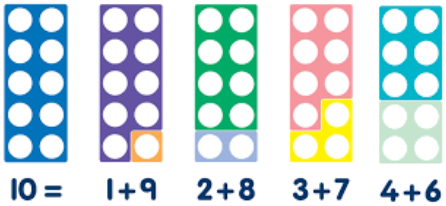


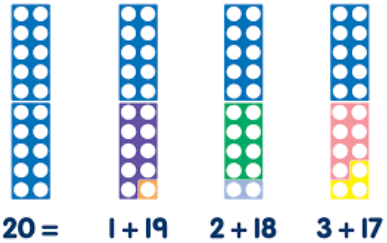


Year 1

- Add one-digit and two-digit numbers to 20, including 0
- Using a range of manipulatives to total groups of objects up to 20 (Numicon, fingers, multi-link, dienes and other objects)

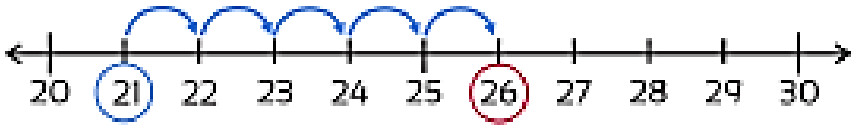
- To count on from a given number using the bigger number first and adding the smaller number (children to have a secure knowledge of ordering numbers, which will allow them to select the bigger number)
- Count, read and write numbers to 100 in numerals
- Use of manipulatives such as Numicon to represent and show an understanding of number bonds to 10 and 20 (once children are secure using manipulatives, next step is to recall number bonds mentally)



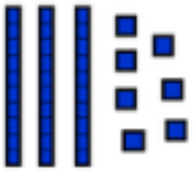


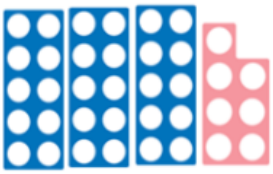
Year 2

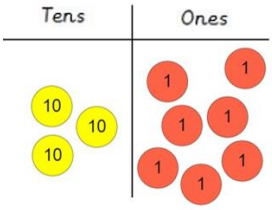
- Ensure knowledge of two-digit + one-digit counting on from a given number



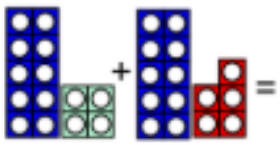
- Adding three single digit numbers by counting on and using knowledge of number bonds
- Having a secure knowledge of number bonds to 10, 20 and 100 (in multiples of 10)
- Counting on from a given number using knowledge of number bonds where appropriate (two-digit + one-digit)
- Using a range of manipulatives to show an understanding of two-digit numbers (including partitioning into tens and ones e.g. 37 = 30 + 7 which is the same as 3 tens and 7 ones

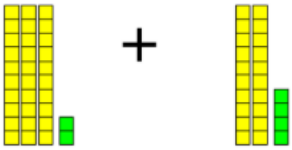


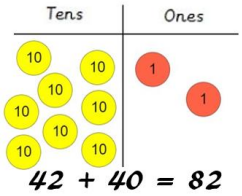




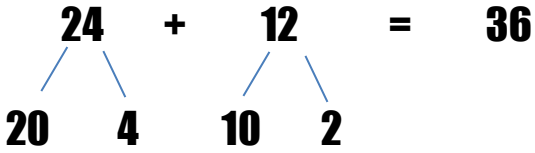
- Using knowledge of place value to add a two-digit number and tens using manipulatives and building onto mental strategies
- Add up to two-digit and two-digit numbers using manipulatives







- Using knowledge of partitioning to add two-digit add two-digit numbers (partitioning to be used when adding two-digit numbers)



Year 3

- Adding numbers with up to three-digits using column method. Children should be confident using column addition without carrying first:

$$\begin{array}{r} 365 \\ +\ 213 \\ \hline 578 \\ \hline \end{array}$$

Once secure, children are to begin carrying across boundaries but ALWAYS carry below (to ensure children do not get confused when they move on to multiplication):

$$\begin{array}{r} 598 \\ +\ 363 \\ \hline 961 \\ \hline 11 \end{array}$$

Year 4

- Adding numbers with up to four-digits using column method (see Year 3 strategies and consolidate understanding of the column method):

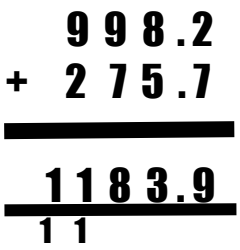
$$\begin{array}{r} 5982 \\ +\ 2946 \\ \hline 8928 \\ \hline 11 \end{array}$$

- Check understanding through missing numbers:

$$\begin{array}{r} \square 98 \\ +\ 3\square 7 \\ \hline 745 \\ \hline \square\square \end{array}$$

Year 5 and 6

- Add whole numbers with more than four-digits using column addition, introducing addition of money and decimals
- Continue with the column addition method with up to four-digits and/or decimals
- Ensure when addition includes decimals that the decimal point **does not** move:

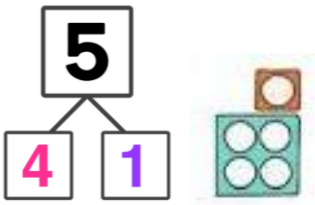


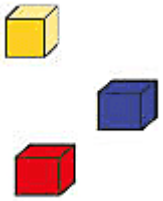
Subtraction

EYFS

Practical Maths

- Understand the 'one more than/one less than' using objects.
- Automatically recall number bonds for numbers 0-5 and some to 10.
- Compare quantities up to 10 in different contexts, recognising when one quantity is greater than, less than or the same as the other quantity

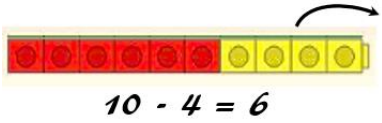




'one less than…'

Year 1

- Subtract one-digit and two-digit numbers to 20, including 0
- Using a range of manipulatives to physically take away groups of objects up to 20 (Fingers, multi-link, dienes, etc.):



10 - 4 = 6

13 - 5 = 8

- To count back from a given number using the bigger number first and subtracting the smaller number (children to have a secure knowledge of ordering numbers which will allow them to select the bigger number):

9 – 4 = 5

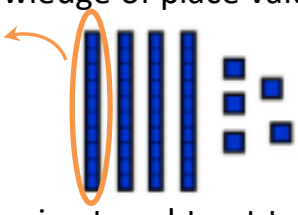
- Rather than using bigger numbers once pupils show a secure understanding, move on to subtraction with missing numbers:

5 - 2 = □ □ = 5 - 2
5 - □ = 3 3 = □ - 2
□ - 2 = 3 3 = 5 - □
□ - □ = 3 3 = □ - □

N.B. Numicon should **only** be used for difference questions and by laying the smaller number on top of the bigger number:

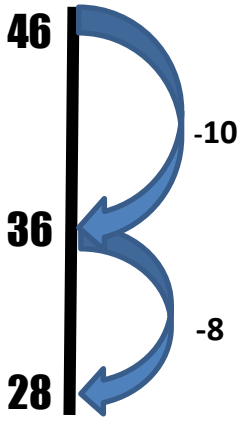
Year 2

- Subtract up to two-digit and two-digit numbers
- Subtracting by counting back from a given number
- Use knowledge of number bonds to 10, 20 and 100 (in multiples of 10) to subtract e.g. 10 - 7 = 3 so 100 – 70 = 30 using a range of manipulatives to support concrete understanding
- Use manipulatives and knowledge of place value to find 10 less than a given two-digit number.



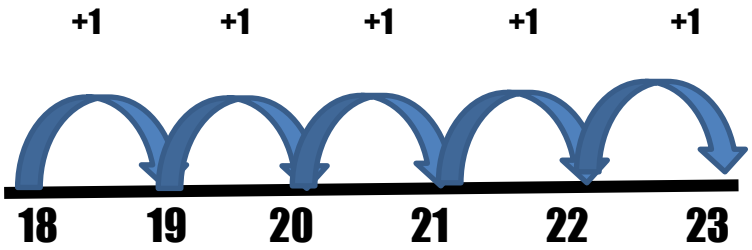
- Counting back using partitioning to subtract two-digit and two-digit numbers e.g.

46 - 18 = 46 - 10 - 8



- Subtract by finding the difference counting up when the difference is small. Show how this works using manipulatives.

23 - 18 = 5

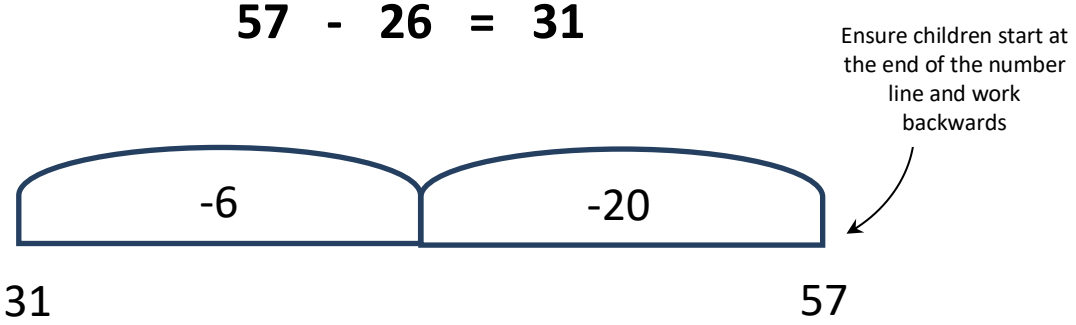


- Use the inverse relationship between addition and subtraction (include finding missing numbers)

Year 3

- Subtract numbers with up to three-digits using column subtraction (begin with number line subtraction, progressing to column subtraction)

57 - 26 = 31



Once secure move on with column subtraction focusing on the compact version.

- Children to be confident using column subtraction without exchanging first:

$$\begin{array}{r} 975 \\ -\ 213 \\ \hline 762 \\ \hline \end{array}$$

- Introduce exchanging once secure with column subtraction:

$$\begin{array}{r} 5\ {}^{6}\!\not{7}\ {}^{1}3 \\ -\ 2\ 4\ 6 \\ \hline 3\ 2\ 7 \\ \hline \end{array}$$

Year 4

- Subtract numbers with up to four-digits using column subtraction (see Year 3 strategies and consolidate understanding of the column subtraction):

$$\begin{array}{r} {}^{5}\cancel{6}\,{}^{1}2\,{}^{6}\cancel{7}\,{}^{1}1 \\ 2\;4\;3\;6 \\ \hline 3\;8\;3\;5 \end{array}$$

- Check understanding of column subtraction through missing numbers:

$$\begin{array}{r} \square\;9\;8 \\ -\;3\;\square\;7 \\ \hline 6\;4\;1 \end{array}$$

Year 5 and 6

- Subtract whole numbers with more than four-digits using column subtraction, (introduce addition of money and decimals)
- Ensure when subtraction includes decimals that the decimal point **does not** move.

$$\begin{array}{r} {}^{5}\cancel{6}\,{}^{1}2\,{}^{6}\cancel{7}\,{}^{1}1.4 \\ 1\;3\;3\;6.3 \\ \hline 4\;9\;3\;5.1 \end{array}$$

Multiplication

EYFS

Practical Maths

- Explore and represent patterns within numbers to 10, including evens and odds, double facts and how quantities can be distributed equally.

Year 1

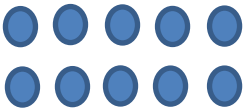
- Doubling using manipulatives and using recall
- Counting on in 2s, 5s and 10s using a range of manipulatives (Numicon, multi-links etc.) and using repeated addition

Year 2

- Use manipulatives to count on in regular groups (2s, 5s and 10s)
- Relate practical objects to repeated addition. E.g. 2 x 5 =

2 + 2 + 2 + 2 + 2 or 5 + 5

- Draw arrays e.g. 2 x 5 and know that they are commutative =



- Record methods and use the symbols x and =

Year 3 and 4

- Multiply two-digit by one-digit numbers. Begin drawing on known mental methods, progress to formal written methods
- Write and calculate mathematical statements for multiplication. Pupils to use mental methods and progress to formal written methods:

$$\begin{array}{r} 32 \\ \times\ \ 3 \\ \hline 96 \\ \hline \end{array}$$

- Move onto adding an extra digit:

$$\begin{array}{r} 52 \\ \times\ \ 4 \\ \hline 208 \\ \hline \end{array}$$

To extend pupils, move onto carrying. In multiplication, you must always carry at the top, never below.

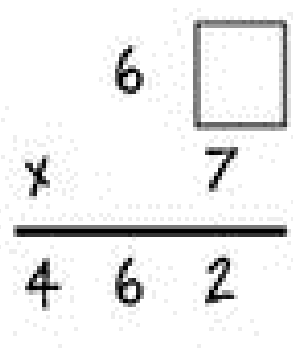
$$\begin{array}{r} {\scriptstyle 5}\ \ \\ 38 \\ \times\ \ 7 \\ \hline 266 \\ \hline \end{array}$$

When carrying, carry above and cross out to show that you have added it on.

3 x 7 = 21
21 + 5 = 26 →

$$\begin{array}{r} \cancel{5}\ \ \\ 38 \\ \times\ \ 7 \\ \hline 266 \\ \hline \end{array}$$

Once children are confident carrying, identify missing numbers in a multiplication problem:



Explain to children how to work backwards using the inverse.

6 x 7 = 42
46 - 42 = 4
42 ÷ 7 = 6

Missing number = 6

Year 4

- Multiply two-digit by one-digit, including decimals by 10, 100, 1000.

Multiplying and Dividing by 10, 100 and 1000

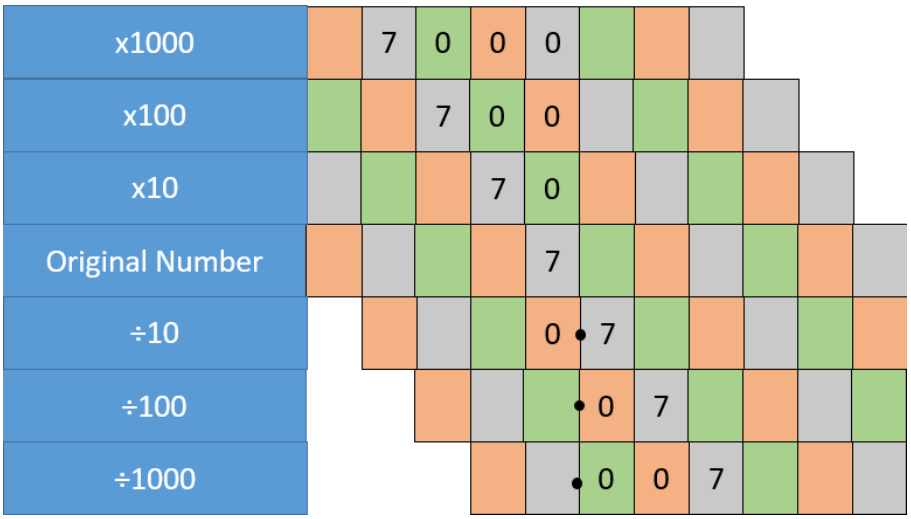
10 000	1000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$

Multiplying

X 10	digits move LEFT **1** space
X 100	digits move LEFT **2** spaces
X 1000	digits move LEFT **3** spaces

Dividing

÷ 10	digits move RIGHT **1** space
÷ 100	digits move RIGHT **2** spaces
÷ 1000	digits move RIGHT **3** spaces

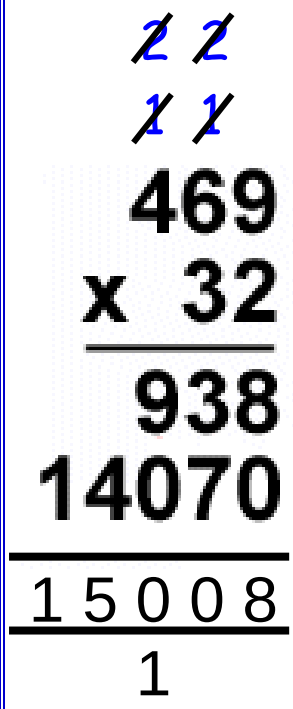


Children must be fully aware that the decimal point NEVER moves and the digits move instead.

- Write and calculate mathematical statements for multiplication.
- By the end of Year 4, children must know all of their multiplication tables up to 12.

Year 5 and 6

- Multiply numbers up to four-digit by 1 and two-digit numbers using long multiplication
- Write and calculate mathematical statements for multiplication. Pupils to use mental methods and progress to formal written methods



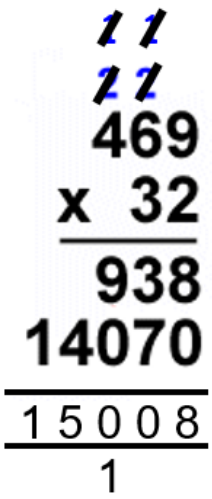
1) 9 x 2 = 18, place the 8 carry the 1 which is a ten
2) 6 x 2 = 12 + carried 1 = 13 (once carried cross it out, place the 3 carry the 1)
3) 4 x 2 = 8 + carried 1 = 9
4) Cross out the 2 as it has now been used
5) Place a 0 to show you are multiplying by 10 (place value holder)
6) 9 x 3 = 27, place the 7 carry the 2
7) 6 x 3 = 18 + carried 2 = 20 (once carried cross it out , place the 0 carry the 2)
8) 4 x 3 = 12 + carried 2 = 14 (place both numbers as there is nothing left to multiply by)
9) Now add the two rows using column addition and carry below

Always remember your **place value holder**, you need to a place a zero to hold the place of the ten. Therefore, if you are multiplying by hundreds, you need to place two place value holders, as there are two places of value within a hundred.

Year 6

(Multiplying decimals)

Apply the same method for multiplying decimals, but remove the decimal point until the calculation is complete. Once the calculation is complete, put the decimal point back. You can identify where the decimal point needs to go by counting the decimal places in the sum.



E.g. 46.9 x 3.2 =

Two decimal places = **150.08**

E.g. 4.69 x 3.2 =

Three decimal places = **15.008**

E.g. 4.69 x 0.32 =

Four decimal places = **1.5008**

Division

EYFS

Practical Maths

- Explore and represent patterns within numbers to 10, including evens and odds, double facts and how quantities can be distributed equally.

Year 1

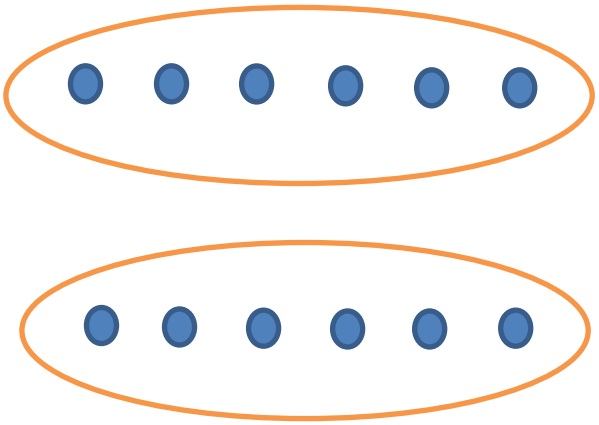
- Halving and sharing using manipulatives

- Division as arrays

12 ÷ 2 =

Number of objects

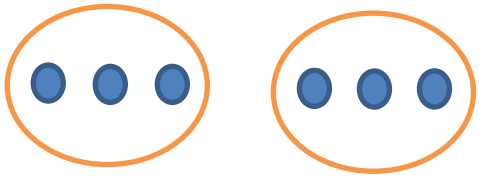
Number of rows



Year 2

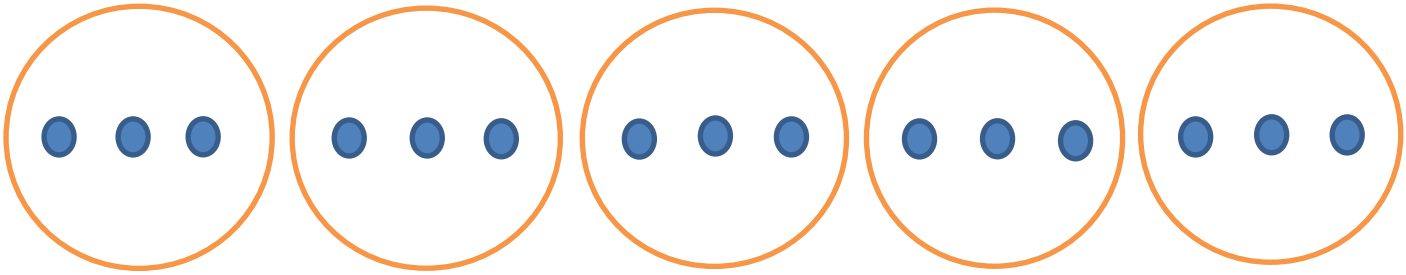
- Division by sharing and grouping using manipulatives
- Division recorded using arrays, e.g. I have 6 objects and put them into 2 groups. How many are in each group?

6 ÷ 2 =



E.g. I have 15 objects and need to share them between 5 people. How many will each person get?

15 ÷ 5 =



- Division using inverse of multiplication facts mentally

E.g. 5 x 2 = 10 so 10 ÷ 2 = ☐ and 10 ÷ ☐ = 2

Year 3 and 4

- Divide two-digit numbers by one-digit. Teachers must ensure pupils are aware of place value in order to find the correct answer.

$2\overline{)84}$

$\begin{array}{r} 4 \\ 2\overline{)84} \end{array}$ Do the 8 first, 8÷2=4

$\begin{array}{r} 42 \\ 2\overline{)84} \end{array}$ Then do the 4, 4÷2=2

1) How many 2s in 8?
   8 ÷ 2 = 4
2) Place the 4 above the 8 in the tens column.
3) How many 2s in 4?
   4 ÷ 2 = 2
4) Place the 2 above the 4 in the ones column.
5) Children to read the answer using an understanding of place value as 42.

Once children are able to divide whole numbers equally, move onto numbers with a remainder.

$4\overline{)64}$

1) How many 4s in 6?

   6 ÷ 4 = 1 r 2

$\begin{array}{r} 1 \\ 4\overline{)6^{2}4} \end{array}$

2) Place the 1 above the 1 and carry the 2 across to the 4

   (Making the number 24)

3) How many 4s in 24?

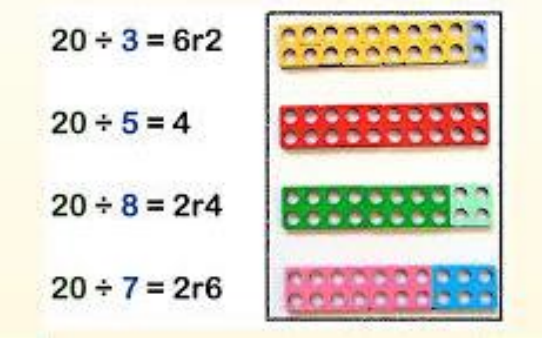
   24 ÷ 4 = 6

$\begin{array}{r} 16 \\ 4\overline{)6^{2}4} \end{array}$

4) Place the 6 above the 24, the answer becomes 16

64 ÷ 4 = 16

Numicon can also be used to help children understand the concept of reminders:

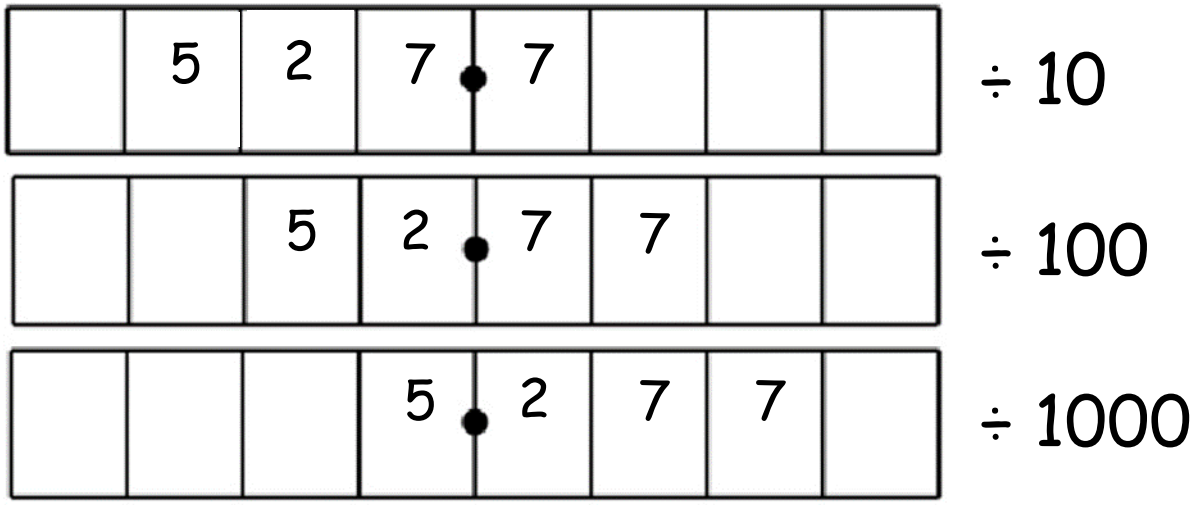


Year 4

- Divide two-digit by one-digit, including decimals by 10, 100, 1000.

5277 ÷ 10 = 527.7
5277 ÷ 100 = 52.77
5277 ÷ 1000 = 5.277

Just like multiplication, ensure the decimal point never moves and the digits move instead.



Year 5

- Divide up to four-digits by one-digit using short division, interpret remainders as fractions and decimals.

Pupils to divide using the same method as Year 3 and 4, but moving onto bigger numbers and interpreting remainders in different ways.

956 ÷ 5 = **191 r 1** OR **191.2** OR **191 ⅕**

$$5\overline{)956} = 191\ r\ 1$$

$$5\overline{)956} = 191\frac{1}{5}$$

$$5\overline{)956.0} = 191.2$$

As you can see, there are three different ways to interpret the remainders, making each answer slightly different.

Pupils must be able to interpret simple remainders in the relevant context, depending on the problem they are solving.

Children should use this knowledge to answer division word problems such as:

- How many boxes do you <u>need?</u> (Round answer down to nearest whole number)
- How many boxes can you <u>fill? (Round answer up to next whole number</u>

Year 6

By the time pupils reach year 6, they should be able to divide four-digit numbers by one-digit and interpret remainders in different ways (as shown above). The focus for year 6 is to divide numbers with up to four-digits by two-digits. See example B.

B =

		0	1	8	2
2	1	$3^{3}8^{17}2^{4}2$			
	21		126		
	42		147		
	63		168		
	84		189		
	105		210		

Tip: Encourage children to estimate their times tables, rather than writing out entire lists of times tables.

E.g.: 1 x 21 = 21
5 x 21 = 105
10 x 21 = 210

$$\begin{array}{r} 0\ 1\ 8\ 2 \\ 21\overline{)\,3^{3}8^{17}2^{4}2} \end{array}$$

8 x 21 = 168
172 - 168 = 4

Pupils can estimate based on these key times tables what the answers could be.

1) First begin to write out your 21 times table. Advise children to use estimation if this takes too long.
2) Next look at how many 21s in 3? The answer is 0, therefore you have to carry the 3.
3) The 3 is carried over to the 8, making 38. How many 21s in 38? The answer is 1, place the 1 above the 38.
4) You now need to work out the remainder. 38 – 21 = 17
5) This stage requires you to carry 17 over to the 2, making 172.
6) How many 21s in 172? 21 x 8 = 168, therefore you place 8 above 172.
7) Now work out the remainder, 172 – 168 = 4, therefore you have to carry the 4 over to the 2, making 42.
8) Finally, how many 21s in 42? The answer is 2 and there are no remainders, which means the 2 needs to go above the 42, making the answer 182.
9) If the answer doesn't divide exactly, you may interpret the remainders in the same way as shown in Year 5 division.

Multiplication and Division

This should be memorised by individuals from 1-12 times tables with their corresponding division facts. Including multiplications and divisions with differing place values:

60 x 7 = 420 0.9 x 4 = 3.6 30 x 40 = 1200
180 ÷ 6 = 30 240 ÷ 80 =3 3.2 ÷ 0.8 = 4

Doubling and Halving

Doubling

When doubling any number pupils need to be aware that they are multiplying by two but work it out by means of repeated addition.

34 x 2 = 68
34 + 34 = 68

Halving

Whenever a problem presents as ÷2, children are to halve it using this method to reinforce that divide by 2 is the same as halving. When halving children to use their knowledge of partitioning. a) is the initial teaching and b) and c) show progression.

a) 46

40 6

20 + 3 = 23

b) 46

20 + 3 = 23

c)

$$2 \overline{)\, 4\ 6}$$

2 3

a) 37

30 + 7

15 + 3.5 = 18.5

b) 37

15 + 3.5 = 18.5

c)

$$2 \overline{)\, 3\ {}^{1}7\ .\ {}^{2}0}$$

1 8 . 5

Fractions

This covers fractions and the four operations – not simplifying and finding equivalents.

Addition and Subtraction of Fractions

Year 3

- Add and subtract fractions with the same denominator (within a whole number):

$$\frac{5}{7} + \frac{1}{7} = \frac{6}{7}$$

Year 4

- Add and subtract fractions with the same denominator

$$\frac{5}{7} + \frac{4}{7} = \frac{9}{7}$$

Year 5 and 6

- Add and subtract fractions where the denominators are multiples of the same number

Q. $\frac{1}{2} + \frac{3}{8} =$

$\frac{1}{2} \overset{\times 4}{\underset{\times 4}{}} \mathbf{\frac{4}{8}} + \frac{3}{8} =$

$\mathbf{\frac{4}{8}} + \frac{3}{8} = \frac{7}{8}$

The denominators need to be the same so the half needs to become four eighths.

Q. $\frac{1}{2} + \frac{1}{3} =$

$\frac{1}{2} \overset{\times 3}{\underset{\times 3}{}} \mathbf{\frac{3}{6}} + \frac{1}{3} \overset{\times 2}{\underset{\times 2}{}} \mathbf{\frac{2}{6}} =$

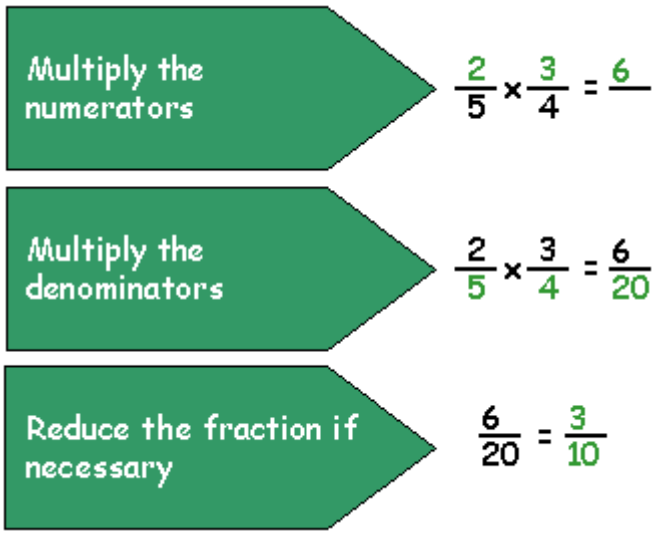
$\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$

The denominators need to be the same. 6 is the lowest common multiple of 3 and 2 and therefore should be used as the denominator.

Multiplying and Dividing Fractions

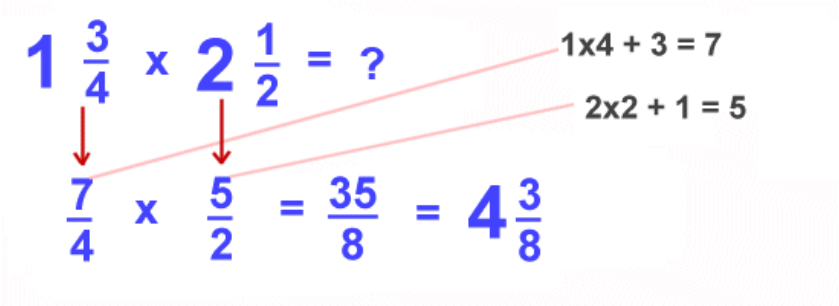
Multiplying fractions

1. Simplify the fractions if not in lowest terms.
2. Multiply the numerators of the fractions to get the new numerator.
3. Multiply the denominators of the fractions to get the new denominator.



Multiplying Mixed Numbers

When multiplying mixed numbers you need to change the mixed number into an improper fraction before you multiply.



For example, if the number is $2\frac{1}{3}$, you will need to change this to $\frac{7}{3}$ before you multiply. You may also need to change the answer back to a mixed number when you have finished multiplying.

In this example $1\frac{3}{4}$ has been changed to the fraction $\frac{7}{4}$ and $2\frac{1}{2}$ to the fraction $\frac{5}{2}$. The multiplied answer was then converted back to a mixed number at the end.

Dividing Fractions

Keep, change, flip

$$\frac{7}{3} \div \frac{2}{8} = \frac{7}{3} \times \frac{8}{2}$$

Keep *Change* *Flip*

1. **Keep** the first fraction.

2: **Change** the division sign to a multiplication sign.

3. **Flip** the second fraction, so the denominator becomes the numerator and the numerator becomes the denominator.

4: Solve the problem using multiplication skills, then simplify. You may need to convert from an improper fraction to a mixed number.

$$\frac{7}{3} \times \frac{8}{2} = \frac{56}{6}$$

$$\frac{56}{6} = 56 \div 6 = 9 \text{ r } 3$$

$$9 \text{ r } 3 = 9\frac{3}{6} = 9\frac{1}{2}$$

Converting improper fractions:
First you need to divide the numerator by the denominator. Your mixed number becomes the amount of times your total can equally divide into your denominator and your remainder becomes your numerator. Don't forget to simplify if and when possible.