Calculation Policy for Mathematics

The following calculation policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculation across the federation.

Age Stage Expectations:

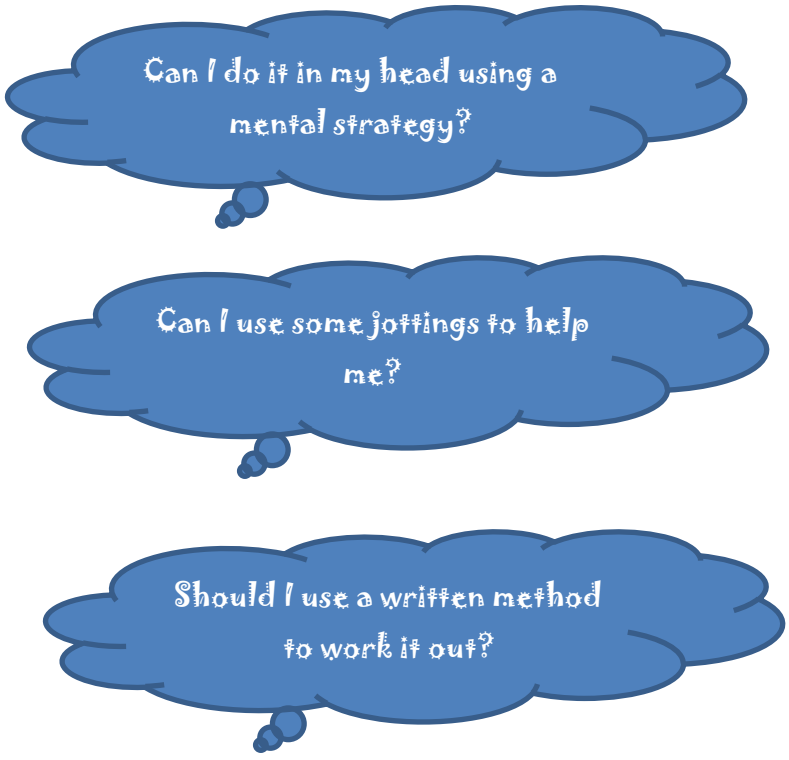
This policy is a progressive document and it is vital that the pupils are taught appropriate methods to support them with their understanding of calculation according to the developmental stage they are at. Children should only be moved on to the next stage when they are ready. This may mean they are working above or below the expectations set out for their age group in the National Curriculum.

Providing a Context for Calculation:

It is important that any type of calculation is given a real life context. This combined with a problem solving approach will help build children's understanding of the purpose of calculation, and help them recognise when to use certain operations and methods when faced with unfamiliar problems.

Choosing a Calculation Method:

Each operation is broken into two sections: the steps that lead towards a formal written method; and the range of informal and mental methods that children should be introduced to. Discussion of alternative methods and their decisions for choosing a particular method should form a part of any calculations teaching (see reasoning objectives in the long term plan for age-appropriate expectations). Children need to be taught and encouraged to use the following processes in deciding what approach they will take to a calculation – this will help them select the most appropriate method for the numbers involved:



Progression in Addition

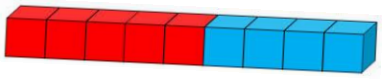
Vocabulary
Add, addition, more, plus, increase, sum, total, altogether, double, how many more?, tens boundary, hundreds boundary, partition, inverse, 'carry', decimal places, decimal point

The models & images at each stage are only examples, & a range of different apparatus may be used.

Step 1: Combine two groups together.

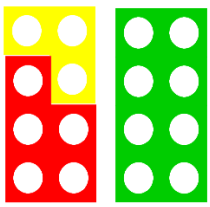
Step 2: Make and say an addition number sentence.

"6 and 4 makes 10"

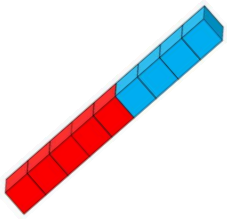


"five add four equals nine"

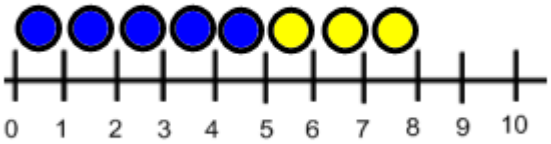
Step 3: **Read an addition sentence using the + and = symbols.**
Show an addition number sentence with apparatus or a picture.
Use counting-on to solve an addition.



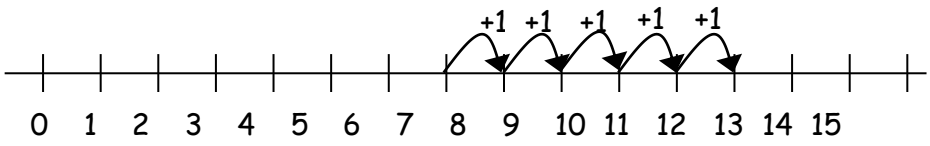
5 + 3 = 8



5 + 4 = 9



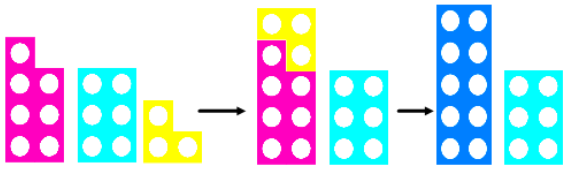
5…6…7…8



Step 4: Complete missing numbers in addition sentences.
See step 3 for models & images.

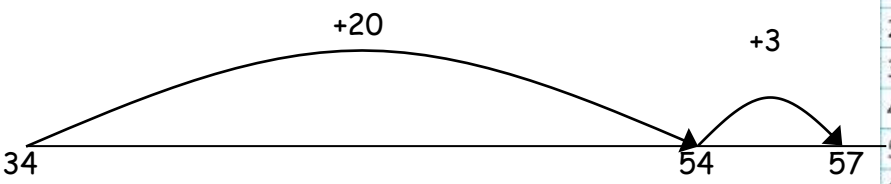
5 + ☐ = 8 ☐ + ☐ = 8 8 = ☐ + 3 8 = ☐ + ☐

Step 5: Add three or more numbers, recognising that they can be added in any order.



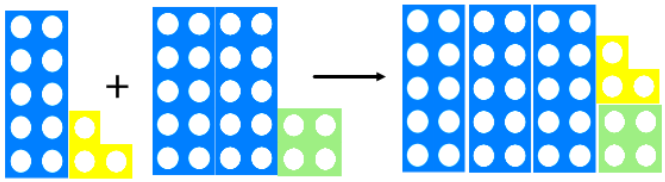
7 + 6 + 3 = 7 + 3 + 6 = 10 + 6 = 16

Step 6: Count on in tens and units.

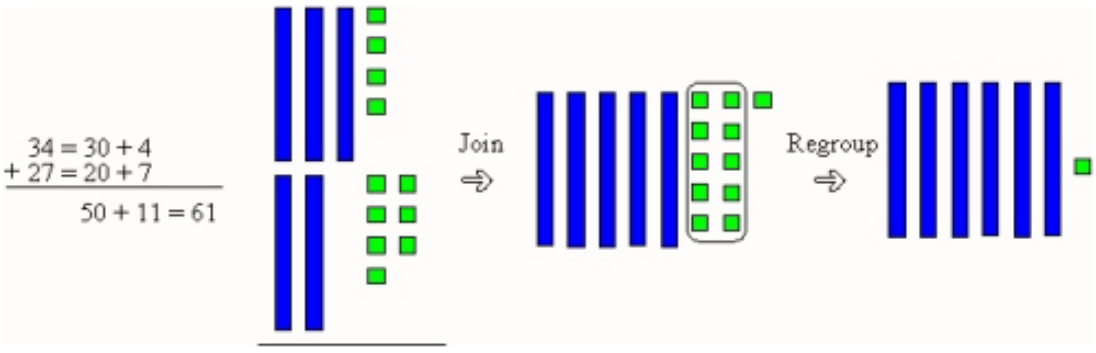


1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43		45	46	47	48	49	50
51	52	53		55	56	57	58	59	60
61	62	63	64		67	68	69	70	
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

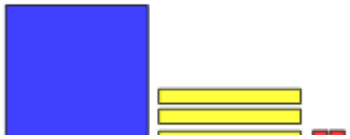
Step 7: Partition into tens and units & recombine.



13 + 24 = 10 + 3 + 20 + 4
(10 3) (20 4)
20 + 10 + 4 + 3
30 + 7
37



Step 8: **Partition into hundreds, tens and units and recombine.**
Partition decimals in the context of money.



..56 + £1.20 = £1 + £1 + 50p + 20p + 6p
50p 6p £1 20p = £2 + 50p + 6p
= £2.56

Step 9: Record partitioning using the expanded vertical method.

Depending on age – this can be extended to any number of digits and decimal places.

$$\begin{array}{r} 27 \\ +\ 34 \\ \hline 11 \quad (7+4) \\ 50 \quad (20+30) \\ \hline 61 \end{array}$$

Add the units first in preparation for the compact method.

Step 10: Reduce the expanded method to the compact method with 'carrying'.

$$\begin{array}{r} 625 \\ +\ 48 \\ \hline 673 \\ 1 \end{array}$$

$$\begin{array}{r} 9.080 \\ 59.770 \\ +\ 1.300 \\ \hline 93.51\,1 \\ 2\,1\ \ 2 \end{array}$$

Empty decimal places need to be filled with a zero to show the place value in each column.

This should only be taught when children are competent, ensuring that they recognise the place value of each digit. If children experience difficulties, return to the expanded method.

Informal Methods of Addition

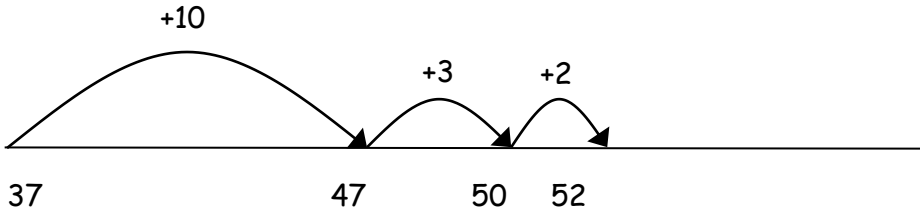
Appropriate informal and mental methods should be taught alongside the above written method, including:

- Counting
- Use of doubles & near doubles
- Number bonds to 10, then 20, then 100, then any multiple of 10 or 100.
- Compensating methods for 9 and numbers near to a multiple of 10 (e.g. adding ten, then subtracting one)
- Partial partitioning (e.g. 27 + 37, add the thirty to make 57, then add another 7)
- Bridging multiples of 10 (e.g. 37 +8, add three to make 40, then another five to make 45)

The above informal methods should be modelled with Numicon, number lines, number squares, bead strings, counters etc.

Examples

Partial Partitioning & Bridging: 37 + 15 = 52

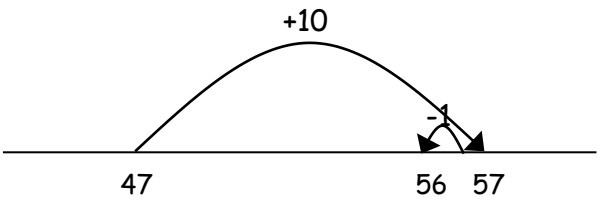


Compensating:

37 + 29 = 66 (+30, then -1)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46		48	49	50
51	52	53	54	55	56		58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

47 + 9 = 56



Vocabulary
Subtract, take away, minus, decrease, count back, how many are left?, how many less?, half, halve, inverse, difference between

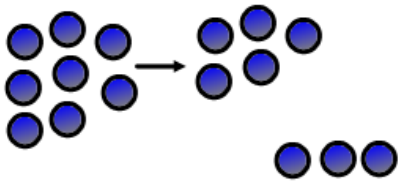
Progression in Subtraction

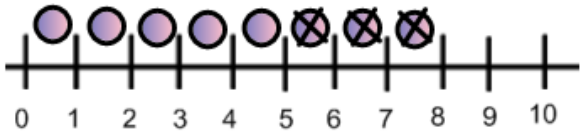
Step 1: Take away a smaller quantity from a larger one.

Step 2: Make and say a subtraction number sentence showing a take away.

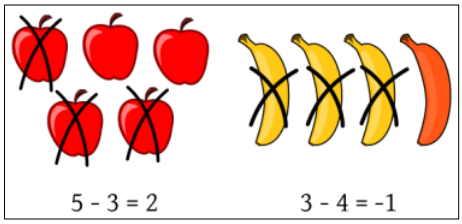
"6 take away 3 leaves 3" *"6 subtract 3 equals 3"*

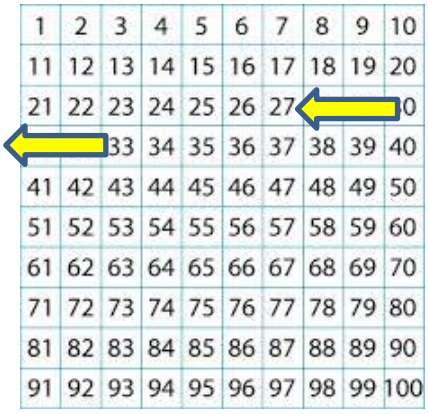
Step 3: Read a subtraction sentence using the - and = symbols.
Show a subtraction number sentence using apparatus or pictures.
Use counting back to solve a subtraction.





8 – 3 = 5

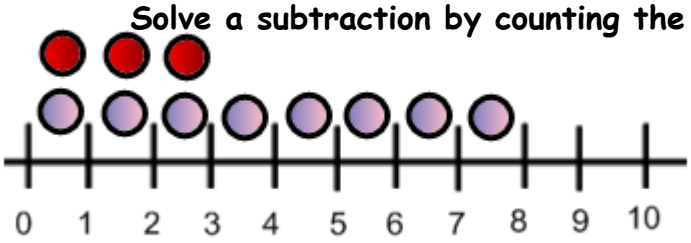




1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27			0
		33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

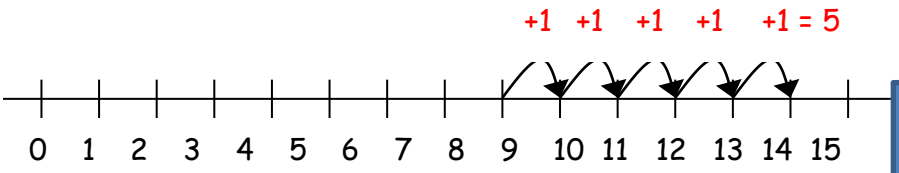
Step 4: Solve a subtraction or difference calculation by counting the difference or 'how many more'.

Solve a subtraction by counting the difference.



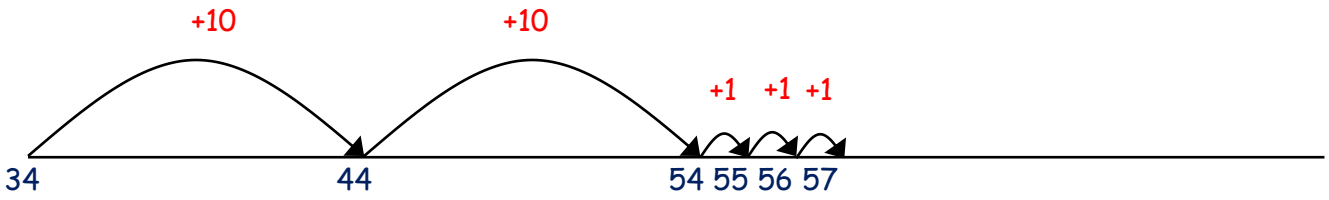
"The difference between 8 and 3 is 5." 8 – 3 = 5

13 - 8 = 5



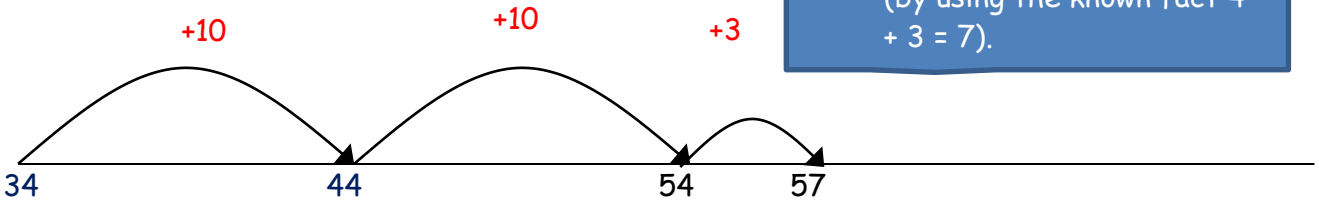
57 - 34 = 23

Children will begin to use empty number lines starting with the smallest number and counting on.



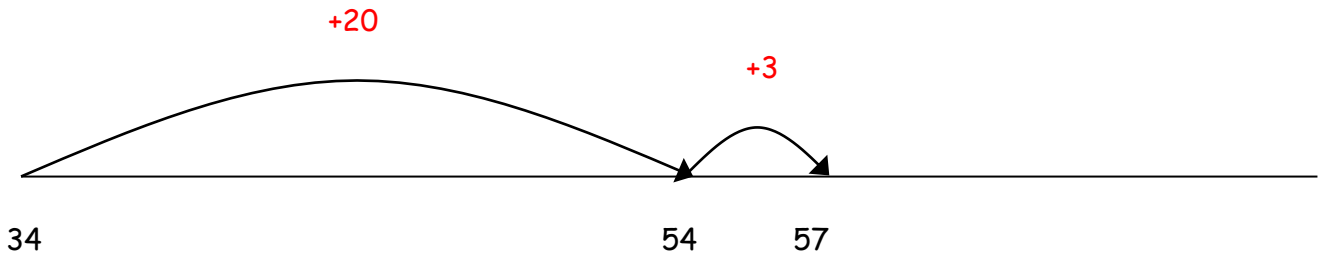
10 + 10 + 3 = 23

- ✓ First counting on in tens and ones.
- ✓ Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7).



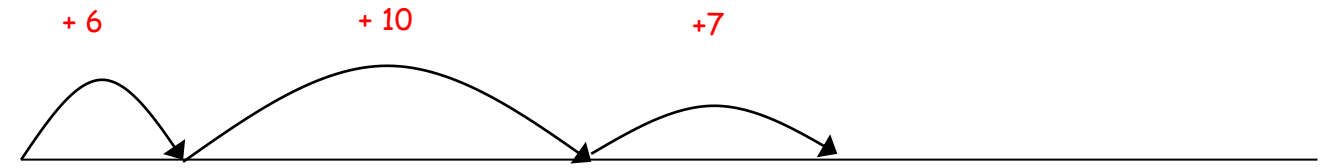
- ✓ Followed by adding the tens in one jump and the units in one jump.

20 + 3= 23



✓ Bridging through ten can help children become more efficient.

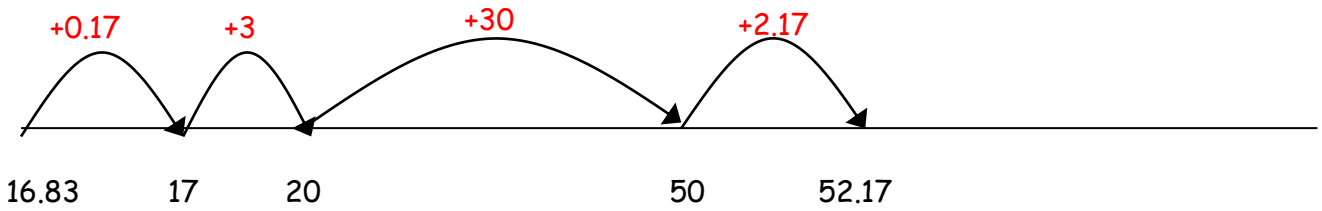
6 + 10 + 7 = 23



✓ This empty numberline method can be used for any subtraction sum including decimals.

52.17 – 16.83 = 35.34

0.17 + 3 + 30 + 2.17 = 35.34



I can use compact decomposition to solve subtraction sums.

✓ This should only be taught when the children have a very secure understanding of place value.

Partitioning and decomposition

754 – 86 = 668

754 =
- 86

✓ This could be demonstrated by the teacher to lead in to a compact method, or taught to the children first.

Step 1 700 + 50 + 4
- 80 + 6

Step 2 700 + 40 + 14 *(adjust from T to U)*
- 80 + 6

Step 3 600 + 140 + 14 *(adjust from H to T)*
- 80 + 6
600 + 60 + 8 = 668

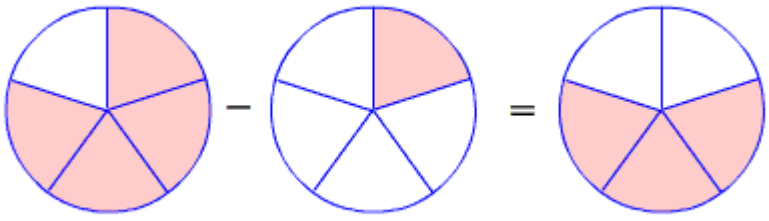
This would then be recorded as compact decomposition

614 1
~~7~~ ~~5~~4
- 86
668

Subtracting Fractions

I can subtract fractions with the same denominator.

$\frac{4}{5} - \frac{1}{5} = \frac{3}{5}$



I can subtract fractions with denominators that are multiples of the same number.

$$\frac{7}{8} - \frac{5}{16} = ?$$

$$\frac{7 \times 2}{8 \times 2} - \frac{5}{16} = \frac{14}{16} - \frac{5}{16} = \frac{9}{16}$$

I can subtract fractions with different denominators and mixed numbers using the concept of equivalent fractions.

$$2\frac{3}{8} - 1\frac{4}{5} = \frac{19}{8} - \frac{9}{5}$$

$$= \frac{95}{40} - \frac{72}{40}$$

$$= \frac{23}{40}$$

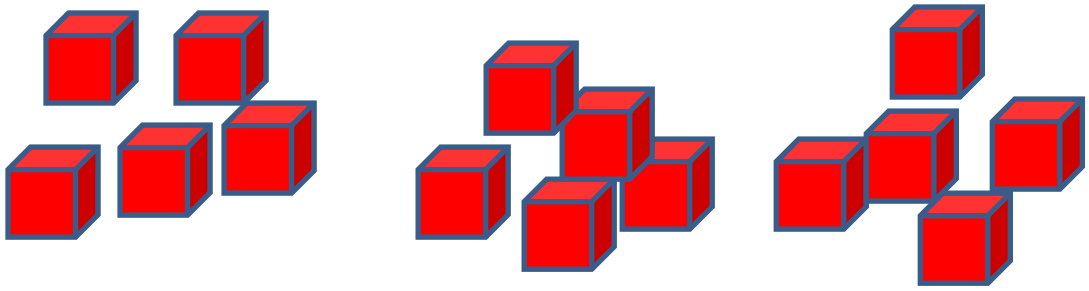
- ✓ Use knowledge of equivalent fractions to ensure both fractions have the same denominator.

Multiplication

Vocabulary

Lots of, groups of, times, product, multiply, multiple of, repeated addition, array, row, column, double, commutative, square, factor, integer, grid method

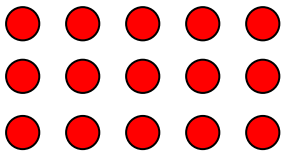
I can place objects in equal groups.



3 lots of 5 = 15 $3 \times 5 = 15$

I can count in 2s, 5s and 10s.

I can understand multiplication as repeated addition using arrays.



5 + 5 + 5 = 15

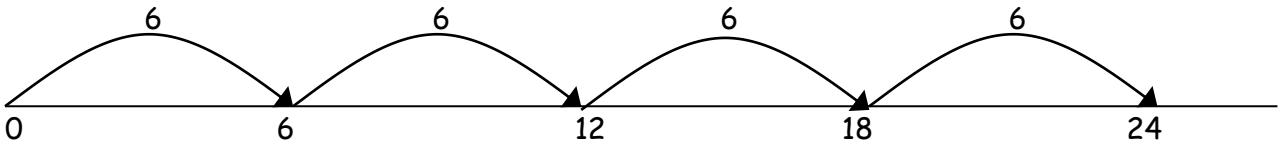
$3 \times 5 = 15$

3 + 3 + 3 + 3 + 3 = 15

$5 \times 3 = 15$

I can understand multiplication as repeated addition using a numberline.

$4 \times 6 = 24$

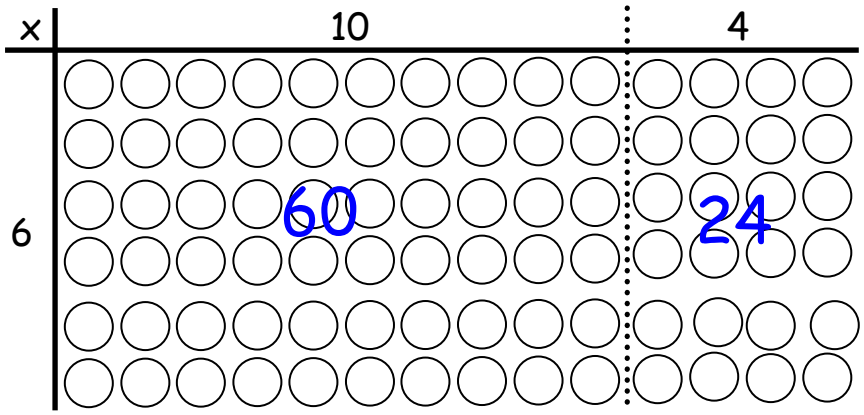


6 + 6 + 6 + 6

I can multiply 2-digits by a single digit number using a grid.

Children will continue to use arrays where appropriate leading into the grid method of multiplication.
This can be used a model for teachers to help introduce children to the grid method.

14 x 6 = 84



(6 x 10) + (6 x 4)

60 + 24

84

Children will approximate first
23 x 8 is approximately 25 x 8 = 200

x	20	3
8	160	24

160
+ 24
184

I can use grid multiplication · 23 x 8 = 184 **:rs up to a 4 digits by a 2 digit number including decima**

x	300	70	2
20	6000	1400	40
4	1200	280	8

372 x 24 = 8928

6000
+ 1400
+ 1200
+ 280
+ 40
+ 8
8928
1

4.92 x 3

Children will approximate first

4.92 x 3 is approximately 5 x 3 = 15

x	4	0.9	0.02
3	12	2.7	0.06

12.00
+ 0.70
+ 0.06
12.76

4.92 x 3 = 12.76

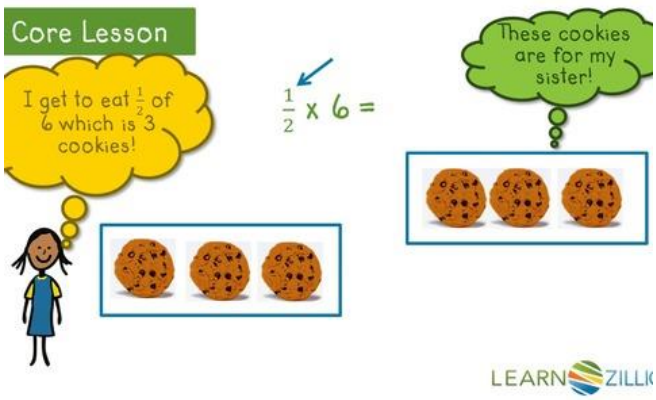
I can use a compact multiplication method.

24 x 37

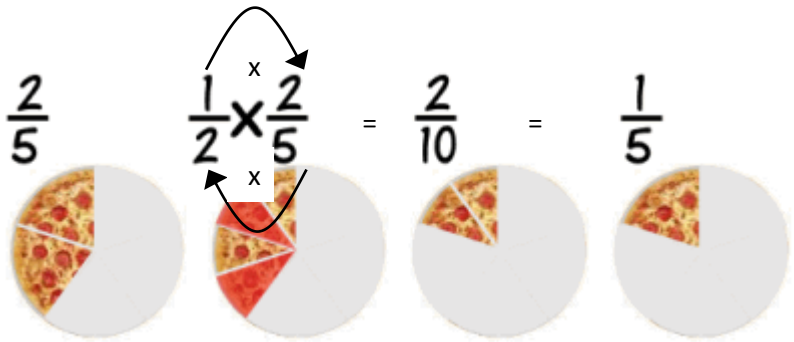
24
X 37
168
720
888

Multiplying Fractions 24 x 37 = 888

I can multiply proper fractions and mixed numbers by whole numbers using pictures and apparatus.

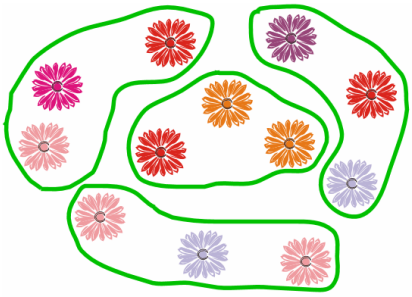


I can multiply simple pairs of proper fractions writing the answer in its simplest form.



Division

I can group and share small quantities using practical apparatus.



12 ÷ 3 = 4

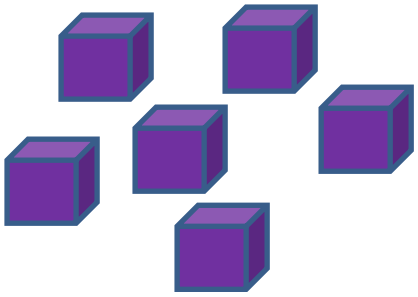
12 ÷ 4 = 3

Vocabulary

Share, share equally, equal groups of, lots of, array, divide, divided by, division, grouping, left over, inverse remainder, quotient, divisor, prime number, prime factor, composite number (non-prime)

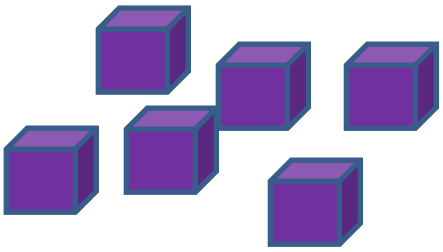
How many groups of 3 can you make from 12?
If you share 12 flowers between 4 people, how many do they get each?

I can find ½ of a group of objects.



½ of 12 is 6

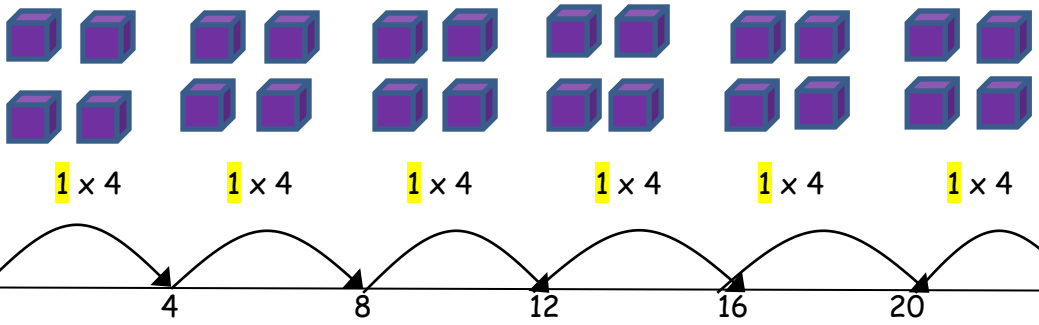
12 ÷ 2 = 6



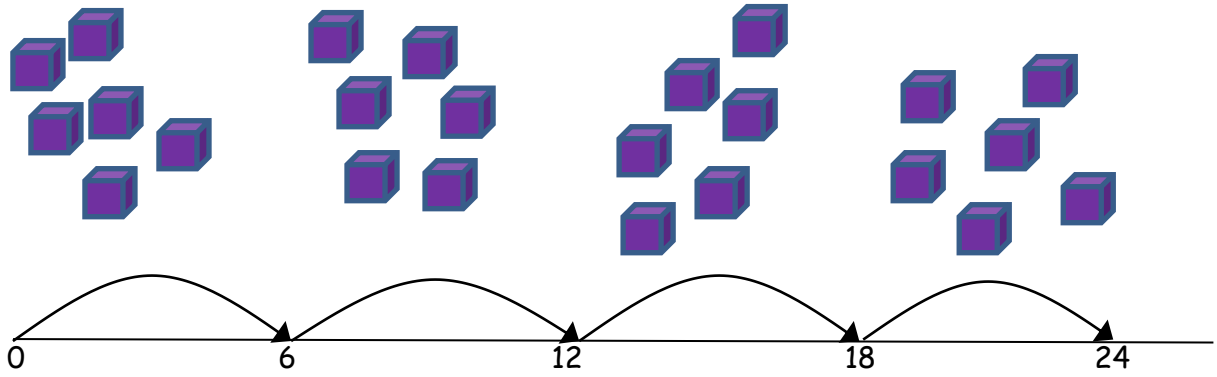
I understand both sharing and grouping as division.

24 ÷ 4 = 6

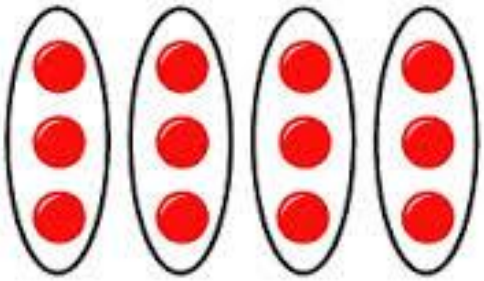
How many groups of 4 are there in 24?



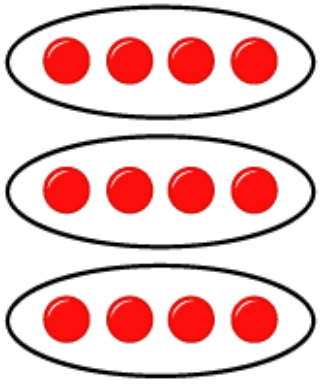
What is 24 shared in to 4 equal groups?



I can group objects using an array.



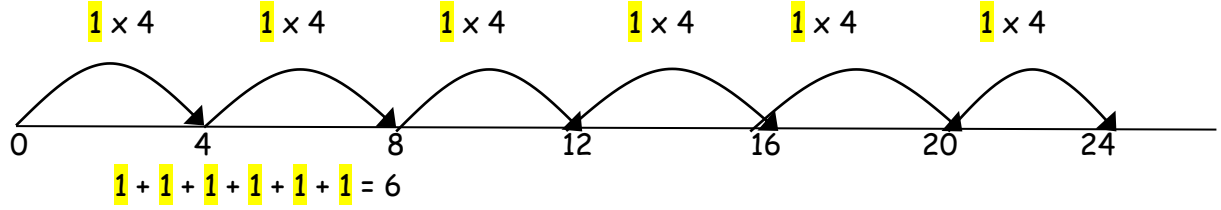
12 ÷ 3 = 4



12 ÷ 4 = 3

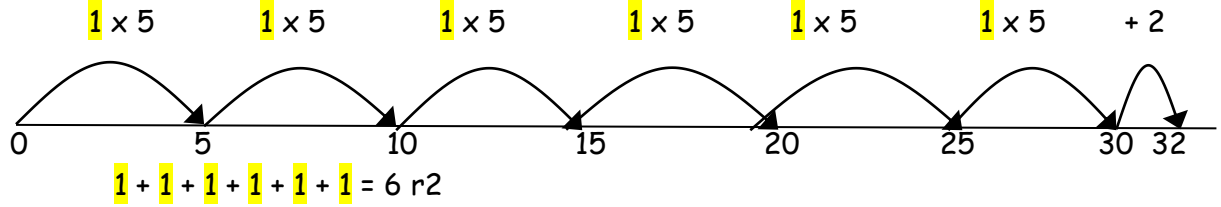
I can understand division as repeated addition using a numberline.

24 ÷ 4 = 6



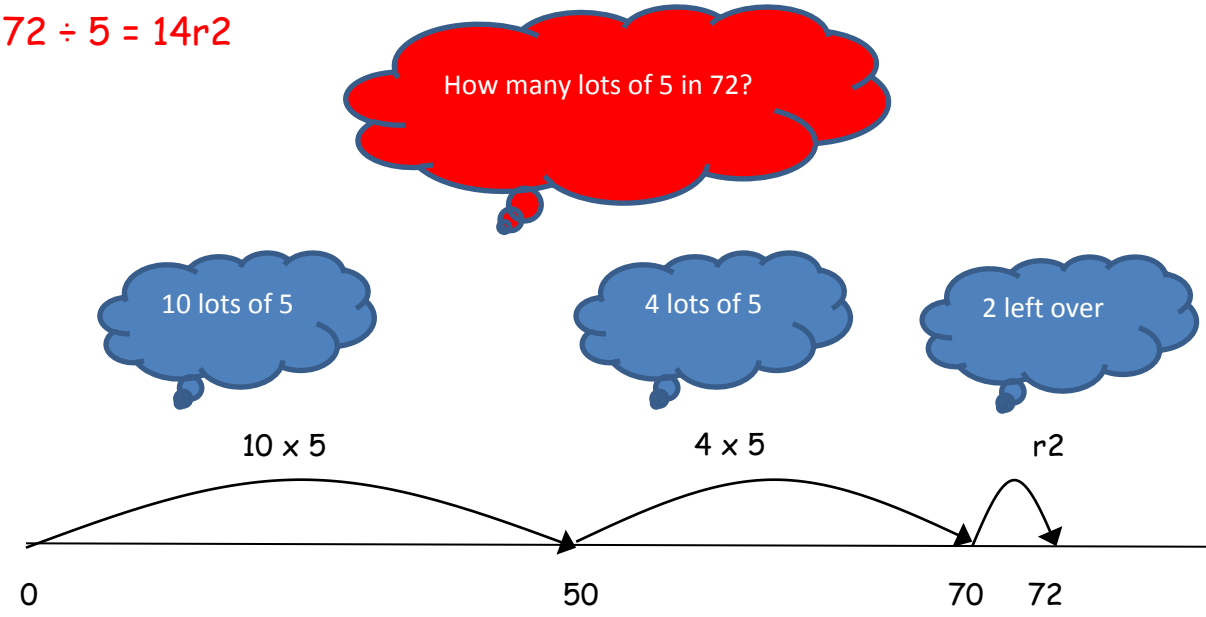
I can use a numberline to find a remainder.

32 ÷ 5 = 6r2



I can divide a number by using a blank numberline and grouping the divisor.

72 ÷ 5 = 14r2



I can use a compact division method.

291 ÷ 3 = 97

$$3\overline{)29^{2}1}\quad 97$$

I can use a compact division method showing the remainder as a decimal.

2.4 ÷ 5 = 0.48

$$5\overline{)2.^{2}4^{4}0}\quad 0.48$$

Dividing Fractions

Divide proper fractions by whole numbers.

$$\frac{2}{3} \div 6 = \frac{2}{3} \div \frac{6}{1}$$

$$= \frac{2}{3} \times \frac{1}{6}$$

$$= \frac{2}{18}$$

$$= \frac{1}{9}$$

✓ Reverse the numerator and denominator of the divisor and then multiply.