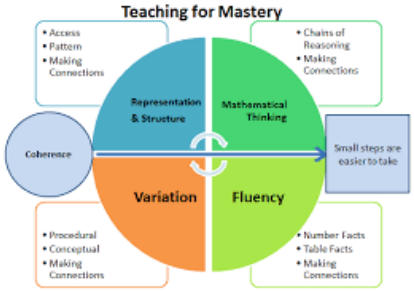
Mathematics Calculation Policy Poulton St Chad's

Genaral Guidance

This policy (is):

- based on research evidence about the most effective ways to teach mathematics to enhance children's understanding (eg Bruner's modes of representation that have morphed into Concrete Pictorial Abstract)
- based on substantive research evidence (Haylock, Anghileri, Thompson, Askew, Boaler, etc) that procedural fluency and conceptual understanding must be taught together
- assumes a *growth mindset* (Dweck). That with hard work all (apart from those with specific needs) can achieve and that such an approach brings about increasing levels of self-motivation (see point on metacognition).
- based on a mastery approach – that mathematical knowledge and understanding is incremental and thus it is essential to "master" each step otherwise gaps in learning will compromise future success. Children will not be accelerated onto content from future years but will be extended through problem solving.



- Adopts a metacognitive approach to learning – children are not being told, they are discovering for themselves (they are becoming more aware of their own thought processes and the way that they learn maths) (see Emma McCrea 2019 "Making every maths lesson count" pg 119. Hence the use of representation as a scaffold to reveal mathematical structures. The child is trying to make sense of their learning and beginning to regulate this.
- Matched to our key learning objectives for assessment.
- Matches the calculation guidance of the NCETM (2015) https://www.ncetm.org.uk/public/files/24756940/NCETM+Calculation+Guidance+Oct+2015.pdf and National Curriculum aims (DfE 2013) that stipulate that pupils "*develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately*" https://www.gov.uk/government/publications/national-curriculum-in-england-mathematics-programmes-of-study/national-curriculum-in-england-mathematics-programmes-of-study
- For further details of how mathematics is taught at ST Chad's please see our mathematics policy.
- See appendix 1 for glossary of mathematical vocabulary

Reception

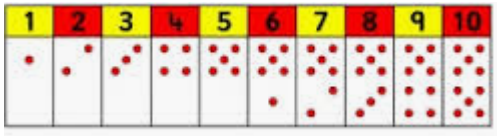
Key Objectives

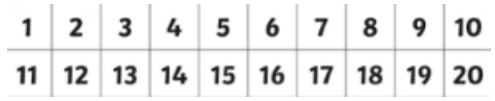
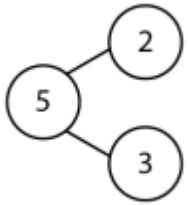
- numbers to ten counting forwards and backwards (we want all children to have an absolutely solid grasp of all of these numbers before they get into Year 1 as all future learning depends on this – see point 1 about counting principles). If children are solid then continue to 20.
- one more one less to ten
- partitioning numbers to ten
- subitising numbers to 5
- conceptually subitising numbers to 10

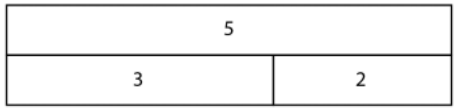
<table>
<tr><th>objective</th><th colspan="2">Representations</th><th>Calculations</th></tr>
<tr><td>numbers to ten counting forwards and backwards (please pay special consideration to 0 – this should come later as it is quite an abstract concept)

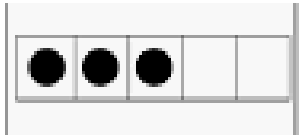
Refer to 5 counting principles (Gellman and Gallistel) No 5 os often neglected can children count in any order (eg I want the giraffe to be number 3 when teddies are lined up)

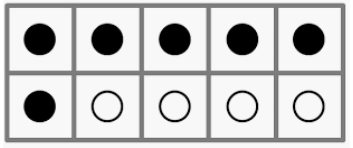
one more one less to ten</td><td colspan="2">Number track / bead strings / any objects that you can think of
 

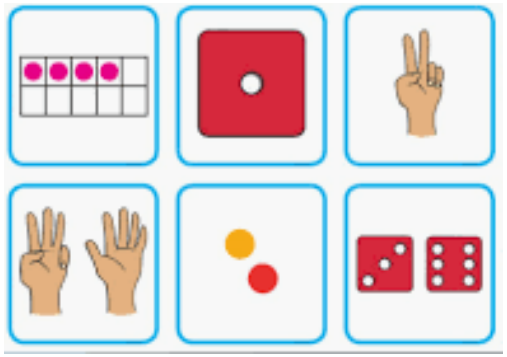
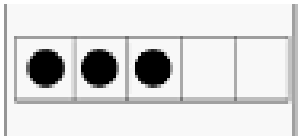
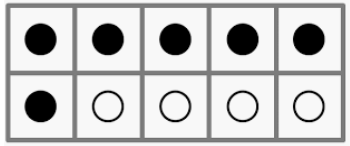




</td><td>Children can use jottings / mark making to show their ideas (see https://nrich.maths.org/6894)</td></tr>
<tr><td>Partition all numbers to ten</td><td colspan="3">Use unifix, 5 and 10 frames (see NCTM), bar model, part whole cherries, number blocks (BBC / NCETM))
 


Bar model:
 



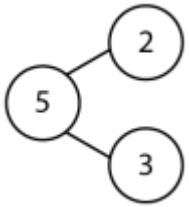
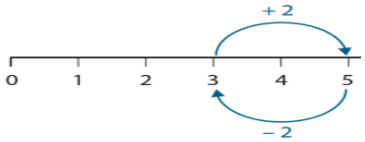
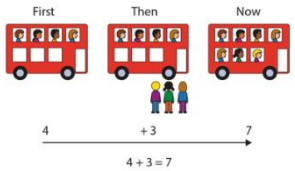

 </td></tr>
</table>

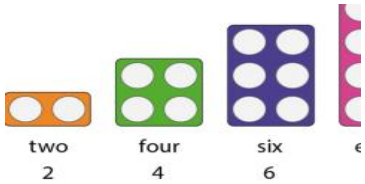
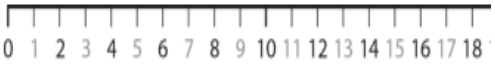
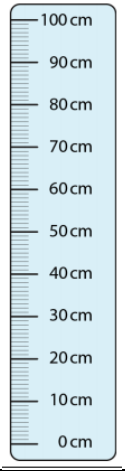
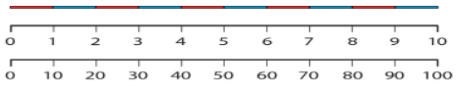
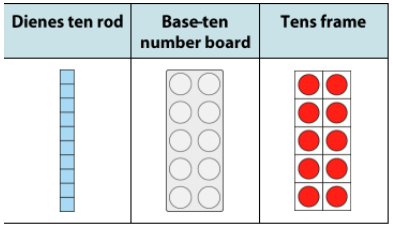
Subitise (see numbers without counting like on a dice) and conceptually subitise (calculate numbers without counting on so two dice rolled with 5 and 2 will be 7)	   

Year 1

Key Objectives

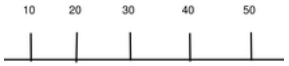
- Numbers to 50 count forwards and backwards especially crossing tens boundaries
- Partition all numbers to ten using part whole cherries and bar model
- Know by heart add and subtract number facts to ten
- Know by heart doubles and halves of numbers to ten
- Know one more and one less of numbers to 50
- Can chant in 2s, 10s and 5s and begin to identify the patterns
- Read and write numbers especially form numerals correctly from top to bottom
- Know the aggregation and partitioning structures of add and subtract
- Know the augmentation and reduction structures of add and subtract
- Know how bonds to ten relate to bonds of multiples of 10 to 100 and use this knowledge.

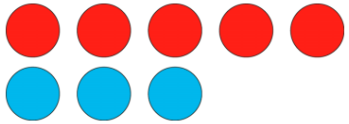
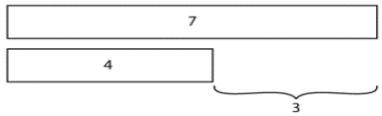
objective	Representations	Calculations
understand the aggregation and partitioning structures of add and subtract	Partitioning:  part – whole cherries  Bar model:  We do **not** use *take away* here – we use **subtract** or **minus**	5 = 3 + 2 5 = 2 + 3 5 – 3 = 2 5 – 2 = 3 2 = 5 – 3 etc **Ensure that this is taught contextually and refer to what the numerals represent**
understand the augmentation and reduction structures of add and subtract	Reduction:    Language here is “take away”	5 = 3 + 2 5 = 2 + 3 5 – 2 = 3 2 = 5 – 3 etc **Ensure that this is taught contextually and refer to what the numerals represent. Note that the context and meaning of numerals and symbols here will be very different to the above.**

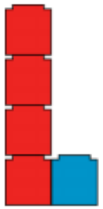
<table>
<tr>
<td>Know by heart addition and subtraction facts within 10
eg facts to 7</td>
<td>part – whole cherries
Bar
use of bead strings
Numicon
  </td>
<td>7 + 0
6 + 1
5 + 2
4 + 3
3 + 4 etc</td>
</tr>
<tr>
<td>Numbers to 50 count forwards and backwards <u>especially crossing tens boundaries</u> (this can be extended to 100).</td>
<td>straws – bundling in tens
100 grid
<table>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr>
<tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr>
<tr><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td><td>36</td><td>37</td><td>38</td><td>39</td><td>40</td></tr>
<tr><td>41</td><td>42</td><td>43</td><td>44</td><td>45</td><td>46</td><td>47</td><td>48</td><td>49</td><td>50</td></tr>
</table></td>
<td></td>
</tr>
<tr>
<td>Can chant in 2s, 10s and 5s and begin to identify the patterns</td>
<td>Numicon
 
 
two 2 four 4 six 6
Skip counting in twos/counting even numbers – number line:
 
 
  </td>
<td>Relate to money and unitise but <u>do not</u> use notation.</td>
</tr>
<tr>
<td>Know how bonds to ten relate to bonds of multiples of 10 to 100 and use this knowledge.</td>
<td> 
Gattegno chart:
<table>
<tr><td>1000</td><td>2000</td><td>3000</td><td>4000</td><td>5000</td><td>6000</td><td>7000</td><td>8000</td><td>9000</td></tr>
<tr><td>100</td><td>200</td><td>300</td><td>400</td><td>500</td><td>600</td><td>700</td><td>800</td><td>900</td></tr>
<tr><td>10</td><td>20</td><td>30</td><td>40</td><td>50</td><td>60</td><td>70</td><td>80</td><td>90</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
</table></td>
<td> 
use part – whole cherries and bar model showing tens – make link between ones and tens explicit.</td>
<td>3 = 1 + 2 so 3 tens = 1 ten + 2 tens so 30 = 10 + 20
7 – 3 = 4 so 7 tens – 3 tens = 4 tens so 70 – 30 = 40
etc
3 tens > ☐</td>
</tr>
</table>

Year 2

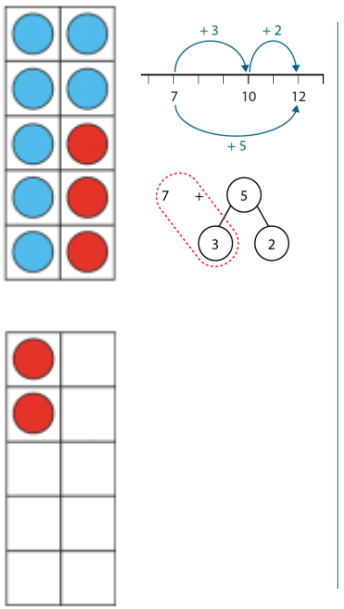
- Numbers to 100 count forwards and backwards especially crossing tens boundaries
- Partition all numbers to 15 using part-whole cherries and bar model
- Know + and – number facts to 20 using strategies including **bridging ten doubling / halving**
- Know the difference structure of subtraction
- Know one more and one less of numbers to 100
- Know ten more and ten less of numbers to 100 (use number grid / base ten / arrow cards / number line)
- Add and subtract 2-digit and one digit 26 + 6 or 32 – 5
- Add and subtract 2-digit and 2-digit (**<u>NO columns please</u> – there exists much research evidence that formalisation of procedure too early results in many children not looking at quantity value but rather following procedures blindly and inefficiently (eg 101 – 99 as a column)**
- Repeated addition structure of multiplication
- 2, 5 and 10 x tables including patterns of their multiples
- 2019 – 20 just the minimum on fractions to get through SATs (see Spine)

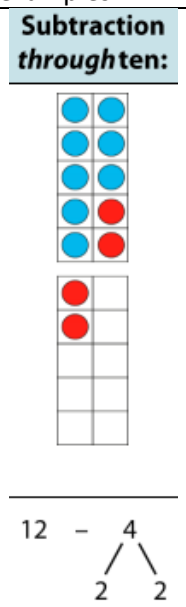
Objective	Representation	calculation
Numbers to 100 count forwards and backwards especially crossing tens boundaries Know one more and one less of numbers to 100 Know ten more and ten less of numbers to 100	 splat out numbers and children to identify them     (use number grid / base ten / arrow cards / number line)	39 + 1 = 49 + __ = 50 40 – 1 = 40 = 1 + __ 39 = ? – 1 ? + 10 = 35 89 = ? - 10 67 = 10 + ? 15 is ten less / fewer than

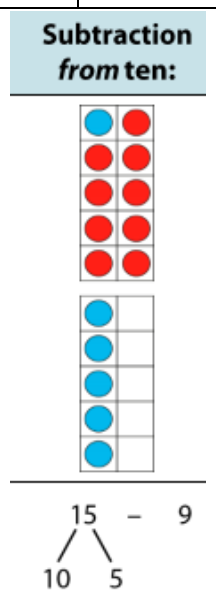
<table>
<tr>
<td>Know the difference structure of subtraction</td>
<td>Difference:
 
Bar model:
 


Language used here is not take away it is difference / how many more/fewer or how much more / less (what is the gap)
Use continuous and discrete examples</td>
<td>Ensure that this is taught contextually and refer to what the numerals represent. Note that the context and meaning of numerals and symbols here will be very different to the partition and reduction structures of subtraction.

Relate to graphs

5 – 3 = 2 (2 is the difference)
2 = 5 – 3 (2 is the difference)
5 – 3 = 6 – 4 (2 is the difference)</td>
</tr>
<tr>
<td>Know + and – number facts to 20 using strategies including bridging ten doubling / halving</td>
<td> 




</td>
<td>Subtract through subtract from

$12-2=10$
$10-2=8$
so
$12-4=8$

$10-9=1$
$1+5=6$
so
$15-9=6$

Note: the subtract from ten strategy seems unintuitive and these strategies will take considerable time for children to become fluent but they set firm foundations for future learning in KS2.(Eg 102 - 95 = 100 – 95 +2)</td>
</tr>
<tr>
<td>Add and subtract 2-digit and one digit 26 + 6 or 32 – 5

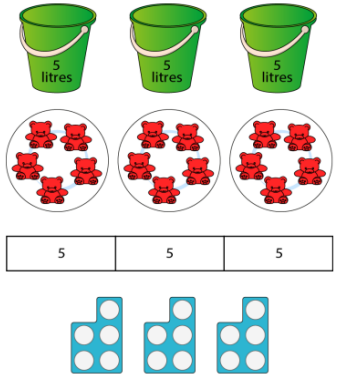
Add and subtract 2-digit and 2-digit

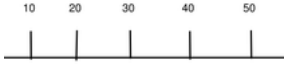
Note: this builds on knowledge of above objectives.</td>
<td>Use the knowledge and understanding of bridging and of number facts and relate to numbers within 100.

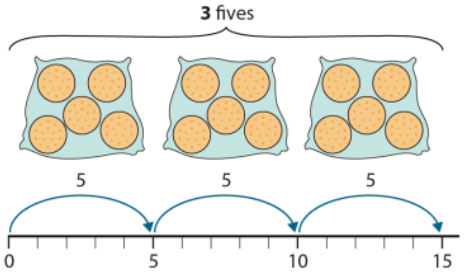
Use number lines</td>
<td>Not crossing ten
7 – 3 = 4 so 17 – 3 = 14 so 37 – 13 = 24 etc
Bridging ten
12 – 5 = 8 so 22 – 5 = 18 so 52 – 15 = 38</td>
</tr>
</table>

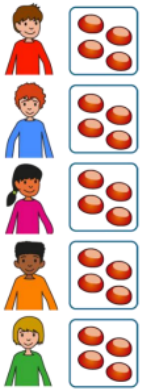
<table>
<tr>
<td>Add and subtract 2-digit and 2-digit</td>
<td>Use of sticks and crosses to add and subtract 2 2-digit numbers (exchanging 10 x for one stck)
x x x + x x x
13 + 23 =
  </td>
<td>13 + 23 = 30 + 6 13 + 28 = 30 + 11
37 – 13 = 30 – 10 and 7 – 3
33 – 17 = 13 – 7 (exchanging one ten for ten ones) and 20 – 10</td>
</tr>
<tr>
<td>Repeated addition structure of multiplication

2, 5 and 10 x tables including patterns of their multiples

Commutativity (3 x 5 = 5 x 3)</td>
<td> 
</td>
<td>5 x 3 = 5 + 5 + 5

What do we know about multiples of 2, 5 10? What about odd / even numbers.
 
Highlight multiples on number grid nd number line
 
</td>
</tr>
<tr>
<td>To understand that division can refer to “sharing” and “grouping”.

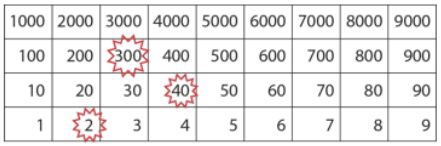
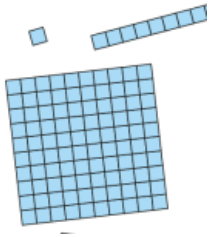
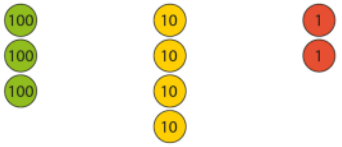
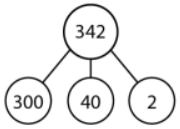
To develop efficient methods of dividing numbers. Using times-table knowledge other than skip counting.</td>
<td>Grouping
 

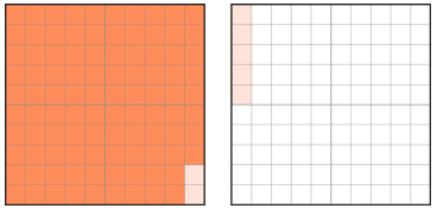
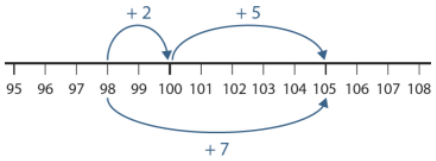
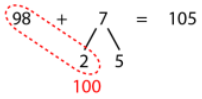
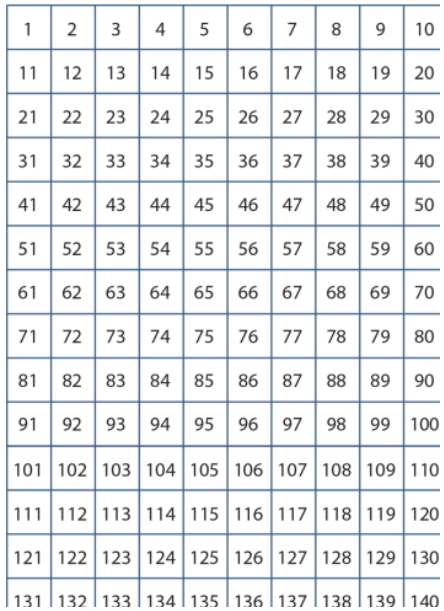
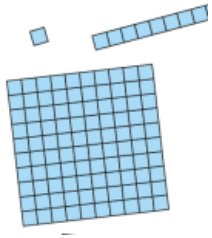
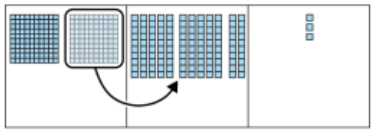
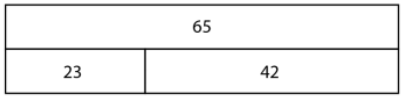
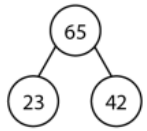
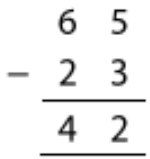
5 + 5 + 5 = 15
15 ÷ 5 = 3
‘Fifteen divided into groups of five is equal to three.’</td>
<td>Sharing
‘Twenty conkers are shared equally between five children. Each child gets four conkers.’
  </td>
<td>Ensure that division is taught contextually. Draw attention to what each number in the division equation represents. So this sharing example: 20 ÷ 5 = 4 the 20 represents the 20 conkers etc.</td>
</tr>
</table>

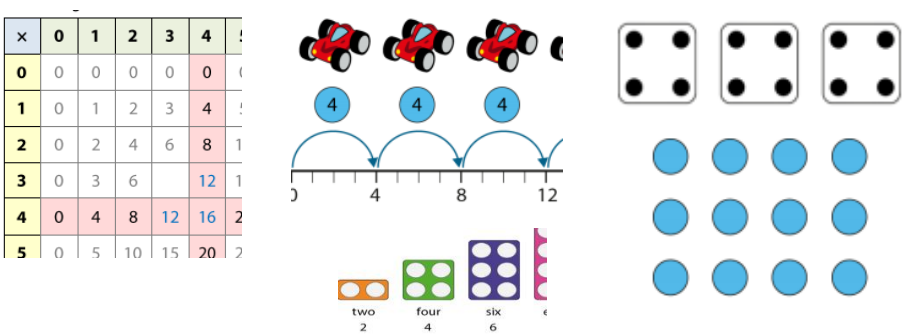
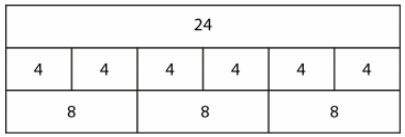
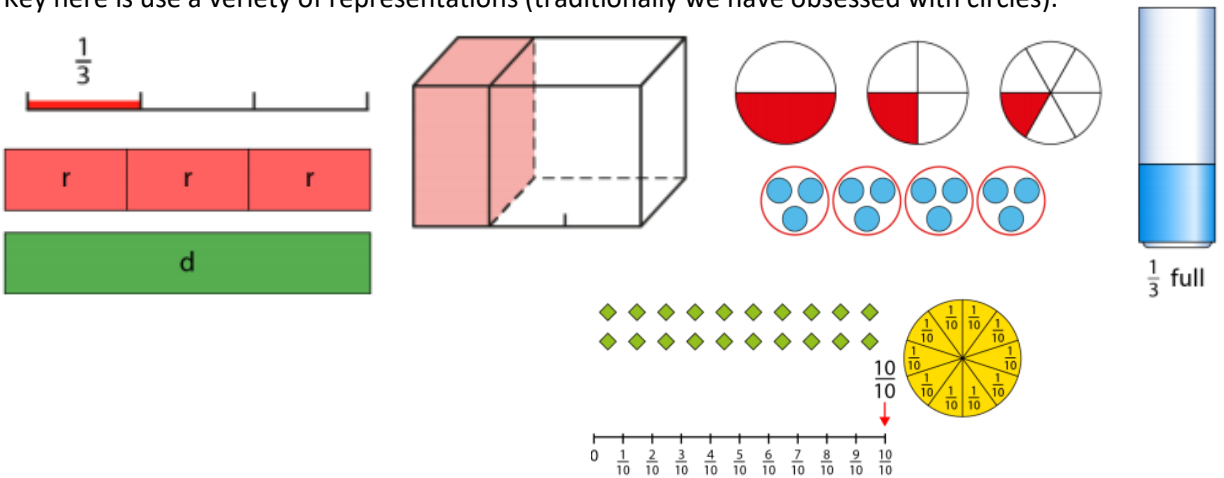
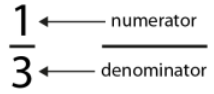
Year 3

The start of year 3 requires transition from KS1 – KS2 therefore it is essential that all aspects of the Year 2 curriculum are thoroughly reviewed and any children who are not meeting any of the above objectives must have intervention until all have mastery.

- Review all Year 2 objectives esp **bridging ten** to ensure that all can do… (there will be some children who were not able to do this in year 2 – we want to move these children away from inefficient counting on in one strategies)
- To know by heart number bonds (known also as complements to 100 (45 + ? = 100)
- Know numbers to 1000 counting forwards and backwards (not all the way to 1000 but chunks) including crossing 100 boundaries
- Know one, ten and a hundred more / less than any number to 1000
- Be adept at mental calculation strategies within 1000 (see NCETM Spine unit)
- Begin to use column addition and subtraction contining to use **all structures** of add and subtract (eg, **augmentation, reduction, partition, aggregation, difference**)
- Know by heart 2, 4 and 8 times tables and patterns across them.
- Know by heart 3, 6 and 9 times tables and patterns across them.
- Use repeated addition structure for multiplication
- Use grouping and sharing structure for division **(see year 2)**
- Understand part whole relationship of fractions / identify unit and non unit fractions / add and subtract fractions where denominator is the same.

Objective	Representation	calculation
Know numbers to 1000 counting forwards and backwards (not all the way to 1000 but chunks) including crossing 100 boundaries Know one, ten and a hundred more / less than any number to 1000	Gattegno grid  Base ten  place value counters  part-whole cherries  	365 = 300 + 60 + 5

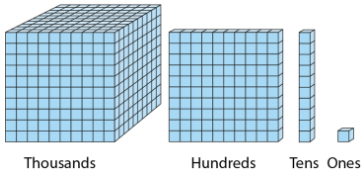
Bridge 100s when adding and subtracting Know one, ten and a hundred more / less than any number to 1000	98 + 7 Hundred grids:  Number line:  Jotting and equations:  Two-hundred grid: 	**98 + 7 = 98 + 2 + 5** **204 – 7 = 204 – 4 – 3** **apply to multiples of ten** **580 + 70 = 580 + 20 + 50** **730 – 70 = 730 – 30 - 40** **204 – 197 = 200 – 197 + 4 (note the progression from counting from ten in year 2 and the importance of getting that strategy clear in Year 2)**
To know number bonds to 100 and relate to hundreds up to 1000 (eg. 32 + 68 =100 so 432 + 68 = 500	 	**100 = 35 + ?** **600 = 535 + ?** **47 + ? = 100** **63 = 100 - ?**
Begin to use column addition and subtraction	     	

Know by heart 2, 4 and 8 times tables and patterns across them. Know by heart 3, 6 and 9 times tables and patterns across them.		**Do not use column methods for multiplciation or division during year 3.** 
Understand part whole relationship of fractions / identify unit and non unit fractions / add and subtract fractions where the denominator is the same. Compare fractions where the denominator is the same.	Key here is use a veriety of representations (traditionally we have obsessed with circles). 	

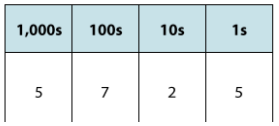
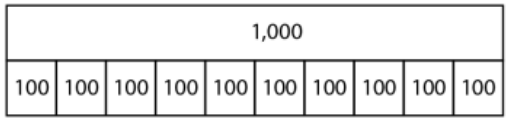
Year 4

- Know numbers to 10,000 counting forwards and backwards (not all the way to 10,000 but chunks) including crossing 100 boundaries and 1000 boundaries
- Know one, ten, a hundred and a thousand more / less than any number to 10,000
- Be able to use column addition and subtraction with 4 digit numbers
- Know by heart and rapidly recall all x tables to 12 x 12
- Understand tenths and hundredths and work with them
- Divide with remainders
- X and div by 10 and 100
- Do short div and short mult
- Understanding mult and division as inverse
- Convert between mixed numbers and improper fractions
- Order and compare fractions

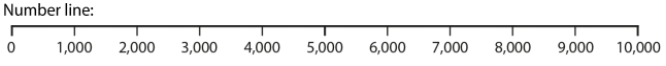
<table>
<tr><th>Objective</th><th colspan="2">Representation</th><th>calculation</th></tr>
<tr>
<td>Know numbers to 10,000 counting forwards and backwards (not all the way to 10,000 but chunks) including crossing 100 boundaries and 1000 boundaries

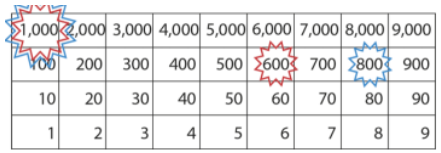
Know one, ten, a hundred and a thousand more / less than any number to 10,000 (calculate mentally)</td>
<td>Base ten
 

Tens frame and 100 place-value counters
 

Place-value chart:
 
</td>
<td>Bar model:
 

Number line:
 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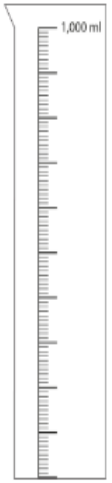
<td> 
</td>
<td>6342 = 6000 + ? + 40 + 2

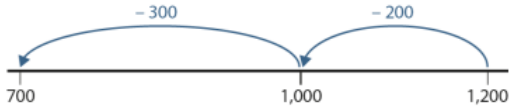
7234 – 500 =

7324 – 80 =

5796 + 500 =</td>
</tr>
</table>

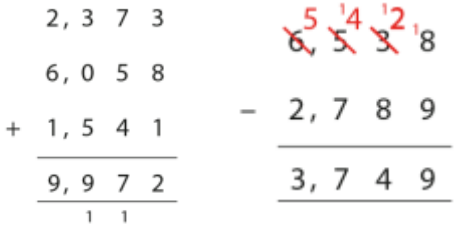
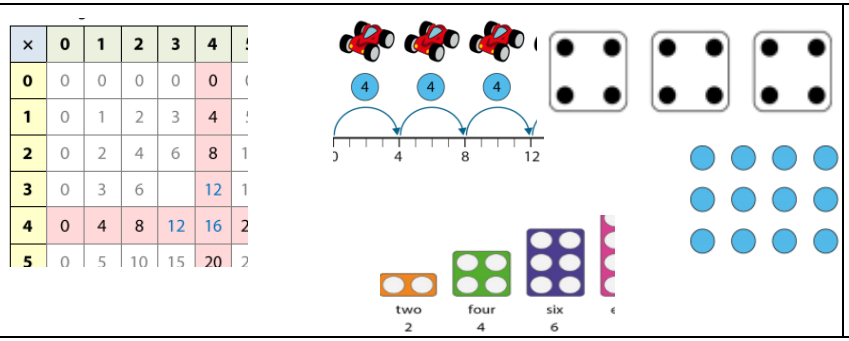
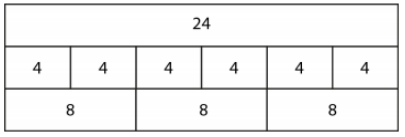
<table>
<tr>
<td>Bridge 1000s when adding and subtracting

Know one, ten, a hundred, thousand more / less than any number to 1000

The key here is crossing 1000 boundaries.</td>
<td>Use number line and apply strategies of bridging 10 and 100 as in year 2 and 3.
 
</td>
<td>1998 + 7 = 1998 + 2 + 5
980 + 70 = 980 + 20 + 50
8800 + 700 = 8800 + 200 + 500

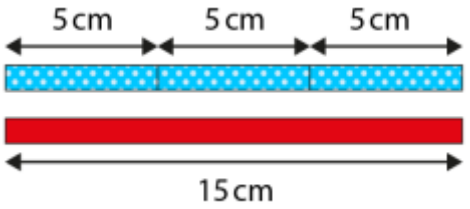
2004 – 7 = 2004 – 4 - 3
2040 – 70 = 2040 – 40 – 30
2400 – 700 = 2400 – 400 – 300

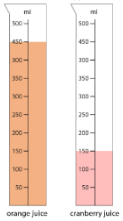
(note the progression from counting from ten in year 2 and the importance of getting that strategy clear in Year 2)</td>
</tr>
<tr>
<td>To know number bonds to 1000 of multiples of 50 relating understanding of bonds to 100 (multiples of 5) Mentally / jotting with number line</td>
<td> 
</td>
<td>100 = 35 + ?
1000 = 350 +

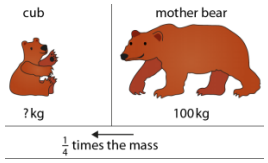
1000 – 350 =?
350 + ? = 1000</td>
</tr>
<tr>
<td>Use column addition and subtraction for up to 4 digit numbers</td>
<td colspan="2">Use base ten and place value counters to help children to understand <u>exchange.</u>
Note: if difference and same difference is thoroughly understood from year 2 the algorithm on the right makes life much easier.
 
</td>
</tr>
<tr>
<td>Know by heart all times tables to 12 x 12
As well as drilling, it is important that children see patterns and relationships so that they remember and make sense of times tables.
The commutative and distributive properties are essential for building mental agility and understanding. These are building blocks to later understanding of algebra in KS3.</td>
<td> 
</td>
<td>7 x 8 = 56 8 x 7 = 56 Commutitive law
12 x 7 = (10 x 7) + (2 x 7) distributive law
7 x 8 = 10 x 8 – 3 x 8
 
</td>
</tr>
</table>

Understand the scaling structure of x that something gets x times bigger / heavier etc (this is different to the repeated addition structure – there are x lots of) **This structure is often neglected and is key to understanding fractions among other things).**

Bar model is key here







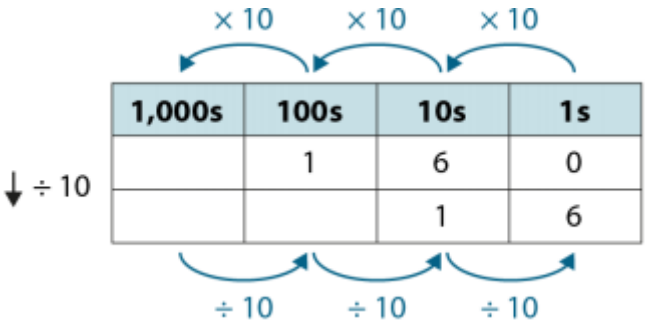
language of times, times as big, times smaller

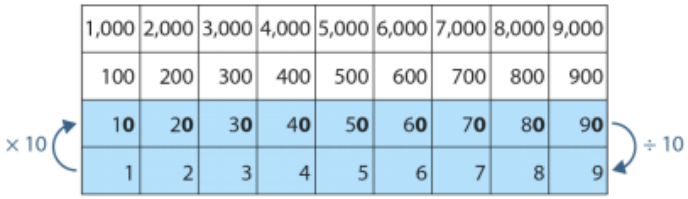
<u>See ITP moving digits</u>

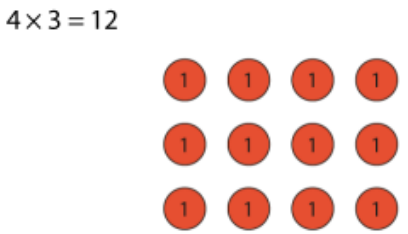
*x and divide **integers** by ten, and 100*

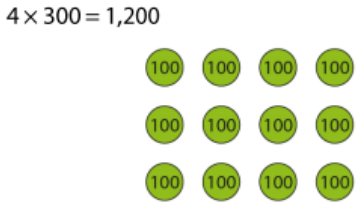
We often use the scaling structure when we x by ten. Something gets ten x bigger rather than ten lots of (although the latter is also a relevant context)

So much future learning is based on this so it is essential that children have a firm grasp.









place value counters and base ten can also be used to show what ten times bigger looks like

Use missing number caculations to ensure for mastery of concept

3 x ? = 30
3 x ? = 300

500 = 10 x ?
7000 = 700 x ?

3 = ? ÷ 10
3 = ? ÷ 100

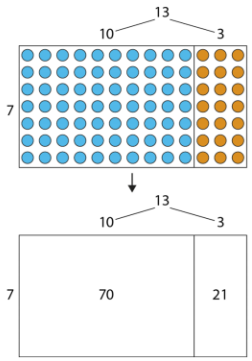
3 7 = ? ÷ 10
370 = ? ÷ 10

3070 ÷ 10 = ?
? ÷ 10 = 630

what is ten times smaller than

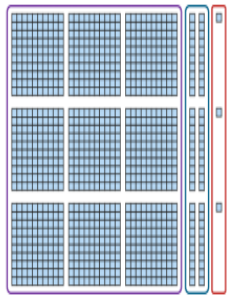
Partition to short multiplication

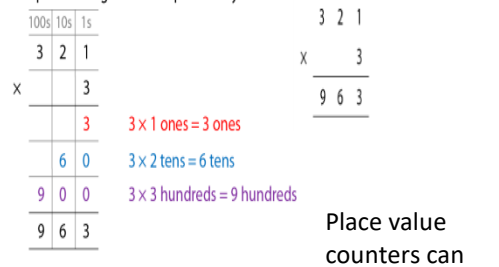
Please follow in this order. If children are rushed into the compact method it often becomes a procedure with no meaning.



321 × 3

Dienes representation:





Place value counters can also be used instead / alonside dienes

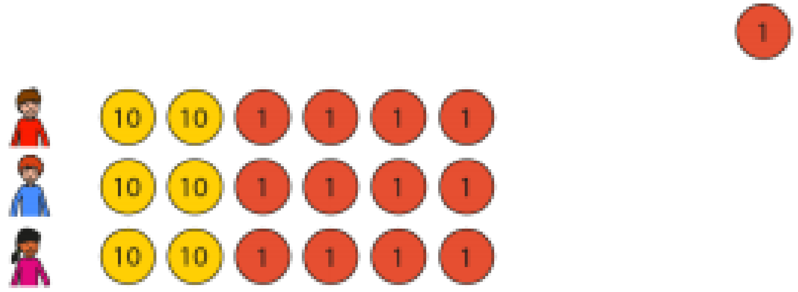
$13 \times 7 = 10 \times 7 + 3 \times 7$
$= 70 + 21$
$= 91$

$7 \times 13 = 7 \times 10 + 7 \times 3$
$= 70 + 21$
$= 91$

Informal written method:

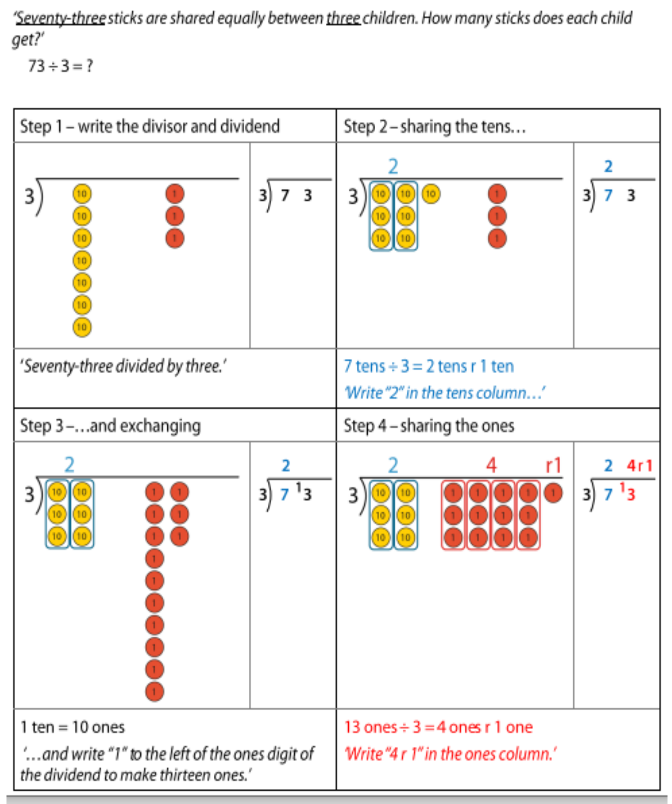
$34 \times 2 = 30 \times 2 + 4 \times 2$
$= 60 + 8$
$= 68$

Partition to short division see https://www.ncetm.org.uk/files/107958602/ncetm_spine2_segment15_y4.pdf	see below



6 tens	÷	3	=	2 tens
13 ones	÷	3	=	4 ones r 1 one
73	÷	3	=	24 r 1

- *'Each child gets twenty-four marbles; there is one marble left over.'*



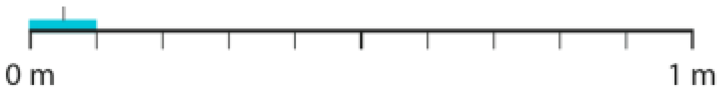
To understand and use tenths

To understand and work with hundredths (see also multiplying and div by 10)

Note: please use base ten hundred block as one and the ten rods to represent tenths and ones cubes to represent hundredths.

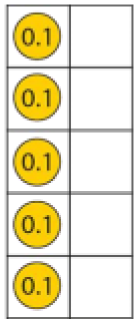
Bar model:

one whole									
one tenth	one tenth	one tenth	one tenth	one tenth	one tenth	one tenth	one tenth	one tenth	one tenth



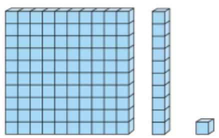
Gattegno chart:

100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	7	8	9
0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9



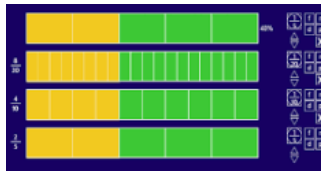
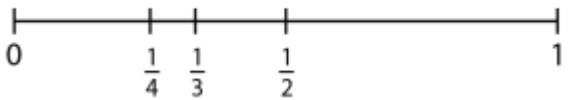
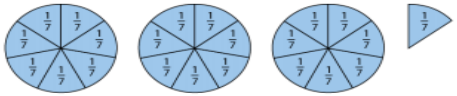
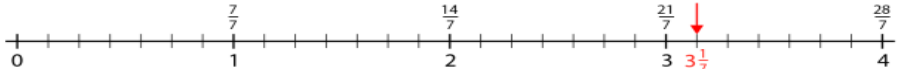
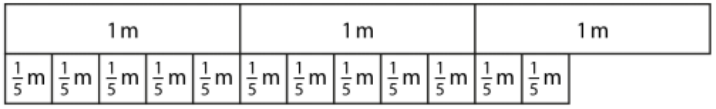
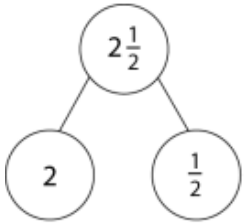
0.5

10s	1s	tenths
0	0	0



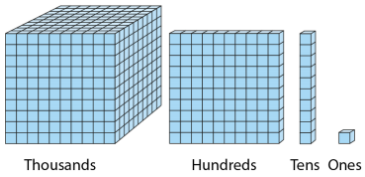
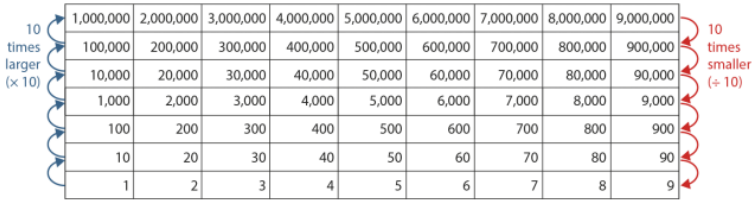
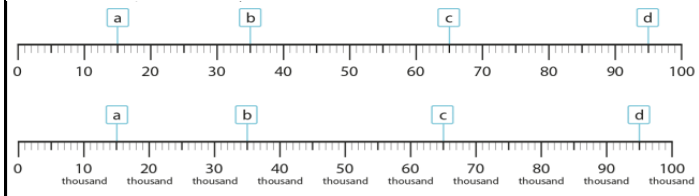
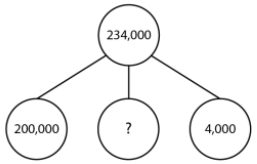
Calculation strategies as mentioned above including bridging ten (one in this case) need to be explicitly applied to work with tenths.

see https://www.ncetm.org.uk/files/95158267/ncetm_mm_sp1_y4_se23_teach.pdf for a comprehensive look at calculating with tenths

To order and compare fractions 1. review same denominators 2. look at same numerators 3. Use half as a benchmark 4. Look at fractions that are one unit away from a whole	use fraction ITP Use a variety of representayions including discrete and continuous. Relate to measure.     $\frac{4}{4}$ $\frac{8}{4}$ $\frac{2}{3}$ $\frac{3}{4}$  	$\frac{1}{3} > \frac{1}{4}$ $\frac{2}{3} > \frac{2}{4}$ $\frac{4}{7} \bigcirc \frac{4}{10}$ $\frac{\square}{6} > \frac{2}{\square} > \frac{\square}{10}$
Convert between mixed numbers and improper fractions For a more comprehensive look at this see: https://www.ncetm.org.uk/files/108920088/ncetm_spine3_segment05_v4.pdf	      	$3\frac{4}{10} = \frac{\square}{\square}$ $\frac{12}{4} = \square$ $\frac{17}{3} = \square\frac{\square}{\square}$ $17 \div 3 = \square$ remainder $\square$

Year 5

- Review x tables so all children are fluent (see Year 4)
- Review formal written methods for add and subtract so that all children are competent when adding and subtracting 5-digit integers and decimals (see year 4 representation and build upon this still using representations)
- Children to understand the bar method for arithmetic structures and applying to number problems (Rob thought this gave them some quick wins)
- To x and div numbers and decimals by 10, 100 and 1000 and explain effect
- Read and write numbers to 1,000,000 and compare any number or group of numbers
- Understand fractions as parts of a whole, compare and order them using a range of methods, make equivalent fractions, convert between mixed and improper fractions
- Be able to do short division and multiplication (**as with Year 4 but with 4 digit numbers – no long division or long multiplication until year 6 please**)
- To know and use vocabulary; multiple, prime, factor, square, cube
- To understand tenths, hundredths, and thousandths and work with them.

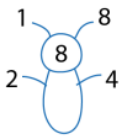
Objective	Representation	calculation
Read and write numbers to 1,000,000 and compare any number or group of numbers	Base ten (only to review y4 work)  Gattegno chart:  1,000,000 2,000,000 3,000,000 4,000,000 5,000,000 6,000,000 7,000,000 8,000,000 9,000,000 100,000 200,000 300,000 400,000 500,000 600,000 700,000 800,000 900,000 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 100 200 300 400 500 600 700 800 900 10 20 30 40 50 60 70 80 90 1 2 3 4 5 6 7 8 9 Place-value chart: Millions / Thousands / Ones (100s, 10s, 1s) 1 10 100 1,000 10,000 100,000 1,000,000 Bar model: 100,000 10,000 × 10   	63,420 = 60,000 + ? + 400 + 20 70, 234 – 50,000 = 70,324 – 800 = 57,960 + 5000 =

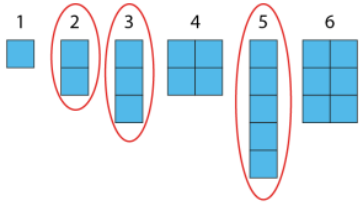
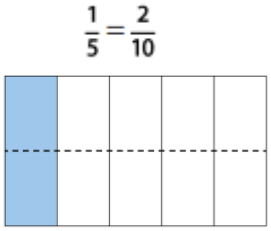
<table>
<tr><td>Bridge 1000s when adding and subtracting

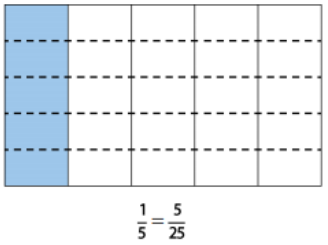
Know one, ten, a hundred, thousand more / less than any number to 100,000

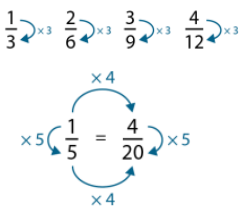
The key here is crossing 1000 / 10,000 boundaries.</td><td>Use number line and apply strategies of bridging 10 and 100 as in year 2 and 3.</td><td colspan="2">19,998 + 7 = 19,998 + 2 + 5
98,000 + 7000 = 98,000 + 2000 + 5000
88,000 + 7000 = 88,000 + 2000 + 5000
99, 998 + 7 = 99,998 + 2 + 5

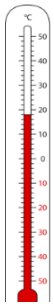
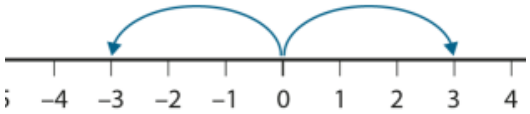
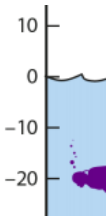
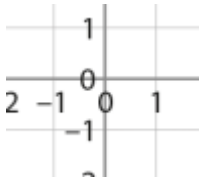
20,004 – 7 = 20,004 – 4 - 3
20,040 – 70 = 20,040 – 40 – 30
24,000 – 7000 = 24,000 – 4000 – 3000

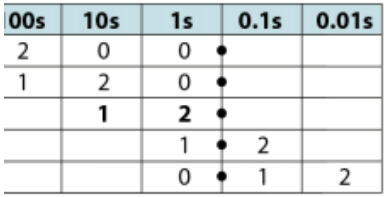
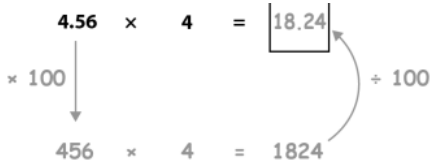
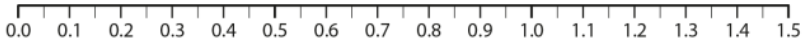
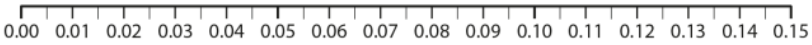
(note the progression from counting from ten in year 2 and the importance of getting that strategy clear in Year 2)</td></tr>
<tr><td>Relate bonds to 100 to bonds to 100,00 and bonds to 1000 to bonds to 1,000,000</td><td colspan="2"><table><tr><td colspan="2">100,000</td></tr><tr><td>23,000</td><td>?</td></tr></table></td><td>100 = 35 + ?
100,000 = 35,000 + ?
100,000 – 35,000 =?
350 + 650 = 1000 so 350,000 + 650,000 = 1,000,000</td></tr>
<tr><td>To know and use vocabulary; multiple, prime, factor, square, cube</td><td colspan="2"><table><tr><th>×</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr><tr><th>0</th><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><th>1</th><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><th>2</th><td>0</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td></tr><tr><th>3</th><td>0</td><td>3</td><td>6</td><td>9</td><td>12</td><td>15</td><td>18</td></tr><tr><th>4</th><td>0</td><td>4</td><td>8</td><td>12</td><td>16</td><td>20</td><td>24</td></tr></table>
Factor bugs
 

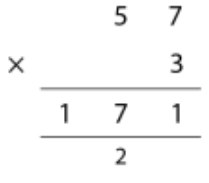
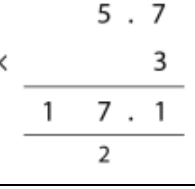
use arrays and unifix cubes to show square, prime and cube numbers
 
</td><td></td></tr>
<tr><td>To be able to find equivalent fractions and simplify fractions</td><td colspan="2"> 

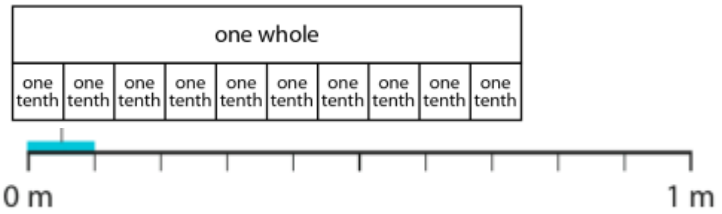
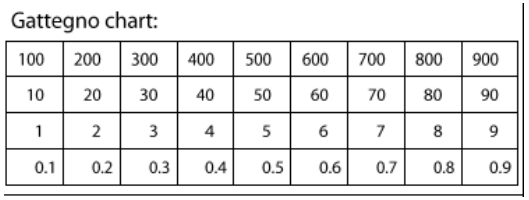
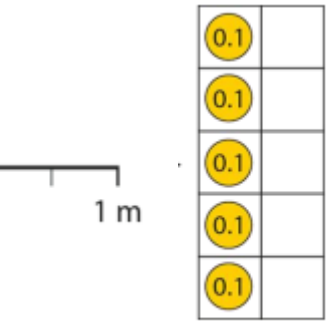
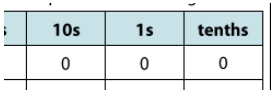
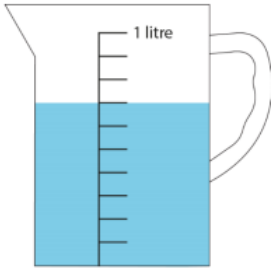
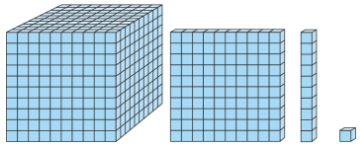
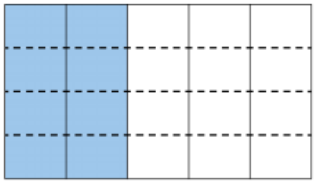
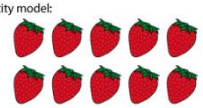
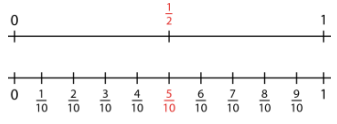
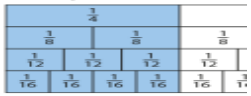
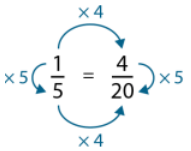
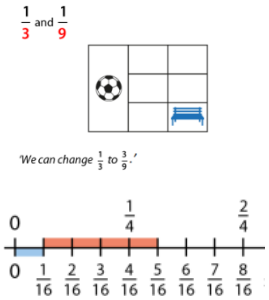
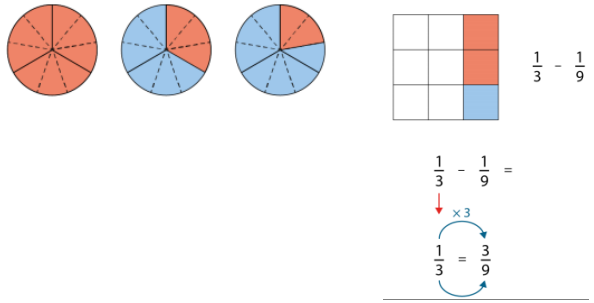
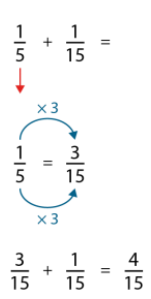
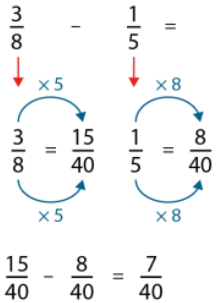
 

 
</td><td> 
</td></tr>
</table>

To count, compare and calculate with negative numbers	 number lines both vertical and    	Use number lines to calculate

x and divide whole numbers and decimals by ten, 100 and explain the effect. ***So much future learning is based on this so it is essential that children have a firm grasp.***	    place value counters and base ten can also be used to show what ten times bigger looks like	Use missing number caculations to ensure for mastery of concept 0.3 x ? = 3 100 x ? = 3 5 = 10 x ? 70 = 700 x ? 0.3 = ? ÷ 10 0.03 = ? ÷ 100 3.7 = ? ÷ 10 0.37 = ? ÷ 10 0.307 ÷ 10 = ? ? ÷ 10 = 630 what is ten / 100 / 1000 times smaller than x

short multiplication **follow on from work done in year 4**	Place value counters can also be used instead / alongside dienes	 make link explicit 

short division of decimal numbers	$5\overline{)225}$ = 51 $5\overline{)225.5}$ = 51.1	
To understand and use tenths, and hundredths (we will not look specifically at thousandths as this is not in the primary curriculum – although they deal with thousandths in maths No problem).	Bar model:  Gattegno chart:     	Calculation strategies as mentioned above including bridging ten (one in this case) need to be explicitly applied to work with tenths, hundredths and thousandths.
Finding equivalent fractions and simplifying	use paper folding, unifix cubes, cuisenaire, fractions ITP  Area model:  Quantity model:   	
Common denomination to add and subtract fractions	 	 

Year 6

- Read and write numbers to 10,000,000 and compare any number or group of numbers.
- To be able to divide by 2-digit divisors (long division) and understand the process.
- To be able to multiply by two digit multiplier (long multiplication)
- To begin to be able to multiply and divide proper fractions by whole numbers
- To link fractions, decimals and percentages (this builds on work done in year 5 where percentages are introduced and links between fractions and decimals are made)

Objective	Representation	calculation
Read and write numbers to 10,000,000 and compare any number or group of numbers		6,320,420 = 6,000,000 + ? + 20,000 + etc 7,670, 234 – 500,000 = 7,056,324 – 800,000 = 5,767,960 + 500,000 =

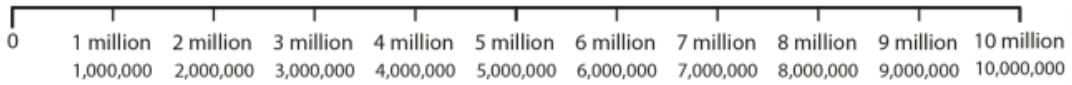
Place-value chart:

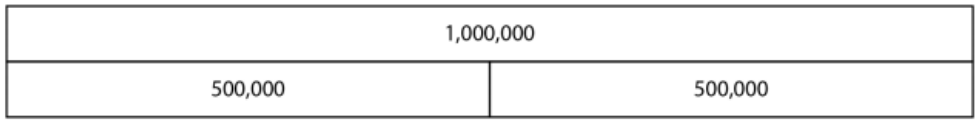
Millions			Thousands			Ones		
100s	10s	1s	100s	10s	1s	100s	10s	1s
								1
							1	0
						1	0	0
					1	0	0	0
				1	0	0	0	0
			1	0	0	0	0	0
		1	0	0	0	0	0	0

Gattegno chart:

10,000,000	20,000,000	30,000,000	40,000,000	50,000,000	60,000,000	70,000,000	80,000,000	90,000,000
1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000	7,000,000	8,000,000	9,000,000
100,000	200,000	300,000	400,000	500,000	600,000	700,000	800,000	900,000
10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000
1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	70	8	9
0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09

Number line:

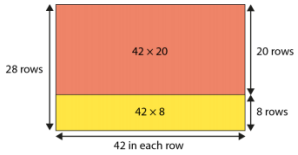




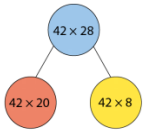
Bridge millions when adding and subtracting	Use number line and apply strategies of bridging 10 and 100 as in year 2 and 3.	**1,999,998 + 7 = 1,999,998 + 2 + 5** **998,000 + 7000 = 998,000 + 2000 + 5000** **988,000 + 7000 = 988,000 + 2000 + 5000** **999, 998 + 7 = 99,998 + 2 + 5 (And the same when subtracting across millions)**

Long multiplication

follow on from work done in year 5



Part–part–whole model:



Short multiplication and combining partial products:

$$\begin{array}{r} 42 \\ \times\ \ 8 \\ \hline 336 \\ \hline 1 \end{array} \qquad \begin{array}{r} 42 \\ \times\ \ 20 \\ \hline 840 \end{array}$$

$$\begin{array}{r} 840 \\ +\ \ 336 \\ \hline 1176 \end{array}$$

- *'There are 1,176 seats in this section of the stadium.'*

	100s	10s	1s	
		4	7	
×		1	8	
	3	7	6	47 × 8
	4	7	0	47 × 10
	8	4	6	

1

$$\begin{array}{r} 3126 \\ \times\ \ 28 \\ \hline 25008 \\ 62520 \\ \hline 87528 \end{array}$$

long division

Ratio chart and partitioning:

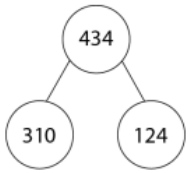
'Becky has 434 cm of ribbon to wrap up prizes for a school competition. Each prize needs 31 cm of ribbon. How many prizes can she wrap?'

434 ÷ 31 = ?

- Create a ratio chart of multiples of the divisor

	×31
1	31
2	62
3	
4	124
5	155
6	
7	
8	248
9	
10	310

- Partition the dividend to calculate



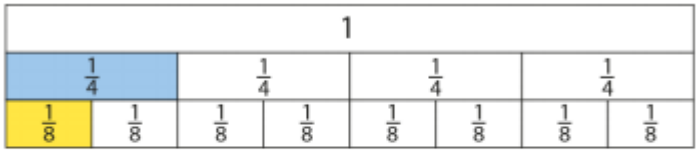
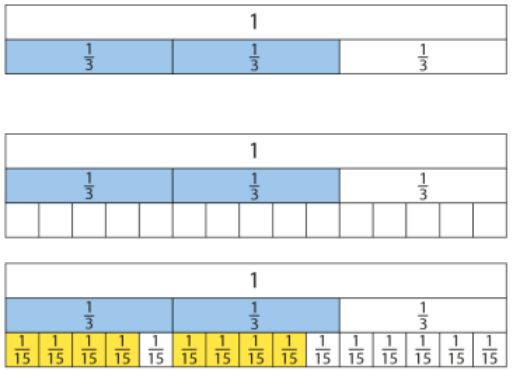
310	÷	31	= 10
124	÷	31	= 4
434	÷	31	= 14

- *'Becky can wrap fourteen presents.'*

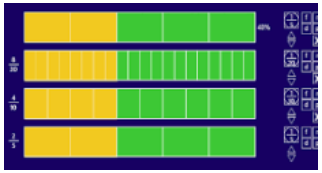
$\begin{array}{r} 0 \\ 31\overline{)434} \end{array}$	4 hundreds ÷ 31 = 0 hundreds r 4 hundreds • *'Write "0" in the hundreds column…'*
$\begin{array}{r} 0 \\ 31\overline{)434} \end{array}$	4 hundreds = 40 tens • *'…and write "4" to the left of the tens digit of the dividend.'*
$\begin{array}{r} 01 \\ 31\overline{)434} \end{array}$	43 tens ÷ 31 = 1 ten r 12 tens • *'Write "1" in the tens column...'*
$\begin{array}{r} 01 \\ 31\overline{)434} \end{array}$	12 tens = 120 ones • *'…and write "12" to the left of the ones digit of the dividend.'*
$\begin{array}{r} 014 \\ 31\overline{)434} \end{array}$	124 ones ÷ 31 = 4 ones (refer to the ratio chart) • *'Write "4" in the ones column.'*

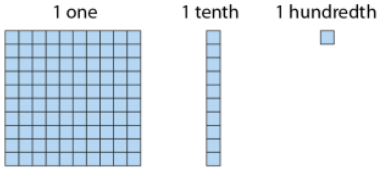
- *'Becky can wrap fourteen presents.'*

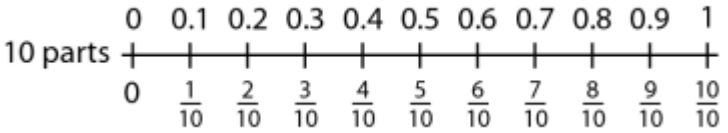
$$\begin{array}{r} 23.6 \\ 15\overline{)354.0} \\ 30 \\ \hline 54 \\ 45 \\ \hline 90 \\ 90 \\ \hline 0 \end{array}$$

To begin to be able to multiply and divide proper fractions by whole numbers (see also) https://www.ncetm.org.uk/files/108920092/ncetm_spine3_segment09_y6.pdf	 $\frac{1}{4} \div 2 = \frac{1}{8} \longrightarrow \frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$ Use linear model. Children to understand that multiplying a number by a proper fraction will lead to a smaller number. (eg, 4 x ½ = ½ + ½ + ½ + ½ = 2 halves). (also use scaling model here - it is half as big) Use commutitive law. $\frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$ $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$  $\frac{4}{5} \times \frac{2}{3} = \frac{8}{15}$ and $\frac{2}{3} \times \frac{4}{5} = \frac{8}{15}$

Linking fractions, decimals and percentages	Use fraction ITP







Fraction notation	Decimal notation	Name
$\frac{1}{10}$	0.1	one-tenth
$\frac{1}{100}$	0.01	one-hundredth

000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	7	8	9
0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09

Percentage	Fraction	Hundred square	Number line
80%	$\frac{\square}{100}$		0% 100%
45%	$\frac{\square}{100}$		0% 100%
31%	$\frac{\square}{100}$		0% 100%
9%	$\frac{\square}{100}$		0% 100%

Appendix 1 Glossary of Mathematical terms

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These symbols are referred to as the **'greater than' (>) and 'less than' (<) symbols**. Children learn that they are used to show whether a number is bigger or smaller than another number (for example, 56 > 34 or 34 < 56).

The **12-hour clock** runs from 1am to 12 noon and then from 1pm to 12 midnight. The **24-hour clock** uses the numbers 00:00 to 23:59 (midnight is 00:00).

2D shapes are two-dimensional, or 'flat'. Examples of 2D shapes are squares, triangles, circles and rectangles.

3D shapes are three-dimensional, and have a volume. Examples of 3D shapes are cubes, cuboids, spheres, cylinders and prisms.

An **acute angle** is one that measures less than 90˚.

An **analogue clock** is a circular-faced clock with the numbers one to twelve around the outside and two hands, a shorter one to measure hours and a longer one to measure minutes. A **digital clock** is a clock which simply shows numbers to denote the time.

Area is the term used to define the amount of space taken up by a 2D shape or surface. We measure area in square units : cm^2 or m^2.

An **array** is a pictorial representation, a picture of rows of dots, to help children understand multiplication and times tables.

Arrow cards are a maths aid used to help children partition numbers (divide them unto units, tens, hundreds, etc) and understand place value.

When a group of numbers are given in **ascending order**, this means they are given in order from smallest to largest (ascending means 'going up'). The opposite is descending order.

The **associative property** states that when we add or multiply numbers it doesn't matter how we group them (we express this as $(a + b) + c = a + (b + c)$ and $(a \times b) \times c = a \times (b \times c)$ in formulae).

In maths, the **average** value in a set of numbers is the middle value, calculated by dividing the total of all the values by the number of values.

Axes are the horizontal and vertical lines used to frame a graph or chart.

A **bar chart** is a chart that displays information (data) by using rectangular bars of different heights, arranged on a vertical axis and a horizontal axis.

The **bar model method** is used in Singapore maths (also known as Asian maths mastery) to help children visualise maths problems, first by handling actual objects, then by drawing pictures of the objects or cubes / dots representing them and finally by drawing one long bar and labelling it with numbers.

A **block graph** (or block diagram) is a simple chart which shows numbers on the vertical axis and labels on the horizontal axis. Each unit is represented by one block.

BODMAS is an acronym used to help pupils remember the correct order to complete mathematical calculations in: Brackets, Orders, Division, Multiplication, Addition, Subtraction.

The **"bridging through ten"** method is a mental maths technique used to add numbers when the answer is larger than 10. Instead of counting in ones we add to the next ten and then add whatever is left. (eg. 7 + 5 = 7 + 3 this is ten and then I add 2 on)

The **'bus stop' method** (also known as short division) is a division technique children are taught in primary school. Children are usually taught the bus stop method once they are confident with chunking (another division technique).

Capacity is the total amount of fluid that can be contained in a container. It is the word we use when we are measuring liquids (in litres or millilitres).

Cardinal numbers allow us to count a set of objects and tell us about **quantity** (one, two, three, four, etc.). This is different to ordinal which tells us about the order of numbers.

A **Carroll diagram** is used to organise data and group it according to whether it fits certain criteria. The information is presented in rows and columns.

A **circle** is a 2D curved shape, every point of which is the same distance from a fixed point in the centre.

The **circumference** is the measurement all the way around the outside edge of a circle.

When something moves in a **clockwise direction**, it is moving in the same direction as the hands on the clock. When something moves in an **anti-clockwise direction**, it is moving in the opposite direction. Children are taught about the language of direction from KS1 onwards.

Coordinates are numbers which determine the position of a point or a shape in a particular space (a map or a graph). Points are marked by how far along they are on the x axis (the horizontal axis) and how far up they are on the y axis (the vertical axis).

The **column method** of addition and subtraction is the method where numbers are arranged in vertical format. The numbers to be added and subtracted are set up in columns of units, tens, hundreds, etc.

The **commutative property** says that we can move numbers around within number sentences without affecting the results of our calculations; this can be expressed in algebra as $a + b = b + a$ and $a \times b = b \times a$.

'Complementary addition' is a subtraction method that involves putting the smaller number at the start of a number line and then jumping up to the bigger number (it's also known as the 'jump strategy'). This makes the concept of subtraction being about finding the difference between two numbers very clear.

Converting into the same units of measurement means understanding that the same length, capacity or weight can be expressed in different units of measurement. For example, weight can be shwon in kilograms (kg) but also grams (g); there are 1000g in 1kg.

A **cube number** is a number that is the product of three numbers which are the same. In other words, if you multiply a number by itself and then by itself again, the result is a cube number. To write the mathematical formula for cube numbers we add a small 3 next to and above the number, for example: 2^3.

Data handling is the term used to refer to primary-school statistics. Children learn about how to collect, interpret and display data in pictograms, tally charts, block diagrams, bar charts, line graphs and pie charts.

A **decimal** is a number expressed in the scale of tens. Commonly speaking we talk about decimals when numbers include a decimal point to represent a whole number plus a fraction of a whole number (tenths, hundredths, etc.).

Degrees are the unit of measurement used to measure angles. A right angle is 90˚, a straight line angle is 180˚ and a full turn is 360˚. We use a protractor (an angle measurer) to measure degrees.

The **denominator** is the bottom number of a fraction. So in the fraction 3/8 the denominator is 8. In the fraction 5/6 the denominator is 6.

When numbers are put in **descending order**, they are ordered from largest to smallest. The opposite is ascending order (from smallest to largest).

A **diagonal** is a straight line joining two nonadjacent vertices of a shape, that is, two corners of a shape that are not next to each other.

The **diameter** is the straight line going through the centre of a circle, connecting two points on the circumference.

According to the **distributive property**, multiplication distributes over addition. This can be expressed in algebra as $a \times (b + c) = a \times b + a \times c$.

Division facts are the division number sentences related to times tables. For example, 30 ÷ 3 = 10, 27 ÷ 3 = 9 and 24 ÷ 3 = 8 are all division facts for the 3x table.

In 3D shapes, the **edges** are the lines where two faces meet.

An **equation** is a number sentence where one side equals the other, for example 4 + 4 = 10 - 2.

An **equilateral triangle** has three equal sides and three equal angles.

When two fractions are **equivalent**, this means they are the same in terms of shape and size, but are expressed using different numbers (for example, 1/3 is equivalent to 2/6 or 3/9). **Simplifying a fraction** means finding an equivalent fraction where the numbers are reduced as much as possible.

An **estimate** is sometimes called a 'clever guess'. Estimating means roughly calculating or judging a number or value.

Expanded notation is writing numbers or number sentences in which the numbers are partitioned (so 67 + 43 could be written as 60 + 7 + 40 + 3).

In 3D shapes, the faces are the flat parts of the shape.

A **factor** is one of two or more numbers that divides a given number without a remainder. In the number sentence 4 x 5 = 20, both 5 and 4 are factors of 20.

Finding the difference between two numbers means subtracting the smaller number from the larger number. This concept is usually taught with complementary addition (subtraction on a number line).

A **formula** is a group of mathematical symbols and numbers that show how to work something out. Formulae children will learn in primary school include the formula for calculating the perimeter and area of 2D shapes and the formula for the volume for 3D shapes.

The **grid method** is a written technique used to teach children multiplication. It involves partitioning numbers into tens and units before they are multiplied, and placing them in a grid. The numbers are then multiplied two by two and the results are added together to give a total answer.

The **highest common factor** of two numbers is the largest whole number which is a factor of both. A factor is one of two or more numbers that divides a given number without a remainder.

A **horizontal** line is a line that runs from right to left, like the horizon.

Imperial units of measurement were used in the UK before the adoption of the metric system. According to the national curriculum, children in Y5 are taught about imperial measurements.

An **improper fraction** is one that is 'top-heavy' so the numerator is bigger than the denominator, for example 7/3.

Carrying out a **mathematical investigation** means applying skills and knowledge to solving problems. Investigations differ from word problems because there isn't always just one way of one way of working them out and the solution might have to be found through trial and error. Often, there is not just one answer; there could be several.

An **integer** is a whole number. This can be a negative or positive number; 0 is also an integer.

Inverse operations are opposite operations; one reverses the effect of the other. Subtraction is the inverse of addition and division is the inverse of multiplication.

An **isosceles triangle** has two equal sides and two equal angles.

A **line graph** is used to display information which changes over time. It is plotted on a graph as a series of points joined with straight lines.

Long division is a written method of dividing numbers (usually a three- or four-digit number by 2 digit (or more) number).

Long multiplication (or column multiplication) is a written method of multiplying numbers (usually a two- or three-digit number by another large number). As in column addition and column subtraction, the numbers are positioned in columns according to their place value.

The **lowest common denominator** (or least common denominator) is the smallest number that is exactly divisible by each denominator of a set of fractions.

The **lowest common multiple** of two numbers is the smallest whole number which is a multiple of both. A multiple is a number that can be divided by another number a certain number of times without a remainder.

Mass refers to the weight of an object. It is usually measured in grams and kilograms.

The **mean** is the total of all the values in a set of data, divided by the number of values.

The **median** is the middle number in a list of numbers, ordered from smallest to largest.

A **mirror line** is the central line which can be drawn on a symmetrical shape to show that both sides of the shape are exactly the same.

A **mixed number** is made up of a whole number and a fraction, for example 9 3/4.

The **mode** is the value that appears most often in a set of data. In this case, the mode is 9 seconds.

A **multiple** is a number that can be divided by another number a certain number of times without a remainder. In the number sentence 4 x 5 = 20, 20 is a multiple of 4 and a multiple of 5.

A **negative number** is a number smaller than 0 (for example, -1, -3, -36).

A **net** is what a 3D (three-dimensional) shape would look like if it were opened out flat.

Number bonds are the pairs of numbers that make up a given number (number bonds to 10 are 1 + 9, 2 + 8, 3 + 7, 4 + 6, 5 + 5; number bonds to 20 are 1 + 19, 2 + 18, 3 + 17, 4 + 16, 5 + 15).

Number facts are basic addition, subtraction, multiplication and division calculations that children should learn to recall instantly.

A **number line** is a straight, horizontal line with numbers placed at even increments along the length. It's not a ruler, so the space between each number doesn't matter, but the numbers included on the line determine how it's meant to be used. A **number ladder** is the vertical version of a number line.

A **number sentence** is an arrangement of numbers and symbols, such as the following: 6 + 7 = 13 (addition number sentence), 45 - 6 = 39 (subtraction number sentence), 8 x 9 = 72 (multiplication number sentence), 48 ÷ 8 = 6 (division number sentence).

A **number square** is a primary-school maths aid, a square filled with numbers (ordered sequentially). Younger children will often use a number square with numbers from one to 20. You'll also commonly see number squares from one to 100.

The **numerator** is the top number of a fraction. So in the fraction 3/8 the numerator is 3. In the fraction 1/9 the numerator is 1. If a fraction has 1 as its numerator, it is called a unit fraction.

An **obtuse angle** is one that measures between 90˚ and 180˚.

An **even number** is a number that can be divided into two equal groups. Even numbers always end in 2, 4, 6, 8 and 0. An **odd number** is a number that cannot be divided into two equal groups. Odd numbers end in 1, 3, 5, 7, 9.

The four mathematical **operations** are addition, subtraction, multiplication and division.

Ordinal numbers (first, second, third, etc.) tell us the position of an item in a list. Dates are ordinal numbers.

Parallel lines are straight lines that always stay the same distance from each other and never meet.

Partitioning means separating numbers into the tens, units, hundreds, thousands, etc. that make them up (so 2967 is 2000 + 900 + 60 + 7). Partitioning helps children understand place value.

A **percentage** is a number or ratio expressed as a fraction of 100. When we talk about percentages, we imagine that 'a whole' has been divided into 100 equal parts.

The **perimeter** is the distance around the edge of a 2D shape.

When two lines are **perpendicular**, they are at right angles to each other.

A **pictogram** is a chart that uses pictures to represent data. Pictograms are set out in the same way as bar charts, but instead of bars they use columns of pictures to show the numbers involved.

Pie charts are circular charts divided up into sections (or 'slices') to represent values of different sizes.

Place value is the value of each digit in a number. It means understanding that 582 is made up of 500, 80 and 2, rather than 5, 8 and 2.

Polygons are 2D shapes with straight, fully closed sides. Polygons can have any number of sides. Common polygons are triangles, squares, pentagons, hexagons.

A **prime number** is a number greater than 1 that cannot be divided evenly by any number other than itself or 1. For example: 13 is a prime number because you cannot divide it (without a remainder) by any number except 13 or 1.

A **prism** is a 3D shape with flat sides and two identical ends. Prims have the same cross-section all along the shape, from end to end.

The **product** of two numbers is the result you get when you multiply them together (for example, 12 is the product of 3 and 4 and 20 is the product of 4 and 5).

Proportion tells us about a portion or part in relation to a whole.

A **pyramid** is 3D shape with a polygon base and flat (triangular) sides that join at a common point (the apex).

A **quadrilateral** is a 2D shape with four sides. The following shapes are quadrilaterals: square, rectangle, rhombus, trapezium, parallelogram, kite.

The **radius** is the distance from the centre of a circle to the edge of the circle.

The **range** is the difference between the lowest value and the highest value in a data set.

A **ratio** compares values, telling us how much of one thing there is compared to another thing.

Reflecting a shape in a mirror line means drawing a symmetrical copy of the shape, flipped over the line (exactly the same size but facing in the opposite direction).

Reflective symmetry is when a shape or pattern is reflected in a line of symmetry or a mirror line. The reflected shape will be exactly the same as the original, the same distance from the mirror line and the same size.

A **reflex angle** is an angle that measures between 180˚ and 360˚.

Regular shapes have sides that are all equal and interior (inside) angles that are all equal. **Irregular shapes** have sides and angles of any length and size.

A **right angle** is an angle that measures 90˚. It is also known as a 'quarter turn' because it is a quarter of a full turn, which measures 360˚.

A **right-angled triangle** is a 2D shape with three sides and an angle that measures 90º.

Roman numerals are the numbers that were used in ancient Rome, combinations of letters from the Latin alphabet (I, V, X, L, C, D and M).

Rotating shapes means moving them around a fixed point (clockwise or anticlockwise, and by a certain number of degrees). The shape stays the same, but its position in the space will change.

Rotational symmetry is when a shape or pattern can be rotated or turned around a central point and remains the same.

Rounding numbers means adjusting the digits (up or down) to make rough calculations easier. We usually round numbers to the nearest 10, 100 and 1000.

Repeated addition is a method of helping children understand multiplication. Children are asked to work out, for example, what 3 'lots of' 5 are. They will be shown that this can be written as 5 + 5 + 5 (repeated addition number sentence) as well as 3 x 5 (multiplication number sentence).

When we talk about increasing the size of a 2D shape the size by which we make the shape larger is described by its **scale factor**.

A **scalene triangle** is a three-sided 2D shape in which the sides are all unequal.

'Shared between' is a term used in word problems to indicate division. Children learn that by sharing equally into groups they are dividing.

When you multiply a number by itself, the result is a **square number**. To write the mathematical formula for square numbers we add a small 2 next to and above the number, for example: 3^2.

Standard units are the units we usually use to measure the weight, length or capacity of objects (grams and kilograms, centimetres, metres and kilometres, millilitres and litres). **Non-standard units** are used by younger children to introduce them to the concept of measuring (for example: handspans, the length of a pencil).

Subitising – the ability to see numbers without calculating like on a dice. This is a very important precursor to advanced arithmetic. Conceptual subitising – this is adding (or subtracting) two numbers by seeing the numbers and calculating quickly (not counting on). Eg. Rolling two dice and knowing the answer.

The **sum** of two numbers is the answer you get when you add them both together (for example, the sum of 5 and 4 is 9).

Something is symmetrical when it is the same on both sides. A shape has **symmetry** if a central dividing line (the mirror line) can be drawn on it, to show that both sides of the shape are exactly the same.

A **tally chart** uses marks representing numbers to collect data quickly and efficiently. One vertical mark is used to represent each unit; when five objects are counted the fifth line is crossed through the first four.

Tessellation is when shapes fit together exactly with no gaps. Common examples of **tessellating shapes** are floor tiles.

A **time interval** is the length of time in between two given times.

In geometry **translation** means moving a shape into a different position, without changing it in any way.

A **triangle** is a polygon with three sides and three angles. It is a 2D shape.

Triangular numbers are a sequence of numbers generated by arranging a pattern of dots into equilateral triangles.

A quarter turn is a 90˚ movement, **clockwise or anti-clockwise**. A half turn is 180˚ and a full turn is 360˚.

A **two-step problem** is a word problem that requires two operations to solve it; a **multi-step problem** requires more than two operations before the solution can be found.

A **unit fraction** is a fraction where the numerator (top number) is 1 and the denominator (bottom number) is a whole number.

A **Venn diagram** shows the relationship between a group of different things (a set) in a visual way, by sorting data into two or three circles which overlap in the middle. Each circle follows a certain rule, so any numbers or objects placed in the overlapping part (the intersection) follow both rules.

In 3D shapes, the **vertices** are the points where two or more edges meet. The angles of a 2D shape are also sometimes referred to as 'vertices' (singular: vertex).

A **vertical** line runs up and down the page, from top to bottom.

Volume is the amount of 3D space an object occupies or takes up.

A **word problem** (also known as a story problem) is a 'real-life' scenario where a problem needs to be solved by way of a mathematical calculation.