

# Bounds Green School

## Calculation Policy

September 2014



# Introduction

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This calculation policy has been written to reflect two important things:

- the new *Mathematics programme of study for key stages 1 and 2 (PoS)*
- our school ethos that a strong sense of number and number relationships underpin the development of more advanced skills

It is divided into three sections: addition and subtraction, multiplication and division, and fractions. Each section contains objectives from the PoS which relate to calculation as well as objectives from the *Teaching Children to Calculate Mentally* publication by DfE 2010. Following the objectives is a series of pictures of manipulatives, models and images.

## Aims

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- To ensure consistency and progression across the school
- To ensure our children develop a set of efficient and reliable formal methods for calculation
- To ensure our children can use these methods with confidence and understanding

## How to use

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This calculation policy has been designed for regular and frequent use. Use it to form the basis of your weekly planning, but refer also to the non-statutory notes and guidance for each year group published in the PoS as well as relevant and appropriate parts of documents and resources that you have found useful in the past. The pictures of manipulatives, models and images within each section can be used as a reminder for how best to support the children's understanding at each stage. Use these manipulatives, models and images as an integral part of your classroom.

You will at times have to refer to objectives and guidance of the previous year group in order to allow children whose understanding is not sufficiently strong to consolidate their understanding of these areas before moving on. You must not, however, progress to new content if you have children whose understanding is strong; rather, you must offer challenge through rich problems to allow children to deepen their understanding more fully and to allow them opportunities to build more connections. This complies with the government objective that it is mastery that is important, not acceleration.

At Bounds Green, children are encouraged to use mental calculation (including jottings) as a first port of call and to use a written method for calculations where a mental method is not easily applied. For this reason, mental calculation is an in-built feature of our school calculation policy.

**Jess King**  
**Maths Subject Leader**  
**September 2014**

# Bounds Green School Addition and Subtraction Calculation Policy

We will strive to ensure that children progress through the programmes of study at 'broadly the same pace'. Those who need to will have further experiences and opportunities to consolidate, while children with a secure understanding will be challenged through rich tasks to deepen their mathematical reasoning.

The decision about the appropriateness of ICT tools (including calculators) in mathematical activities rests with the class teachers.

Years 1 and 2	Years 3 and 4	Year 5 and 6
<b>MENTAL CALCULATION</b> <i>(see Teaching Children to Calculate Mentally for related strategies)</i>		
<ul style="list-style-type: none"> <li>• Find number pairs with a total of 10, then with a total of 20</li> <li>• Know addition doubles for all numbers to at least 10 (<math>8 + 8</math>), then to at least 20 (<math>17 + 17</math>) and use to derive near doubles</li> <li>• Add and subtract one-digit and two-digit numbers to 20, including zero, then recall and use these facts fluently</li> <li>• Derive and add all pairs of multiples of 10 up to 100 (<math>60+40</math>)</li> <li>• Add and subtract numbers using concrete objects, pictorial representations, and mentally, including:               <ul style="list-style-type: none"> <li>• A two-digit number and ones</li> <li>• A two-digit number and tens</li> <li>• Two two-digit numbers</li> <li>• Adding three one-digit numbers</li> </ul> </li> <li>• Read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs</li> <li>• Show that addition of two numbers is commutative and subtraction of one number from another is not.</li> </ul>	<ul style="list-style-type: none"> <li>• Add and subtract numbers mentally, including:               <ul style="list-style-type: none"> <li>○ a three-digit number and ones</li> <li>○ a three-digit number and tens</li> <li>○ a three-digit number and hundreds</li> <li>○ sums and differences of multiples of 10 (<math>50 + 80, 120 - 90</math>)</li> <li>○ pairs of two-digit numbers with a total of 100 (<math>32 + 68</math>)</li> <li>○ addition doubles for multiples of 10 to 100 (<math>90 + 90</math>), then doubles of numbers 1 to 100 (<math>38 + 38</math>), and their corresponding halves</li> <li>○ add near doubles (<math>38 + 37, 60 + 70</math>)</li> <li>○ what must be added to any three-digit number to make the next multiple of 100 (<math>521 + \square = 600</math>)</li> <li>○ add or subtract any pair of two-digit numbers, including crossing the tens and hundreds boundary (<math>47 + 58, 91 - 35</math>)</li> <li>○ add or subtract a near multiple of 10 to a two-digit number (<math>47 + 39</math>)</li> <li>○ add or subtract two-digit or three-digit multiples of 10 (<math>120 - 40, 150 + 140, 370 - 180</math>)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Add and subtract numbers mentally using increasingly large numbers</li> <li>• Use knowledge of the order of operations to carry out calculations involving the four operations</li> <li>• Find sums and differences of decimals (<math>6.5 + 2.7, 7.8 - 1.3</math>)</li> <li>• Find doubles and halves of decimals (half of 5.6, double 3.4)</li> <li>• Add and subtract multiples of 10 to 1000 and decimal numbers with one decimal place (<math>650 + \square = 930, \square - 1.4 = 2.5</math>)</li> <li>• Find what must be added to any four-digit number to make the next multiple of 1000 (<math>4087 + \square = 5000</math>)</li> <li>• Find what must be added to any decimal with units and tenths to make the next whole number (<math>7.2 + \square = 8</math>)</li> <li>• Find what must be added to any decimal with units, tenths and hundredths to make the next whole number (<math>7.26 + \square = 8</math>)</li> <li>• Add or subtract a pair of two-digit numbers or three-digit multiples of 10 (<math>38 + 86, 620 - 380, 350 + 360</math>)</li> <li>• Add or subtract a near multiple of 10 or 100 to any two-digit or three-digit number (<math>235 + 198</math>)</li> <li>• Find the difference between near multiples of 100 (<math>607 - 588</math>) or of 1000 (<math>6070 - 4087</math>)</li> <li>• Add or subtract any pairs of decimal fractions</li> </ul>

		<p>each with units and tenths (<math>5.7 + 2.5</math>, <math>6.3 - 4.8</math>)</p> <ul style="list-style-type: none"> <li>• Add or subtract pairs of decimals with units, tenths or hundredths (<math>0.7 + 3.38</math>)</li> <li>• Find doubles of decimals each with units and tenths (<math>1.6 + 1.6</math>)</li> <li>• Add near doubles of decimals (<math>2.5 + 2.6</math>)</li> <li>• Add or subtract a decimal with units and tenths that is nearly a whole number (<math>4.3 + 2.9</math>, <math>6.5 - 3.8</math>)</li> </ul>
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### WRITTEN METHODS

<ul style="list-style-type: none"> <li>• Read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs</li> <li>• Show that addition of two numbers is commutative and subtraction of one number from another is not.</li> </ul>	<ul style="list-style-type: none"> <li>• Add and subtract numbers with up to three digits, then four digits.</li> <li>• Use a combination of informal methods, number lines and jottings as well as formal written methods of columnar addition and subtraction</li> </ul>	<ul style="list-style-type: none"> <li>• Add and subtract whole numbers with more than 4 digits and including decimals using formal columnar written methods.</li> </ul>
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### INVERSE OPERATIONS, ESTIMATING AND CHECKING ANSWERS

<ul style="list-style-type: none"> <li>• Recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Estimate the answer to a calculation and use inverse operations to check answers</li> </ul>	<ul style="list-style-type: none"> <li>• Use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy.</li> </ul>
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### PROPERTIES OF NUMBERS: odd, even

<ul style="list-style-type: none"> <li>• Recognise odd and even numbers to 20, then to 100 and beyond.</li> </ul>		
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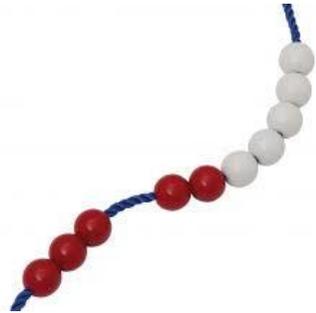
### PROBLEM SOLVING

<ul style="list-style-type: none"> <li>• Solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as <math>7 = \square - 9</math></li> <li>• Progress to solve problems with addition and subtraction using concrete objects and pictorial representations, including those involving numbers, quantities and measures</li> <li>• Apply knowledge of mental and written methods by solving simple problems in practical contexts such as money, including giving change.</li> </ul>	<ul style="list-style-type: none"> <li>• Solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction</li> <li>• Solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why.</li> </ul>	<ul style="list-style-type: none"> <li>• Solve more complex problems which involve decimals, percentages, measures and time.</li> </ul>
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# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF ADDITION AND SUBTRACTION CONCEPTS



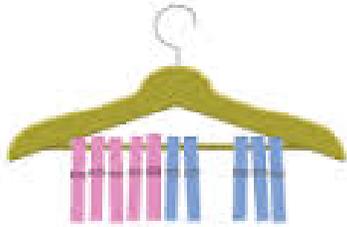
counters



bead string



straw bundles of 10, 100 and 1000 for PV



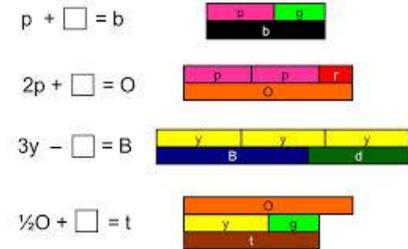
Coat hanger for bonds within 5 and 10



double-sided counters for addition and subtraction facts, comparing, patterning...

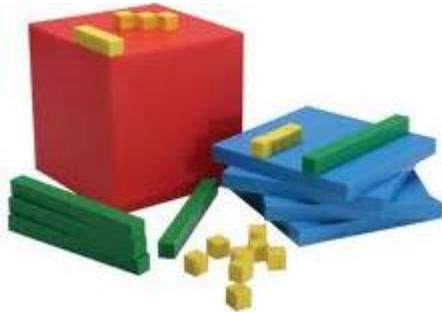


cuisenaire rods



cuisenaire rods and number relationships including inverse

# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF ADDITION AND SUBTRACTION CONCEPTS



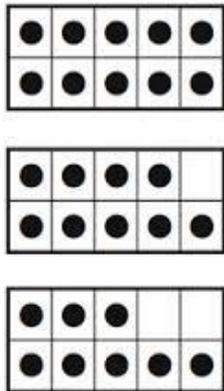
Dienes blocks



place value cards



Numicon



Tens frames for internalising number facts, inverse, subitising...

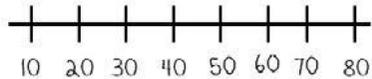
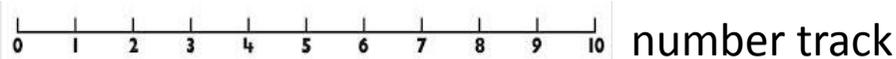


place value counters

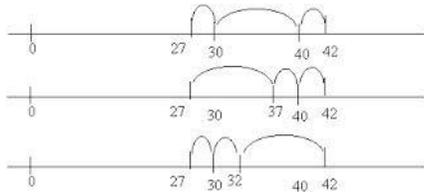


Coins for number facts, exchanging, comparing...

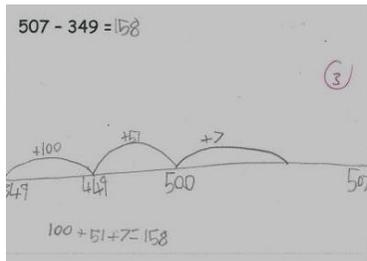
# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF ADDITION AND SUBTRACTION CONCEPTS



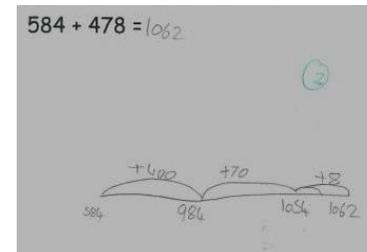
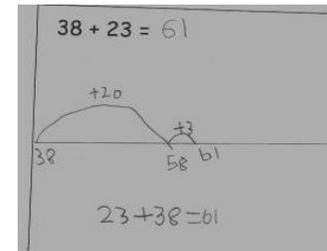
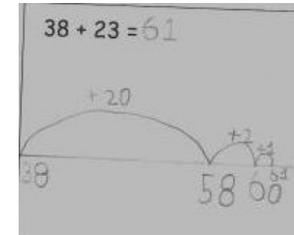
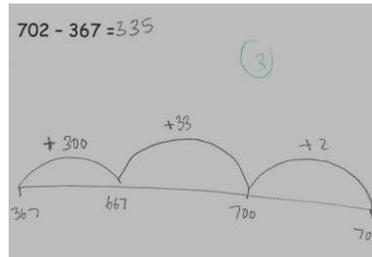
partially calibrated number track



empty number line (ENL)



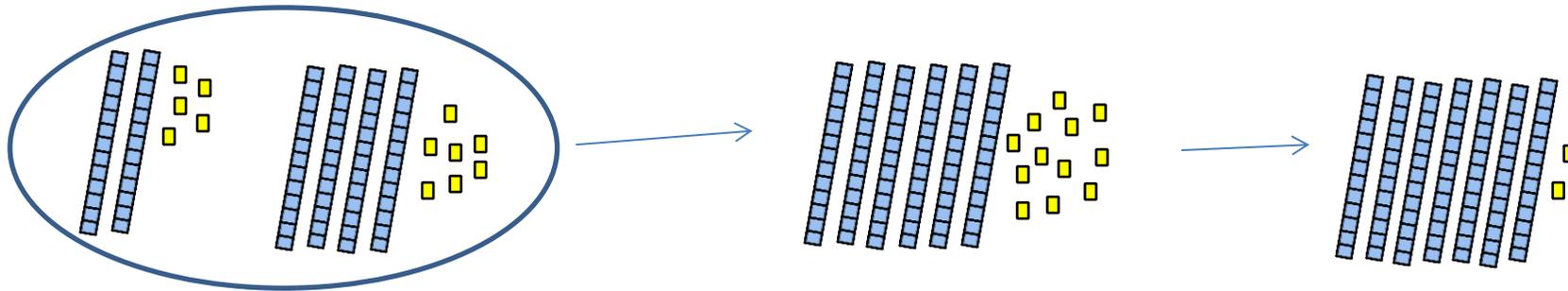
Subtraction by counting on using an ENL



Addition on an ENL



# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF ADDITION AND SUBTRACTION CONCEPTS

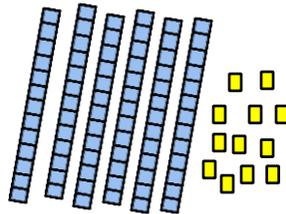
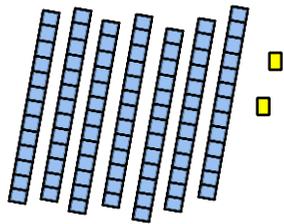


Above: Dienes for combining and exchanging



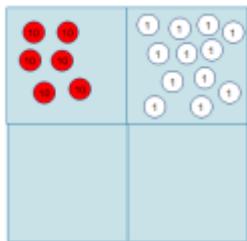
Above: place value counters are used on a calculation mat to combine and exchange. Note that the written representation runs alongside the manipulatives to reinforce understanding of the algorithm, and that the manipulatives are used to add from right to left to mirror the algorithm.

# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF ADDITION AND SUBTRACTION CONCEPTS

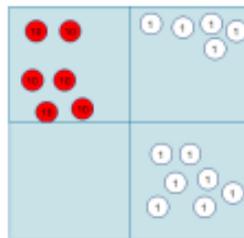


Far left: Dienes used to represent 72 in preparation for a subtraction.  
 Left: One Dienes 10 has been exchanged for 1s to allow for subtraction of any amount.

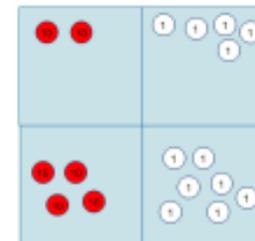
Below: place value counters are used on a calculation mat to represent the subtraction 72 - 47.  
 Note how the calculation is carried out from right to left as in the written algorithm.



$$\begin{array}{r} \cancel{7}2 \\ - 47 \\ \hline \hline \end{array}$$



$$\begin{array}{r} \cancel{7}2 \\ - 47 \\ \hline 5 \end{array}$$



$$\begin{array}{r} \cancel{7}2 \\ - 47 \\ \hline 25 \end{array}$$

# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF ADDITION AND SUBTRACTION CONCEPTS

expanded

$$\begin{array}{r} 200 + 100 + 12 + 8 \\ 300 + 0 + 0 + 0 \\ - 100 + 50 + 4 + 9 \\ \hline 100 + 40 + 8 + 9 \end{array}$$

(solver and recorder)

$$\begin{array}{r} 5 \cancel{0} \cancel{2} . \cancel{2} \cancel{0} \\ - 3 \ 4 \ . \ 4 \ 9 \\ \hline 5 \ 6 \ 7 \ . \ 7 \ 1 \end{array}$$

See STA sample test materials for maths.

# Bounds Green School Multiplication and Division Calculation Policy

We will strive to ensure that children progress through the programmes of study at 'broadly the same pace'. Those who need to will have further experiences and opportunities to consolidate, while children with a secure understanding will be challenged through rich tasks to deepen their mathematical reasoning.

The decision about the appropriateness of ICT tools (including calculators) in mathematical activities rests with the class teachers.

Years 1 and 2	Years 3 and 4	Year 5 and 6
<b>MENTAL CALCULATION</b> <i>(see Teaching Children to Calculate Mentally for related strategies)</i>		
<ul style="list-style-type: none"> <li>Count in multiples of two and five, then three, and in tens from any number, forward and backward</li> <li>Recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables</li> <li>Recognise odd and even numbers to 20, then 100</li> <li>Recognise doubles of all numbers to 20 and then doubles of multiples of 10 to 50, and their corresponding halves</li> <li>Show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot.</li> </ul>	<ul style="list-style-type: none"> <li>Recall and use multiplication and division facts for 3, 4, 6 and 8, then all numbers up to <math>12 \times 12</math></li> <li>Count from 0 in multiples of 25, 50, 100 and 1000</li> <li>Know doubles of multiples of 5 and 10 to 100, e.g. double 35 or 90, then any two digit number, and their corresponding halves</li> <li>Multiply one or two digit numbers by 10 or 100</li> <li>Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods.</li> </ul>	<ul style="list-style-type: none"> <li>Count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000</li> <li>Multiply and divide numbers mentally drawing upon known facts</li> <li>Multiply and divide whole numbers and those involving decimals by 10, 100 and 1000</li> <li>Use multiplication facts to derive products of pairs of multiples of 10 and 100 (<math>30 \times 40</math>, <math>30 \times 400</math>) and corresponding division facts (<math>120 \div 40</math>)</li> <li>Use place value and multiplication facts to derive related multiplication and division facts involving decimals (<math>0.8 \times 7</math>, <math>4.8 \div 6</math>).</li> </ul>
<b>WRITTEN METHODS</b>		
<ul style="list-style-type: none"> <li>Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (<math>\times</math>), division (<math>\div</math>) and equals (<math>=</math>) signs</li> <li>Show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot.</li> </ul>	<ul style="list-style-type: none"> <li>Multiply two-digit and three-digit numbers by a one-digit number progressing to formal written layout</li> <li>Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods</li> <li>Understand the difference between grouping and sharing and can say which of the two is taking place.</li> </ul>	<ul style="list-style-type: none"> <li>Multiply numbers up to 4 digits, then multi-digit numbers, by a one- or two-digit progressing to long multiplication</li> <li>Divide numbers up to 4 digits by a one-digit, then two-digit number progressing to the formal written method of short division, then long division and interpret remainders appropriately for the context</li> <li>Use written division methods in cases where the answer has up to two decimal places</li> <li>Use their knowledge of the order of operations to carry out calculations involving the four operations</li> </ul>

## INVERSE OPERATIONS, ESTIMATING AND CHECKING ANSWERS

- Estimate the answer to a calculation and use inverse operations to check answers

- Use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy

## PROPERTIES OF NUMBERS: multiples, factors, primes, square and cube numbers

- Recognise and use factor pairs of 2-digit numbers and commutativity.

- Identify multiples and factors, and then common factors and common multiples of two numbers
- Recognise and use square numbers and cube numbers and their notation
- Identify, know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers
- Use common factors to simplify fractions; use common multiples to express fractions in the same denomination
- Recall prime numbers up to 19, then up to 100, and establish whether a number up to 100 is prime
- Identify prime numbers less than 100.
- Recall squares of numbers to  $12 \times 12$

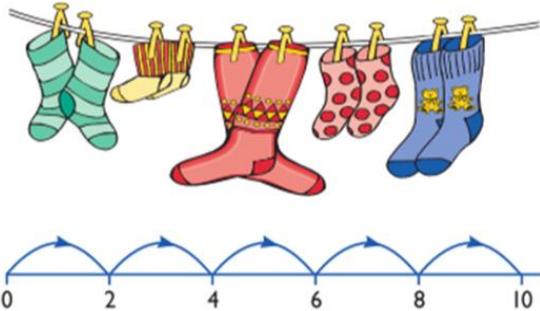
## PROBLEM SOLVING

- Solve one-step, then two-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays and then with mental methods, initially with the support of the teacher, and including problems in context.

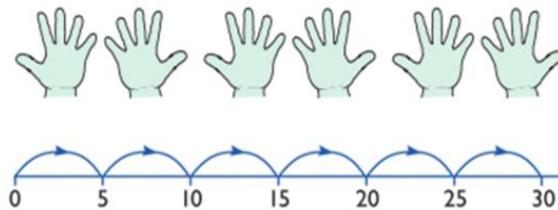
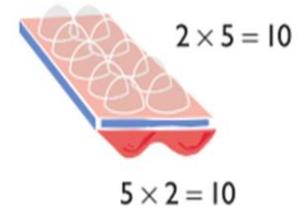
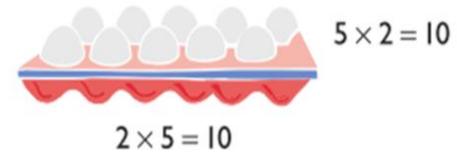
- Solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems
- Solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems
- Apply their knowledge and skills in multiplication and division to investigations.

- Solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes
- Solve problems involving multiplication and division and a combination of these, including understanding the meaning of the equals sign
- solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates
- Use knowledge of order of operations to carry out calculations involving the four operations.

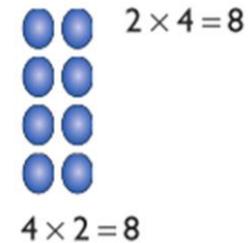
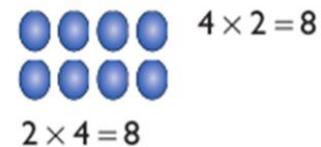
# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION CONCEPTS



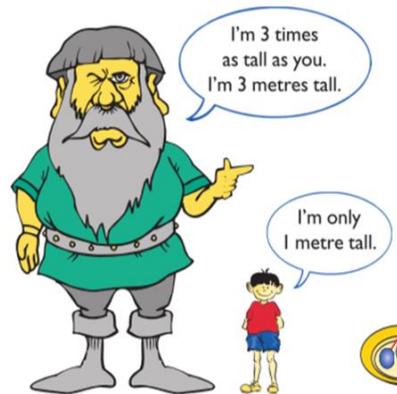
$2 + 2 + 2 + 2 + 2 = 10$   
 $2 \times 5 = 10$   
 2 multiplied by 5  
 5 pairs  
 5 hops of 2



$5 + 5 + 5 + 5 + 5 + 5 = 30$   
 $5 \times 6 = 30$   
 5 multiplied by 6  
 6 groups of 5  
 6 hops of 5

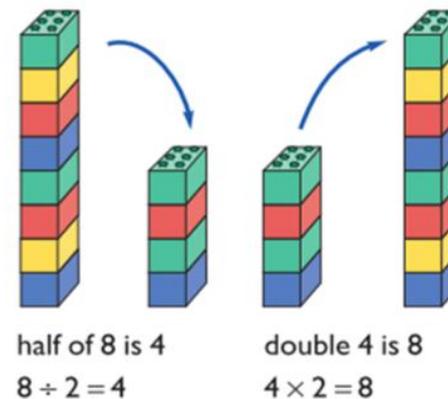
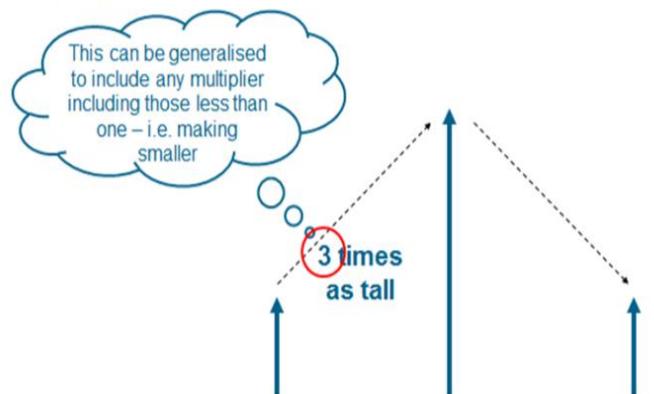


# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS

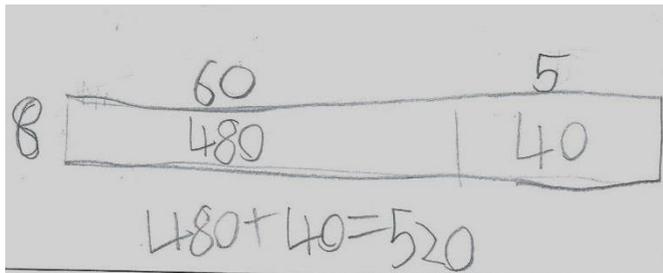
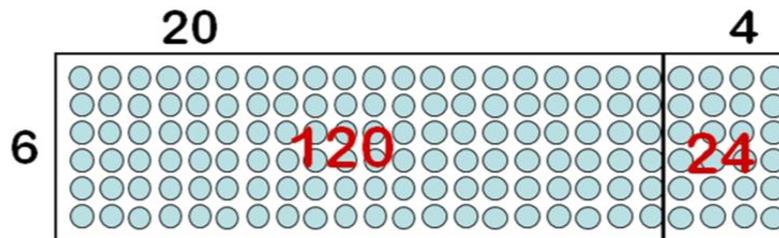


Scaling is an important idea in multiplication and division. It can be seen here in terms of proportion. It hides in everyday images such as boxes of eggs or a sheet of stamps. It also helps children in their understanding of fractions.

## Scaling

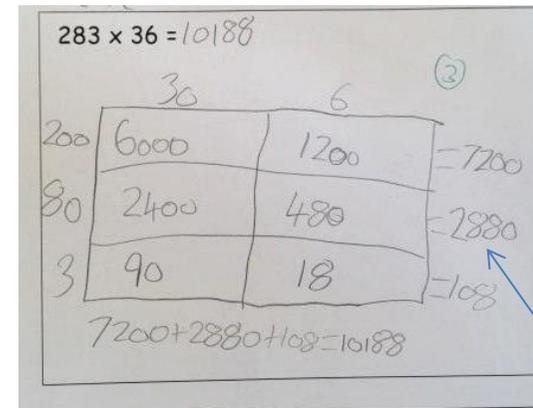
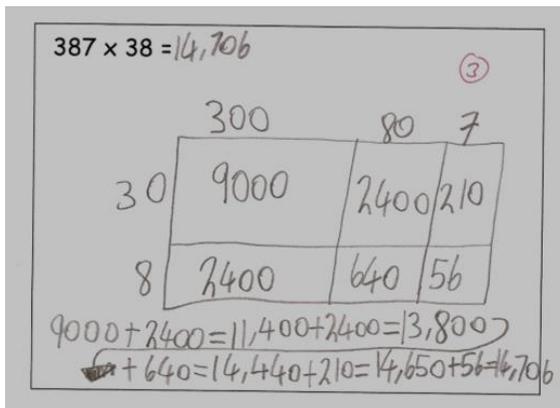


# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS



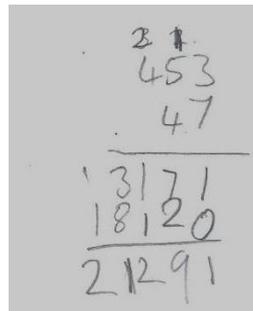
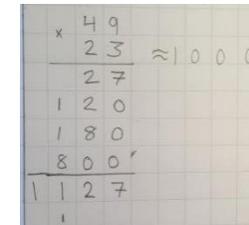
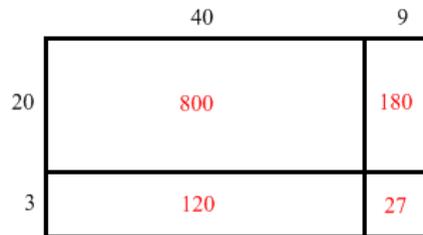
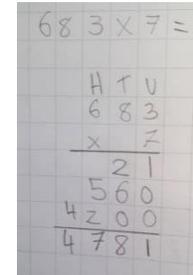
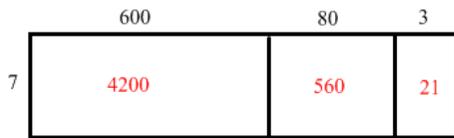
Left: The empty array contains roughly proportional sub-sections.

# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS

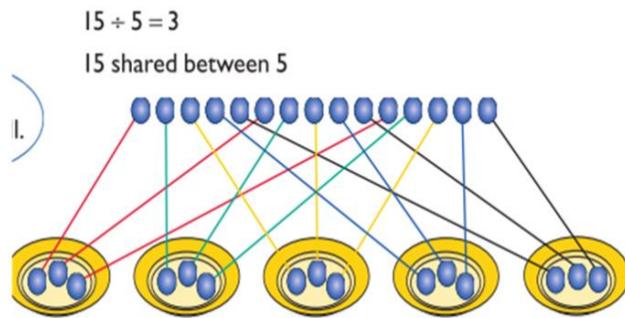


Above: This version, which lays out the addition horizontally across the grid, will become important later when the children begin to use the formal written method.

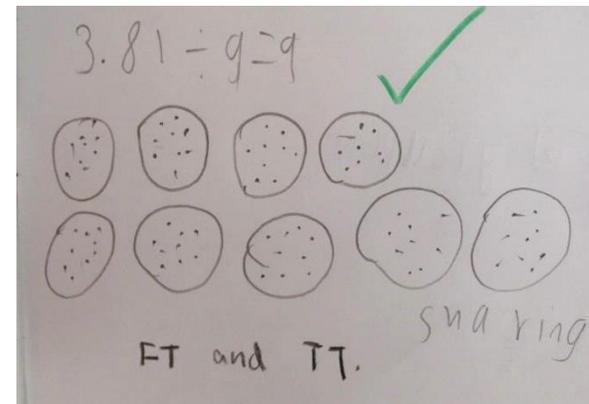
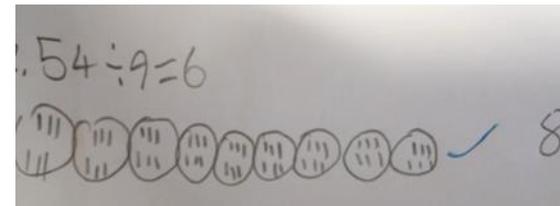
# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS



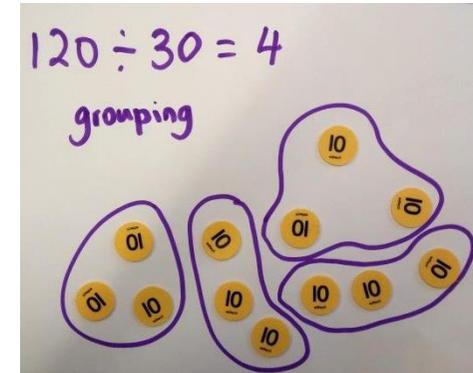
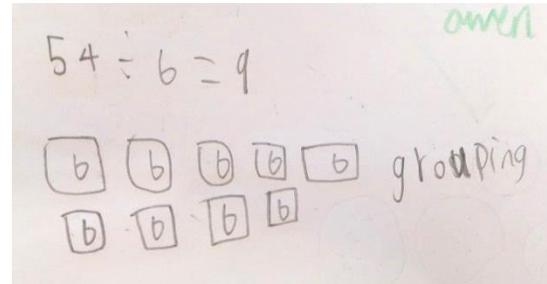
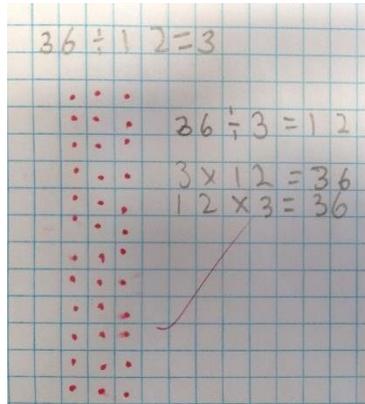
# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF DIVISION CONCEPTS



Sharing is achieved through creating empty sets (the divisor) and then sharing out the dividend one at a time in each set until they are all counted.



# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS



Grouping is achieved through representation of the divisor until the dividend is reached.



5 hops in 15. How big is each hop?

$$15 \div 5 = 3$$

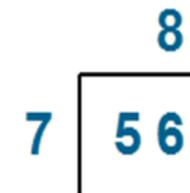
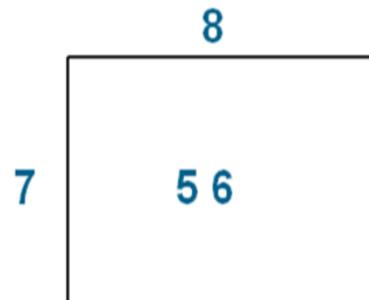
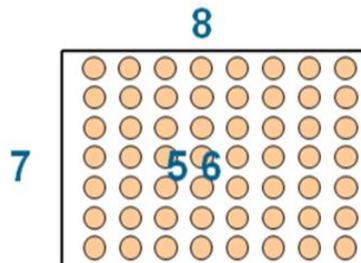


# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS

Standard division

An image for  $56 \div 7$

The array is an image for division too

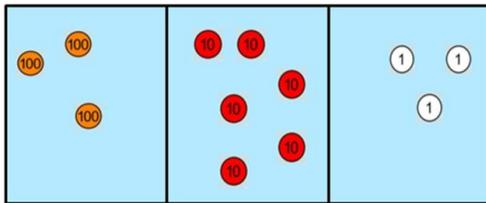


# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS

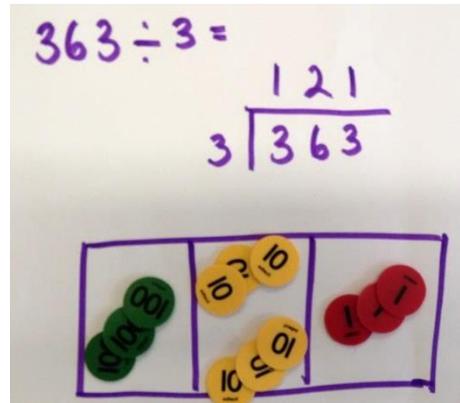
$$363 \div 3 =$$

$$\begin{array}{r} 121 \\ 3 \overline{) 363} \end{array}$$

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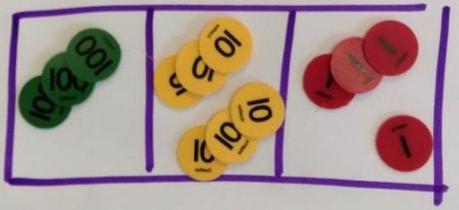


Left: 363 is represented as HTU in PV counters -three 100s, six 10s and three 1s.  
Right: The counters are arranged in groups of 3 (the divisor) giving one group of 3 in the Hs, two groups of 3 in the Ts and one group of three in the Us, giving 121.



$$364 \div 3 =$$

$$\begin{array}{r} 121 \text{ r}1 \\ 3 \overline{) 364} \end{array}$$

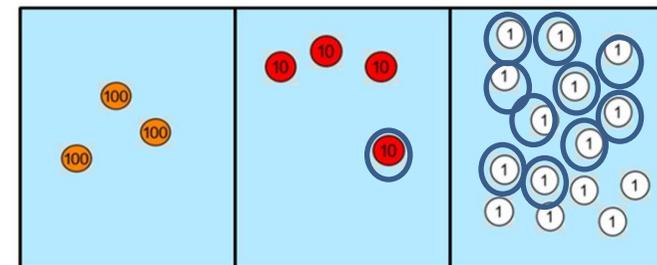


Left: As above but the single remainder results from the increased dividend 364.  
Right: The ringed PV counter in the Ts is exchanged for ten 1s, also ringed, in the units area. The groups of 3 in each area are then counted, giving one group of 3 in the Hs, one group of 3 in the Ts and five groups of 3 in the Us, making 115.

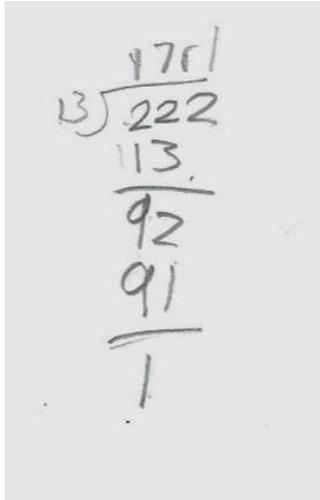
$$345 \div 3 =$$

$$\begin{array}{r} 115 \\ 3 \overline{) 345} \end{array}$$

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## MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS


$$\begin{array}{r} 17 \overline{) 222} \\ \underline{13} \phantom{0} \\ 92 \phantom{0} \\ \underline{91} \phantom{0} \\ 1 \phantom{0} \end{array}$$

This problem illustrates the increasing demand of dividing a multidigit number by a 2-digit number. Only the use of a formal written method will gain the method mark should the child produce the wrong answer.

# Bounds Green School Fractions (including decimals and percentages) Policy

We will strive to ensure that children progress through the programmes of study at ‘broadly the same pace’. Those who need to will have further experiences and opportunities to consolidate, while children with a secure understanding will be challenged through rich tasks to deepen their mathematical reasoning.

The decision about the appropriateness of ICT tools (including calculators) in mathematical activities rests with the class teachers.

Years 1 and 2	Years 3 and 4	Year 5 and 6
<ul style="list-style-type: none"> <li>• Recognise, find and name a half as one of two equal parts of an object, shape or quantity</li> <li>• Recognise, find and name a quarter as one of four equal parts of an object, shape or quantity.</li> </ul>	<ul style="list-style-type: none"> <li>• Count up and down in tenths</li> <li>• Recognise that tenths arise from dividing an object into 10 equal parts and in dividing one-digit numbers of quantities by 10</li> <li>• Recognise, find and write fractions of a discrete d=set of objects: unit fractions and non-unit fractions with small denominators</li> <li>• Recognise and show, using diagrams, equivalent fractions with small denominators</li> <li>• Recognise and show using diagrams, equivalent fractions with small denominators</li> <li>• Add and subtract fractions with the same denominator within one whole (<math>5/7 + 1/7 = 6/7</math>)</li> <li>• Compare and order unit fractions, and fractions with the same denominators.</li> </ul>	<ul style="list-style-type: none"> <li>• Compare and order fractions whose denominators are all multiples of the same number</li> <li>• Identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths</li> <li>• Recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements <math>&gt; 1</math> as a mixed number [for example, <math>2/5 + 4/5 = 6/5 = 1</math> and <math>1/5</math>]</li> <li>• Add and subtract fractions with the same denominator and denominators that are multiples of the same number</li> <li>• Multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams</li> <li>• Read and write decimal numbers as fractions [for example, <math>0.71 = 71/100</math>]</li> <li>• Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents</li> <li>• Round decimals with two decimal places to the nearest whole number and to one decimal place</li> <li>• Read, write, order and compare numbers with up to three decimal places</li> <li>• Solve problems involving number up to three decimal places</li> <li>• Recognise the per cent symbol (%) and understand that per cent relates to ‘number of parts per hundred’, and write percentages as a fraction with denominator 100, and as a decimal.</li> </ul>

<ul style="list-style-type: none"> <li>Recognise, find, name and write fractions <math>\frac{1}{3}</math>, <math>\frac{1}{4}</math>, <math>\frac{2}{4}</math> and <math>\frac{3}{4}</math> of a length, shape, set of objects or quantity</li> <li>Write simple fractions (<math>\frac{1}{2}</math> of <math>6 = 3</math>) and recognise the equivalence of <math>\frac{2}{4}</math> and <math>\frac{1}{2}</math>.</li> </ul>	<ul style="list-style-type: none"> <li>Recognise and show, using diagrams, families of common equivalent fractions</li> <li>Count up and down in hundredths; recognise that hundredths arise when dividing an object by one hundred and dividing tenths by ten</li> <li>Solve problems involving increasingly harder fractions to calculate quantities, and fractions to divide quantities, including non-unit fractions where the answer is a whole number</li> <li>Add and subtract fractions with the same denominator</li> <li>Recognise and write decimal equivalents of any number of tenths or hundredths</li> <li>Recognise and write decimal equivalents to <math>\frac{1}{4}</math>, <math>\frac{1}{2}</math>, <math>\frac{3}{4}</math></li> <li>Find the effect of dividing a one- or two-digit number by 10 and 100, identifying the value of the digits in the answer as ones, tenths and hundredths</li> <li>Round decimals with one decimal place to the nearest whole number</li> <li>Compare numbers with the same number of decimal places up to two decimal places</li> </ul>	<ul style="list-style-type: none"> <li>Use common factors to simplify fractions; use common multiples to express fractions in the same denomination</li> <li>Compare and order fractions, including fractions <math>&gt; 1</math></li> <li>Add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions</li> <li>Multiply simple pairs of proper fractions, writing the answer in its simplest form [for example, <math>\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}</math>]</li> <li>Divide proper fractions by whole numbers [for example, <math>\frac{1}{3} \div 2 = \frac{1}{6}</math>]</li> <li>Associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example, <math>\frac{3}{8}</math>]</li> <li>Identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places</li> <li>Multiply one-digit numbers with up to two decimal places by whole numbers</li> <li>Use written division methods in cases where the answer has up to two decimal places</li> <li>Recall and use equivalences between simple fractions, decimals and percentages, including in different contexts.</li> </ul>
	<ul style="list-style-type: none"> <li>Solve problems that involve all of the above</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems which require knowing percentage and decimal equivalents of <math>\frac{1}{2}</math>, <math>\frac{1}{4}</math>, <math>\frac{1}{5}</math>, <math>\frac{2}{5}</math>, <math>\frac{4}{5}</math> and those fractions with a denominator of a multiple of 10 or 25.</li> </ul>
	<ul style="list-style-type: none"> <li>Solve simple money and measure problems involving fractions and decimals to two decimal places</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems which require answers to be rounded to specified degrees of accuracy</li> </ul>

# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF CONCEPTS RELATED TO FRACTIONS



counters



dominoes



Multi-link

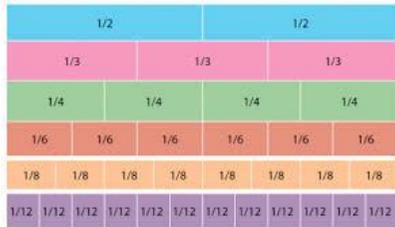


double-sided counters

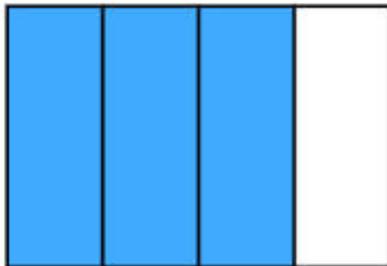
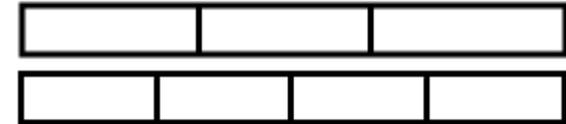


cuisenaire rods

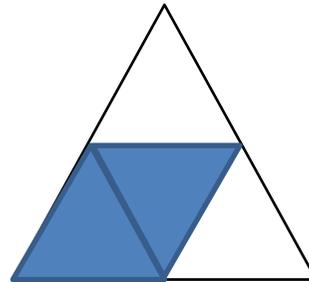
# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF CONCEPTS RELATED TO FRACTIONS



Fraction walls for comparing fractions, finding equivalent fractions, adding and subtracting fractions.

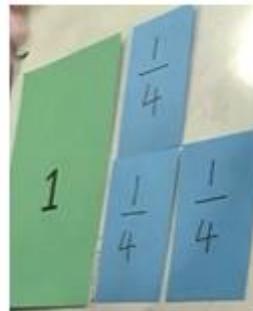


$$\frac{3}{4}$$



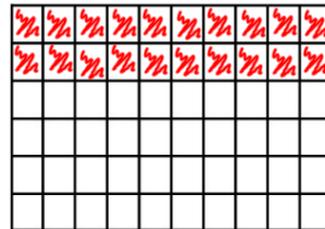
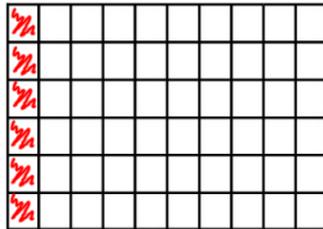
$$\frac{2}{4}$$

Representing fractions within different shapes reinforces the numerator / denominator relationship and allows children to see that, say  $\frac{1}{2}$ , can be represented in many different ways within any given shape.

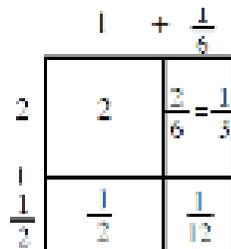


Left: This representation allows children to see equivalent fractions and add and subtract simple fractions with different denominators.

# MODELS AND MANIPULATIVES TO SUPPORT THE DEVELOPMENT OF CONCEPTS RELATED TO FRACTIONS

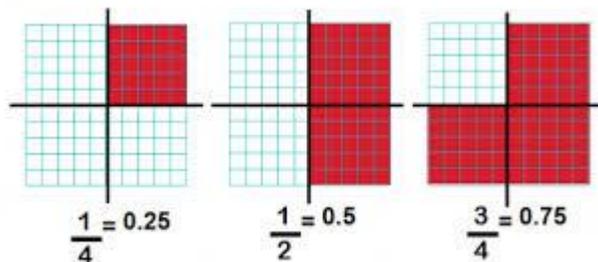


Calculating using empty arrays provides a clear way of exposing the structure of the mathematics. This image represents  $1/10 + 2/6 = 26/60 = 13/30$



This empty array represents  $2$  and  $\frac{1}{2}$  x  $1$  and  $1/6$ .

Eventually, children will represent calculations like these by converting to common denominators without the use of the model.



Empty hundred grids and decimal equivalents. Percentage equivalents can also be extracted from this image.

# Acknowledgements

Some information and images in this document have been taken from:

'The National Strategies Primary: Teaching Children to Calculate Mentally'  
Crown Copyright 2010, Published by the Department for Education  
[www.standards.dcsf.gov.uk](http://www.standards.dcsf.gov.uk)

'Models and Images for Understanding Multiplication and Division'  
PDF file, **Ref: DfES 0508-2003 G(5)**  
[www.edu.dudley.gov.uk/numeracy/planning/understandingxanddivision.pdf](http://www.edu.dudley.gov.uk/numeracy/planning/understandingxanddivision.pdf)