

Girnhill Infant School

Mental Calculation

Policy for

Mathematics



Mental Calculation

Calculating mentally may involve children 'seeing' objects, images or quantities that help them manage the process.

A feature of mental calculation is that it often can be worked out in different ways.

Teaching Mental Calculation Strategies

Children will not be able to visualise how something works if they have not had any practical experiences. We need to provide suitable equipment for children to manipulate and explore how and why a calculation strategy works.

Flexibility in Calculation

Children need to be able to do the following:

- Build up knowledge of number facts
- Build up skill in counting
- Build up the use of reasoning inferences based on knowledge of numbers and the structure of the number system.

Selecting an appropriate method

It is important for children to be able to choose how they work out a calculation. It is not always necessary for children to write and record their mathematics. In some situations it may be simpler and more beneficial to work out mentally. Below are questions that children should be taught and encouraged to ask themselves when faced with a calculation:

- Do I know the answer?
- Can I work it out in my head?
- Do I need to use a jotting?
- Do I need to use a written method?

Mental Calculation with different operations

In developing a progression through mental calculation strategies for addition, subtraction, multiplication and division, it is important that children understand the relevant concepts.

Addition is :

- combining two or more groups to give a total or sum
- increasing an amount

Subtraction is :

- removal of an amount from a larger group (take away)
- comparison of two amounts (difference)

They also need to understand and work with certain principles, that :

- addition and subtraction are inverses
- addition is commutative i.e. $5 + 2 = 2 + 5$ but subtraction is not $5 - 2$ is not the same as $2 - 5$
- addition is associative i.e. $5 + 2 + 4 = 5 + (2 + 4)$ but subtraction is not $9 - 3 - 1$ is not the same as $9 - (3 - 1)$

Multiplication is :

- Repeated Addition

Division is :

- Repeated Subtraction

They also need to understand and work with certain principles that :

- Multiplication and division are inverses

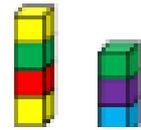
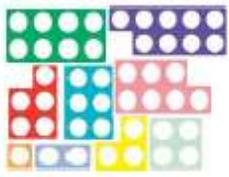
- Multiplication is commutative e.g. $3 \times 4 = 12$ and $4 \times 3 = 12$ but division is not e.g. $12 \div 4 \neq 4 \div 12$

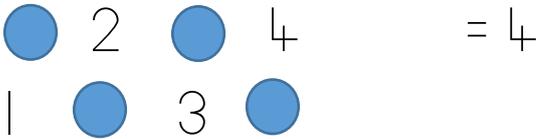
Addition – EYFS

Early Learning Goal:

Using quantities and objects, children add and subtract two single digit numbers and count on or back to find the answer.

Example Equipment:



Mental Calculation Skills	Examples	Pre-requisite skills
Count All	How many counters are here? 	
Count On	$4 + 2 = ?$ 	Knowing values of amounts e.g. recognising the 4 piece of numicon is 4 without touch counting the holes.

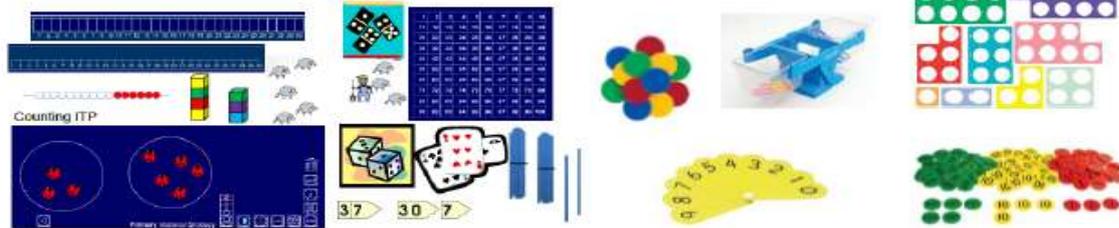
Addition - Year One

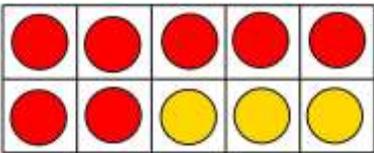
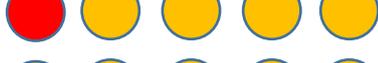
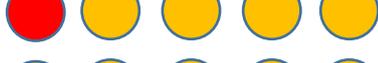
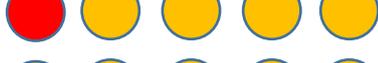
End of Year Objective

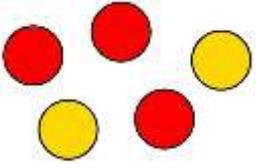
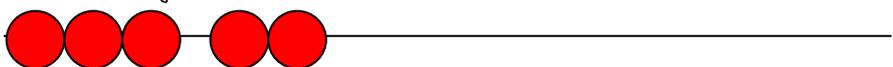
Add and subtract one-digit and two-digit numbers to 20, including zero.

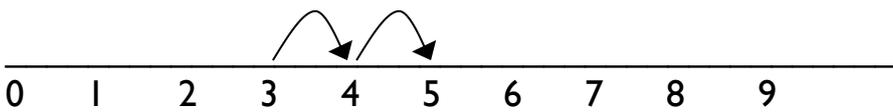
Example Equipment:

Practical equipment, models and images to support children with mental addition:



Mental Calculation Skills	Examples	Pre-requisite skills												
<p>Represent and use number bonds and related subtraction facts within 20</p>	<p>Ten Frames:</p>  <p>Double Sided Counters:</p> <table style="border: none;"> <tr> <td></td> <td>= 5 + 0</td> </tr> <tr> <td></td> <td>= 4 + 1</td> </tr> <tr> <td></td> <td>= 3 + 2</td> </tr> <tr> <td></td> <td>= 2 + 3</td> </tr> <tr> <td></td> <td>= 1 + 4</td> </tr> <tr> <td></td> <td>= 0 + 5</td> </tr> </table> <p>(Same can be done with two colours of unifix)</p> <p>Using and Applying:</p>		= 5 + 0		= 4 + 1		= 3 + 2		= 2 + 3		= 1 + 4		= 0 + 5	<p>Understanding 3ness of 3 etc Beginning to see patterns</p>
	= 5 + 0													
	= 4 + 1													
	= 3 + 2													
	= 2 + 3													
	= 1 + 4													
	= 0 + 5													

	<ul style="list-style-type: none"> • What is $5 + 4$? How can this help with $15 + 4$? Or $25 + 4$? • What do you do to 6 to make 10? How will this help with that to do with 16 to make 20? 																																									
<p>Counting on or back in ones</p>	<p>$4 + 5$ - count on in ones from 4 (or in ones from 5)</p> <p>$8 - 3$ - count back in ones from 8</p> <p>$10 + 7$ - count on in ones from 10 (or use place value)</p> <p>$13 + 5$ - count on in ones from 13</p> <p>$17 - 3$ - count back in ones from 17</p>	<p>Count forwards and Backwards in ones</p> <p>Count in one to one correspondence</p>																																								
<p>Add a pair of single digit numbers/ single digit number and teen number</p>	<p style="text-align: center;">  Counters </p> <p>Beadstrings:</p> <p style="text-align: center;">  </p> <p>Number Tracks:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></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> <td>10</td> </tr> </table> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></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> <td>10</td> </tr> </table> <p>Numberline:</p>											1	2	3	4	5	6	7	8	9	10											1	2	3	4	5	6	7	8	9	10	<p>Understand amounts, symbols and words</p> <p>Have an understanding of number bonds to 20.</p> <p>Place Value - identifying largest number</p>
																																										
1	2	3	4	5	6	7	8	9	10																																	
																																										
1	2	3	4	5	6	7	8	9	10																																	

$+1$ $+1$


Using and Applying:

- If $3 + 2 = 5$, what else do you know?
(e.g. $13 + 2 = 15$, or $30 + 20 = 50$ etc)

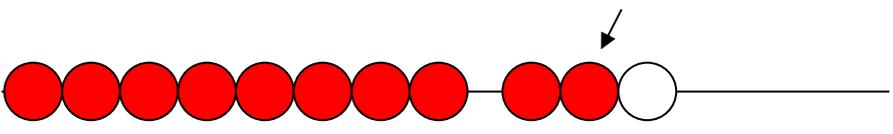
to count on
from

Add a pair of single digit numbers/ single digit number and teen number (partitioning small numbers)

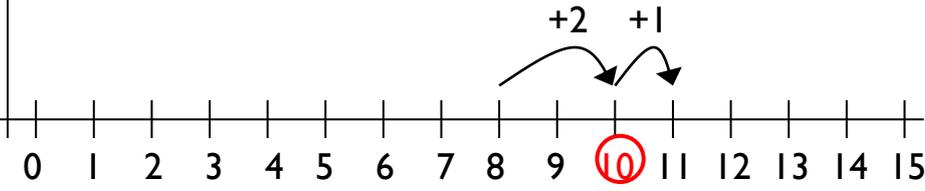
Ten Frame: $8 + 3 = 11$

Beadstrings: $8 + 3 = 11$ 3 partitions into 2 and 1



Numberline: $8 + 3 = 11$

$+2$ $+1$


Knowledge and understanding of number bonds.
Understanding of partitioning.

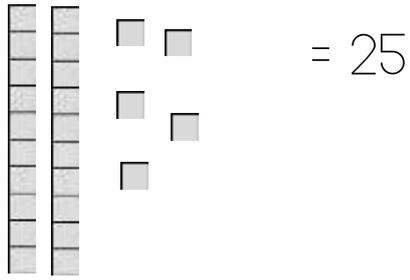
Using and Applying:

Being able to visualise and understand that

$$8 + 5 = (8+2) + 3 = 10 + 3 = 13$$

Add a single digit number to ten or to a multiple of 10

Base 10: $20 + 5$

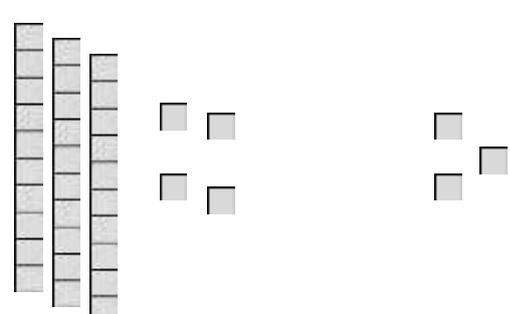
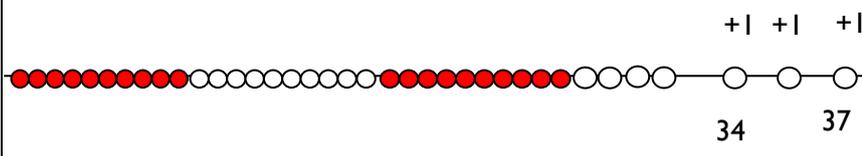


Arrow Cards: $20 + 5$

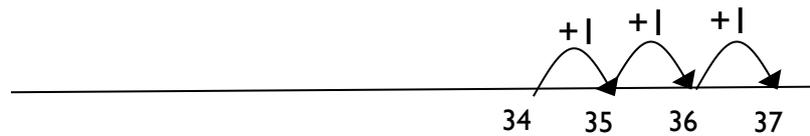


Know and use addition facts.
Place Value – understand what each digit means in a two digit number (tens, ones)

	<p>$78 - 42$ 78 take away 40 and 2 = 78 take away 40 take away 2</p> <p>$80 - 35$ 80 take away 30 and 5 = 80 take away 30 take away 5</p>	<p>backwards in ones and tens.</p> <p>Understand place value, understand which digit represents tens and ones</p> <p>Partition numbers into tens and ones</p>
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<p>Add a two digit number and ones</p>	<p>$34 + 3 = 37$ (shown using Base 10 equipment)</p>  <p>$34 + 3 = 37$ (shown using a beadstring)</p> 	<p>Count using one to one correspondence</p> <p>Count forwards and backwards in ones and tens.</p> <p>Understand place value, understand which digit represents tens and ones</p>
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$34 + 3 = 37$ (shown using a numberline)



Partition numbers into tens and ones

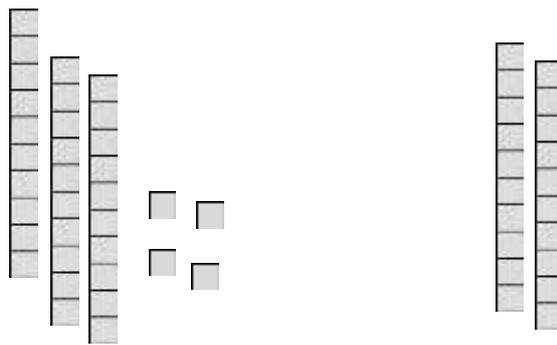
Add a 2 digit number and tens

$34 + 20 = 54$ (shown using Base 10 equipment)

Children could use Base 10 equipment to calculate this as:

$$30 + 20 = 50$$

$$50 + 4 = 54$$



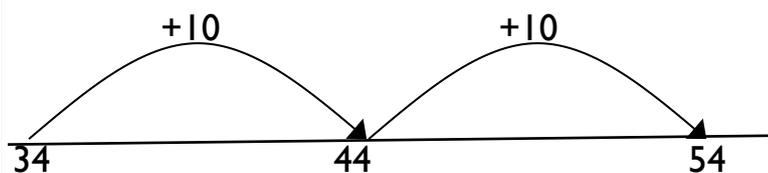
$$34 + 20 = 54$$

Children could use a beadstring to calculate this as:

$$34 + 10 = 44$$

$$44 + 10 = 54$$

$34 + 20 = 54$ (shown using a numberline)



Count forwards and backwards in ones and tens. Understand place value, understand which digit represents tens and ones
Partition numbers into tens and ones

Add two 2
digit
numbers

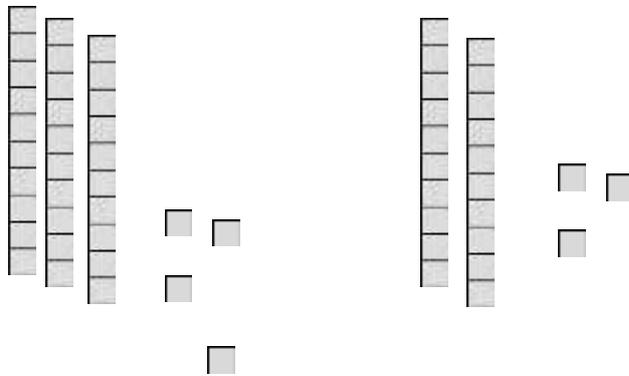
$34 + 23 = 57$ (shown using Base 10 equipment to partition both numbers)

Children could use Base 10 equipment to calculate this as:

$$30 + 20 = 50$$

$$4 + 3 = 7$$

$$50 + 7 = 57$$



$$34 + 23 = 57$$

Children could use a beadstring to calculate this as:

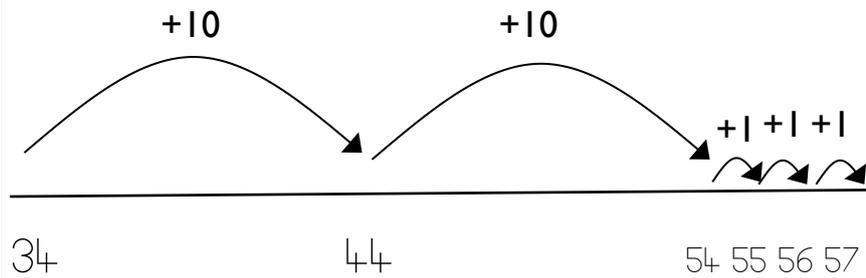
$$34 + 10 = 44$$

$$44 + 10 = 54$$

$$54 + 3 = 57$$

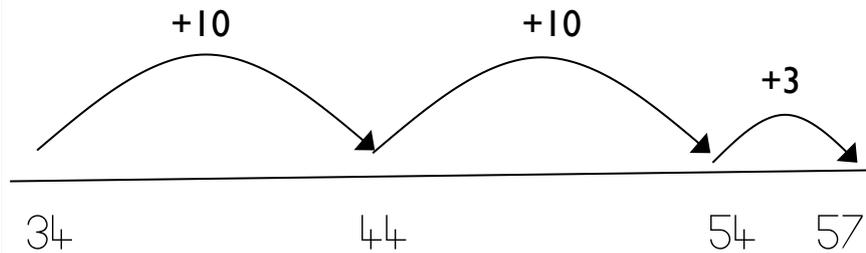
Count forwards and backwards in ones and tens. Understand place value, understand which digit represents tens and ones. Partition numbers into tens and ones.

$34 + 23 = 57$ (shown using a numberline to keep the first number the same and just partition the second)



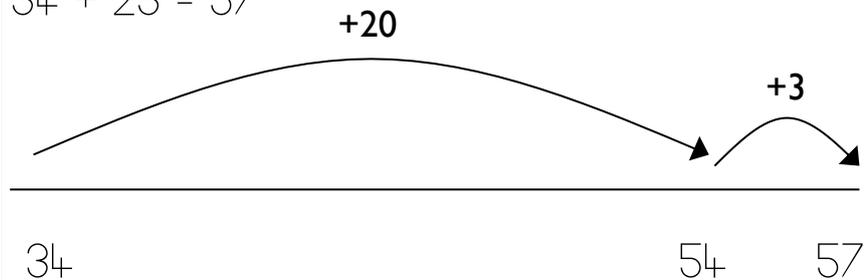
Encourage children to become more efficient by adding the units in one jump (by using the known fact $4 + 3 = 7$).

$$34 + 23 = 57$$



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

$$34 + 23 = 57$$

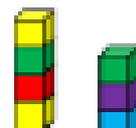


Subtraction - EYFS

Early Learning Goal:

Using quantities and objects, children add and subtract two single digit numbers and count on or back to find the answer.

Example Equipment:



Mental Calculation Skills

Examples

Pre-requisite skills

Taking Away

Take amount away. Count how many are left

$$4 - 2 =$$



1 2

Knowing values of amounts e.g. recognising that 4 counters/4 numicon is worth 4 without touch counting the holes.

Counting Back

Counting back is a very abstract concept for young children so this stage may not be met until Year 1.

$$6 - 2$$



5 4

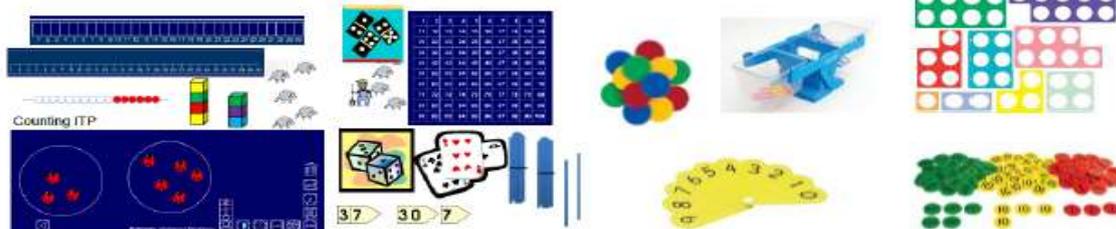
Ability to count forwards and backwards in ones

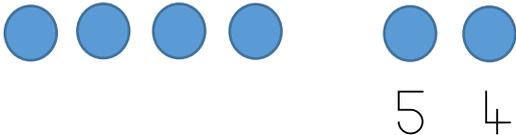
Subtraction - Y1

End of Year Objective: Add and subtract one-digit and two-digit numbers to 20, including zero.

Example Equipment:

Practical equipment, models and images to support children with mental addition:

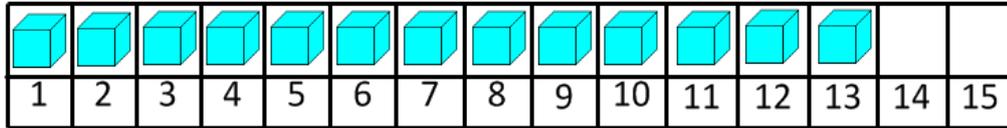


Mental Calculation Skills	Examples	Pre-requisite skills
Counting Back	<p>Counting back is a very abstract concept for young children so this stage may not be met until Year 1.</p> $6 - 2$ 	Ability to count forwards and backwards in ones
Subtracting a one digit number from a	$13 - 5 = 8$ <p>Touch count and remove the number to be taken away, in this case 5.</p>  <p>Beadstring stage 1</p> <p>Touch count to find the number that remains.</p>	Ability to count forwards and backwards in ones.

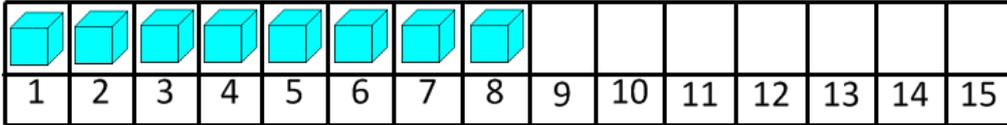
two digit
number



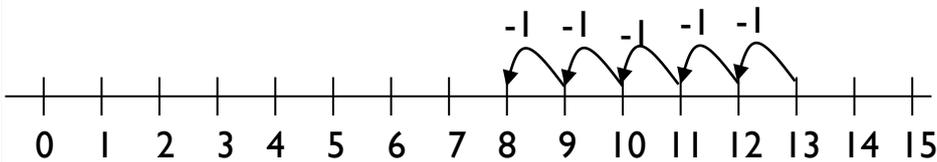
Beadstring stage 2



Number track stage 1



Number track stage 2



Examples of Calculations

$8 + 3$ - doesn't need reordering as the greater number is first already

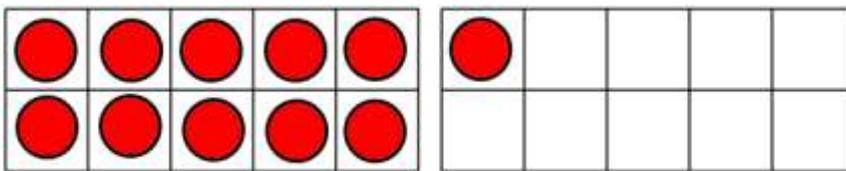
$2 + 7$ - reorder as $7 + 2$

$5 + 13$ - reorder as $13 + 5$

$11 + 6$ - doesn't need reordering as the greater number is first already

Subtracting
using
knowledge
of

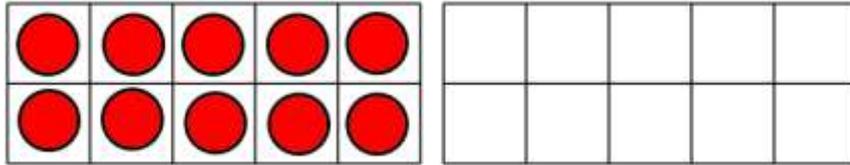
$$11 - 3 = 8$$



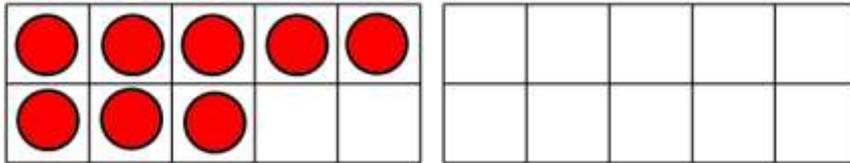
Ten frame stage 1

Partition
numbers in
different
ways, e.g.
 5 as $2 +$

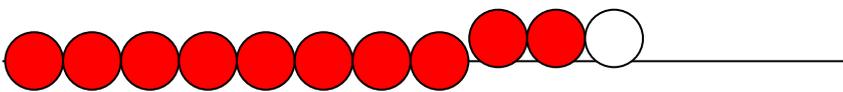
partitioning numbers.



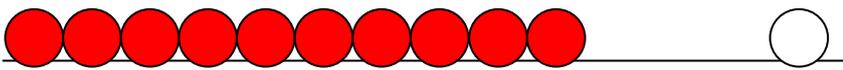
Ten frame stage 2 (take away 1)



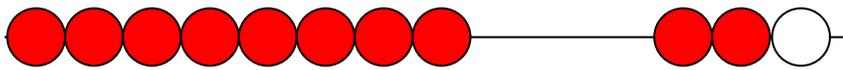
Ten frame stage 3 (take away 2)



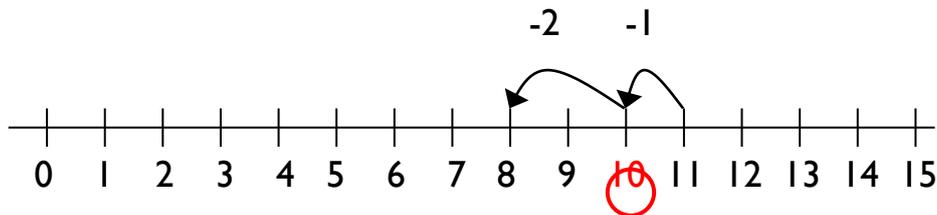
Beadstring stage 1



Beadstring stage 2 (take away 1)



Beadstring stage 3 (take away 2)



Examples of calculations:

$7 + 5$ partitioned as $7 + 3 + 2$

$9 + 7$ partitioned as $9 + 1 + 6$

$6 + 8$ partitioned as $6 + 4 + 4$

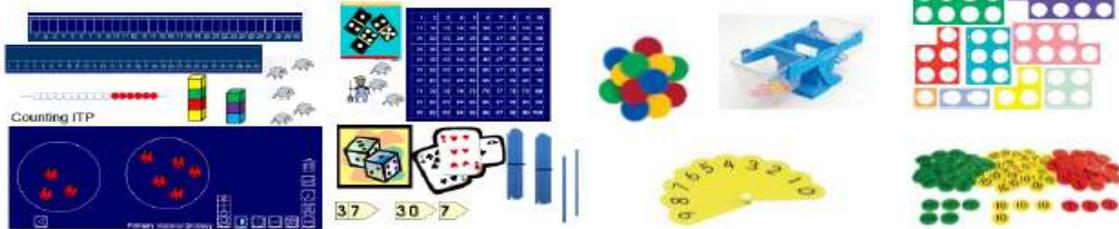
3 to enable $8 + 5$ as $8 + 2 + 3$
Know, or quickly derive, number bonds for numbers up to and including 10.

Subtraction - Y2

End of Year Objective: Add and subtract numbers mentally, including: a two-digit number and ones; a two-digit number and tens; two two-digit numbers; three one-digit numbers.

Example Equipment:

Practical equipment, models and images to support children with mental addition:



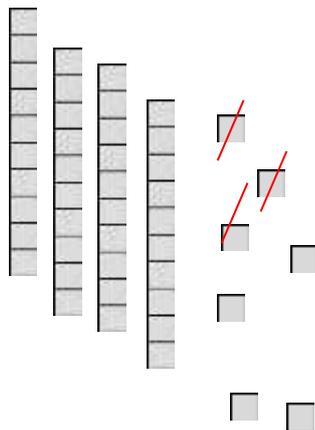
Mental Calculation Skills

Examples

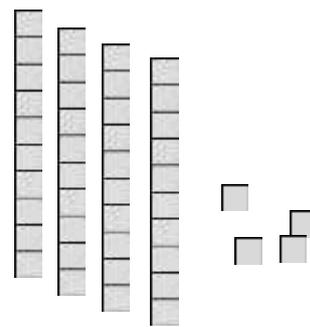
Pre-requisite skills

Subtracting a one digit number from a two digit number

$47 - 3 = 44$ (shown using Base 10 equipment)

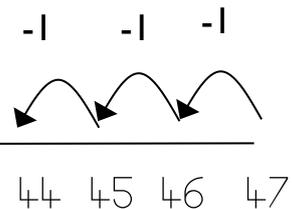


which leaves



so $47 - 3 = 44$

$47 - 3 = 44$ (shown using a numberline)



Counting backwards in ones. Know place value - tens and ones.

Subtracting
a two digit
number
that is a
multiple of
ten from a
two digit
number

$47 - 20 = 27$ (shown using Base 10 equipment)



so $47 - 20 = 27$

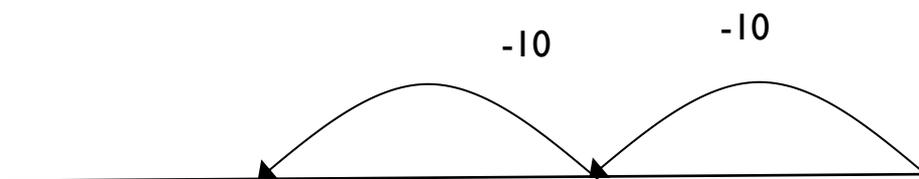
$47 - 20 = 27$ (using a beadstring)

Children could use a beadstring to calculate this as:

$47 - 10 = 37$

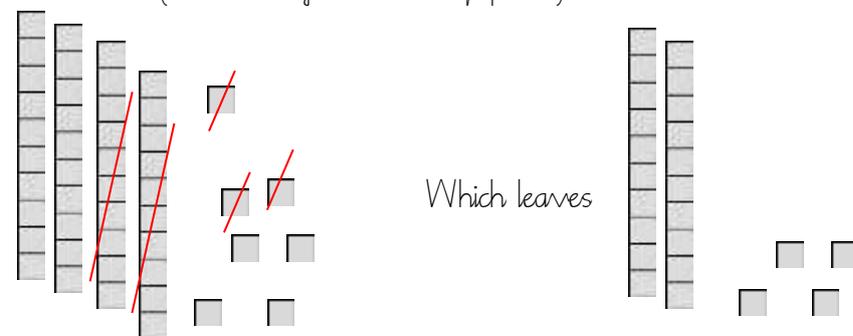
$37 - 10 = 27$

$47 - 20 = 27$ (shown using a numberline)



Subtracting
a two digit
number
and ones
from a

$47 - 23 = 24$ (shown using Base 10 equipment)



So $47 - 23 = 24$

Understand
partitioning
into tens
and ones.
Use known
number
facts.

two digit
number

$$47 - 23 = 24 \text{ (shown using a beadstring)}$$

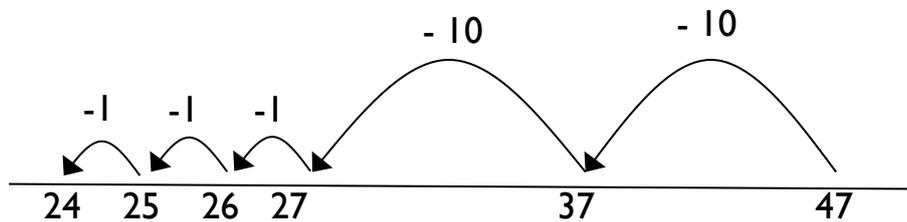
Children could use a beadstring to calculate this as:

$$47 - 10 = 37$$

$$37 - 10 = 27$$

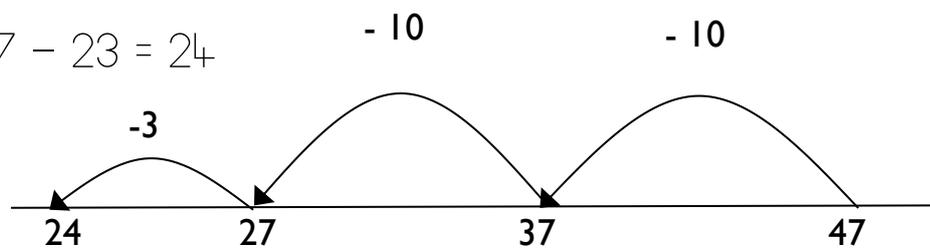
$$27 - 3 = 24$$

$$47 - 23 = 24 \text{ (shown using a numberline)}$$



Encourage children to become more efficient by subtracting the units in one jump (by using the known fact $7 - 3 = 4$).

$$47 - 23 = 24$$



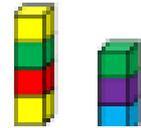
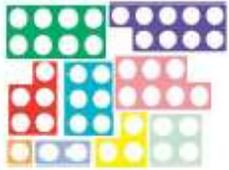
Count
backwards
in tens and
ones.

Multiplication – EYFS

Early Learning Goal:

Solve problems including doubling, halving and sharing.

Example Equipment:



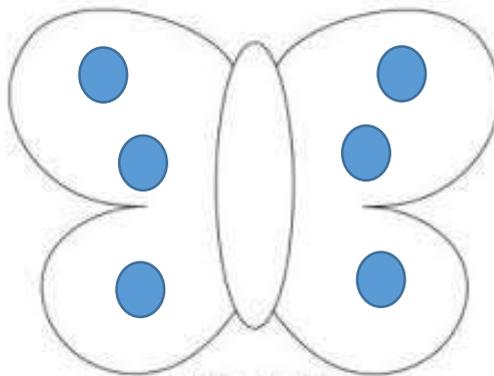
Mental Calculation Skills

Examples

Pre-requisite skills

Doubling

Practical examples of doubling – replicating same on both sides etc.



Language of the same.

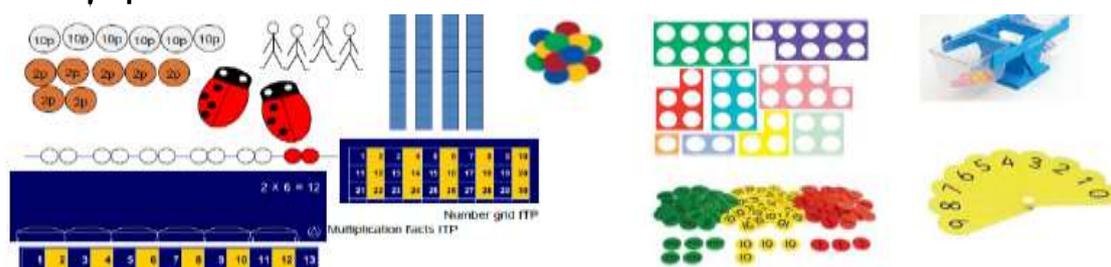
Basic understanding of equivalence.

Multiplication - Year 1

End of Year Objective:

To solve one step problems involving multiplication and division by calculating the answer using concrete objects, pictorial representations and arrays.

Example Equipment:



Mental Calculation Skills

Examples

Pre-requisite skills

Counting on in ones, twos, fives and tens.

- Count on in ones from any number to 100.
-If you count in twos from 0, what will be the first six numbers?
- I'm putting 10p coins into this piggy bank. Count in tens to check how much money is going in.
- Count the number of eyes in this class.

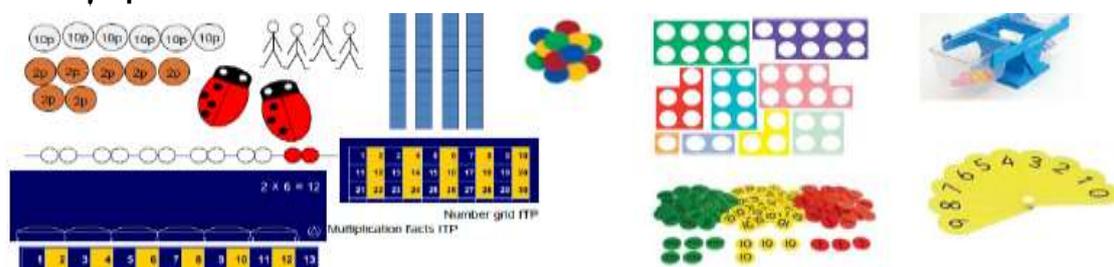
Understanding of 2's, 5's and 10's (pattern, what numbers end in etc)

Multiplication - Year 2

End of Year Objectives:

To solve one step problems involving multiplication and division by calculating the answer using concrete objects, pictorial representations, calculating mentally and arrays.

Example Equipment:



Mental Calculation Skills

Examples

Pre-requisite skills

Double any multiple of 10 up to 100.

Double 15

- $30 + 30 =$
- Explain how you could work out double 45.
- Twice 25 is...
- 40 multiplied by 2 equals...

Double single digit numbers.
 Double multiples of 10.
 Partition two-digit numbers into T and U and recombine T and U (by adding components).
 Understand that doubling is adding the same number to itself.
 Understand that doubling is multiplying by 2.

Find the total number of objects when they are organised in groups of 2, 5 or 10.

- What is the total of six groups of 5?
- How many fingers do these 4 children have? How did you work it out?
- What is the total of this tally?
IIII IIII IIII IIII
- How else could you write $10 + 10 + 10 + 10$?

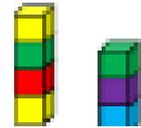
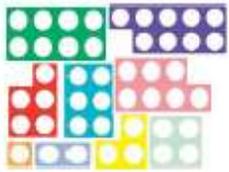
Count on from zero in twos, fives and tens. Relate 'groups of' to repeated addition. Understand that the last number said in the count is the total of the group. Learn and apply $2\times$ table, $10\times$ table and $5\times$ table. Understand and use commutativity (multiplication can be done in any order). Use estimation to predict and check answers.

Division – EYFS

Early Learning Goal:

Solve problems including doubling, halving and sharing.

Example Equipment:



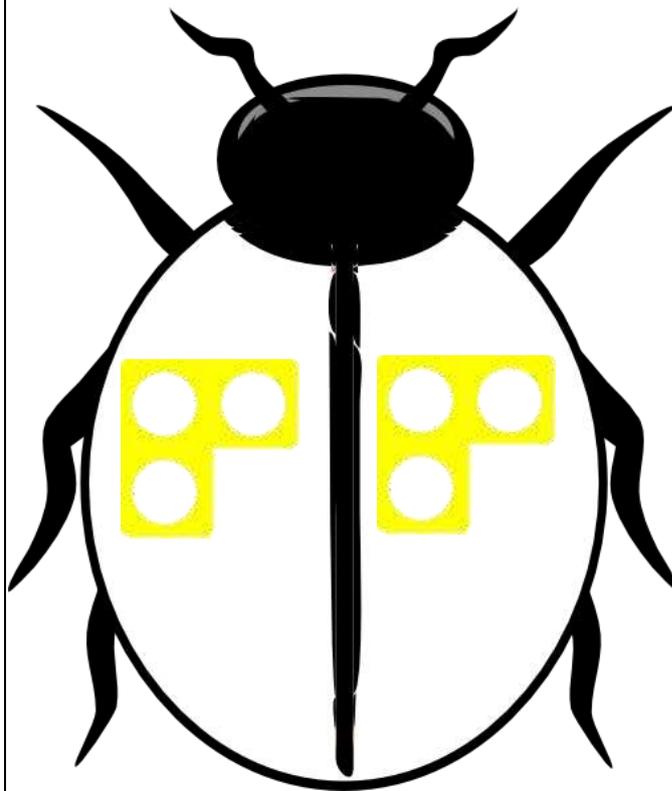
Mental
Calculation Skills

Examples

Pre-requisite skills

Halving

Practical examples of halving –



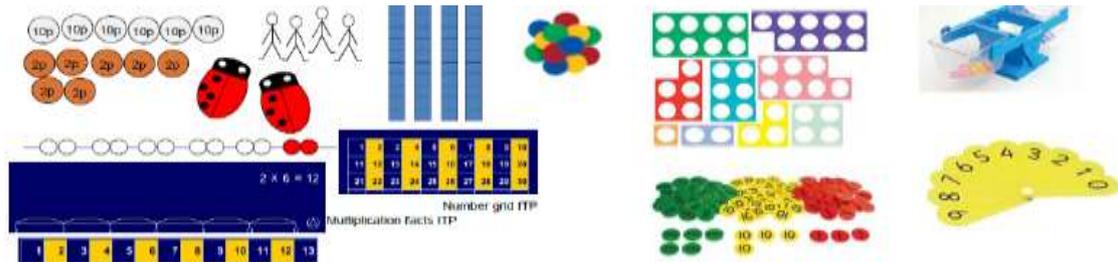
Understanding of
equivalence and
Equal groups
Halving means
splitting down the
middle.

Division - Year 1

End of Year Objectives:

To solve one step problems involving multiplication and division by calculating the answer using concrete objects, pictorial representations and arrays.

Example Equipment:



Mental Calculation Skills

Examples

Pre-requisite skills

Counting back in ones, twos, fives and tens.

Count back in ones from 14 to 0.

- Now try counting back in twos from 14 to 0. How many numbers did you say?
- Count back in tens from 90 to 0.

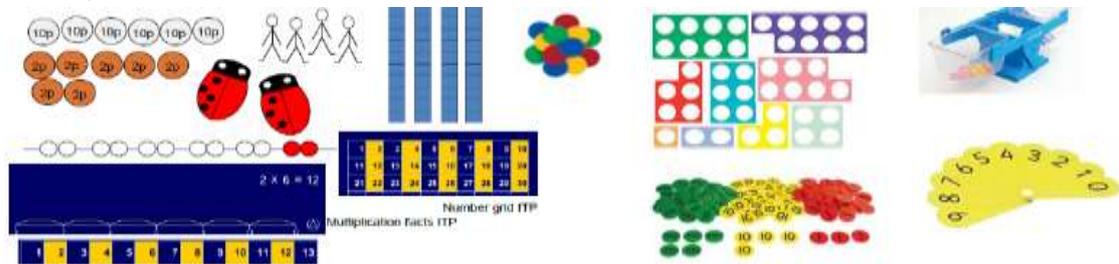
Begin to understand the link between division and repeated subtraction
Cross tens boundaries when counting in ones and twos by understanding the base 10 number system.
Understand the amounts the symbols and words represent.

Division - Year 2

End of Year Objective:

To solve one step problems involving multiplication and division by calculating the answer using concrete objects, pictorial representations, mental calculations and arrays.

Example Equipment:



Mental Calculation Skills	Examples	Pre-requisite skills
Halve any multiple of 10 up to 100, where the answer is even	$40 \div 2$ Use these bundles of straws to help you halve 90.	Know multiples of 10. Halve even numbers to 20. Understand that halving is dividing by 2 and half as one of two equal parts. Understand and use knowledge of base 10 number system to relate $8 \div 2$ to $80 \div 2$.
Find half of even numbers up to 40.	Halve 24 $32 \div 2$ $?? \times 2 = 20$ $28 = ?? \times 2$	As above plus: Know even numbers. Partition numbers in different ways e.g. when

		finding half of 36 partitioning 36 into 20 + 16.
Use times table facts to divide even numbers by 2, 5 or 10.	$18 \div 2$ $45 \div 5$ $60 \div 10$	Know and use division facts related to the $2\times$ table, $5\times$ table and $10\times$ table.