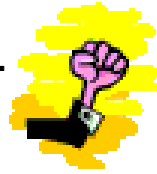


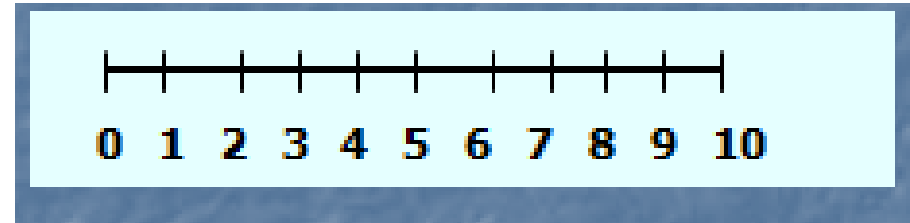
Methods of Calculation

Addition

1. **Practical** addition of real objects.

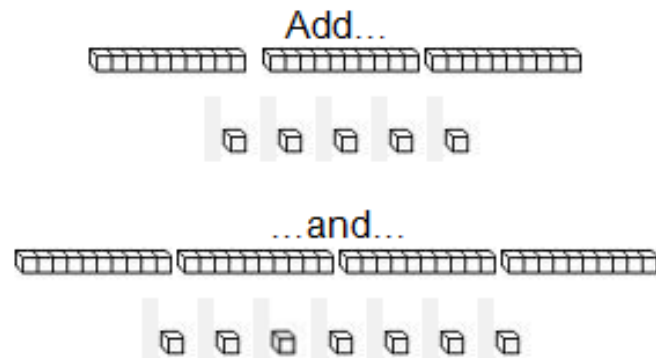


2. Use of a **structured number line** to add.



3. **Partitioning** to add.

$$123 = 100 + 20 + 3$$



By partitioning and recombining

$$30 + 40 = 70$$

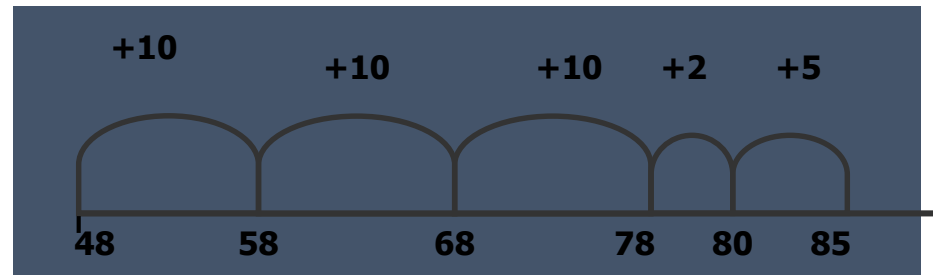
$$5 + 7 = 12$$

$$70 + 12 = 82$$

Addition Continued...

4. Use of an **unstructured number line**.

$$37 + 48 =$$



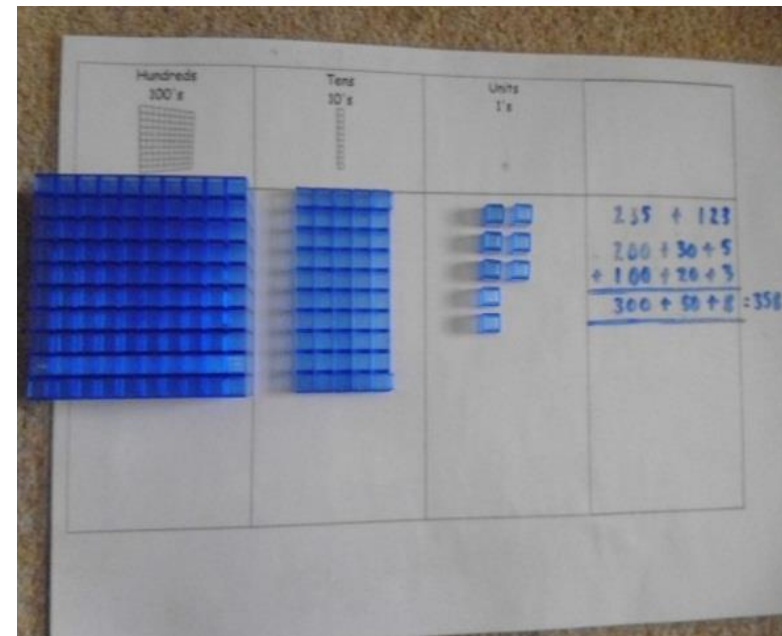
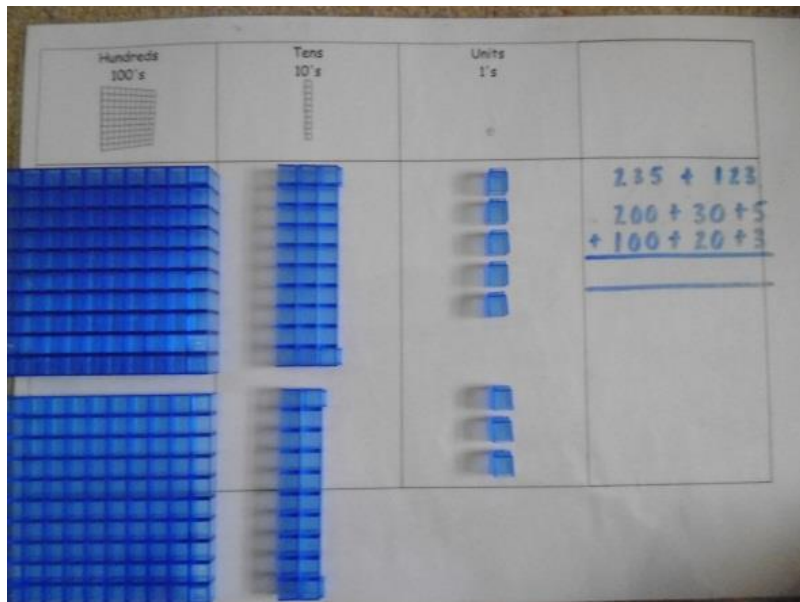
Addition Continued...

5. **Expanded horizontal method, leading to columnar addition:
Adding the least significant digit first.**

$$235 + 123 =$$

Estimate: $235 + 123$ is nearly $240 + 120$ so estimate answer should be near 360.

Illustration of how to use Dienes equipment to ensure children have an understanding of place value when using columnar addition.



Addition Continued...

6. Columnar addition (formal written method):

When children are confident working with larger numbers using the previous strategies, they will be introduced to 'carrying' digits. **2856+1095**

Estimate: 2900+1100 =4000 Answer should be less as I have rounded up.

$$\begin{array}{r} 47 \\ + 76 \\ \hline 123 \\ 11 \end{array} \quad \begin{array}{r} 368 \\ + 493 \\ \hline 861 \\ 11 \end{array} \quad \begin{array}{r} 2856 \\ + 1095 \\ \hline 3951 \\ 11 \end{array}$$

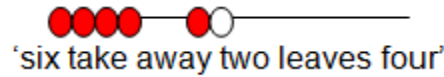
These methods will also be used for larger numbers and decimal calculations

Subtraction

1. Subtraction as taking away from a group:



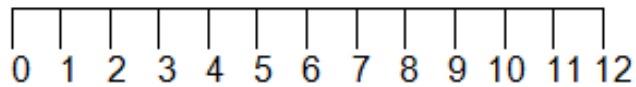
$$\begin{array}{c} \bullet \bullet \bullet \blacktriangleleft \blacktriangleleft \\ 5 - 2 = 3 \end{array}$$



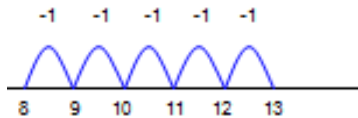
'one less than six is five'

2. Subtracting by counting back and on: children begin to use numbered lines to support their own calculations, initially counting back in ones before beginning to work more efficiently.

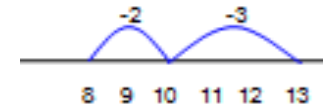
Number line with all numbers labelled



$$13 - 5 = 8$$

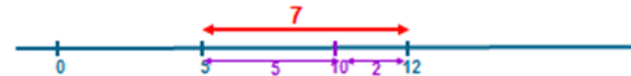


$$13 - 5 = 8$$



3. Finding the difference by either counting on or back.

Finding the difference on a number line.



Comparing two sets: comparison or difference.



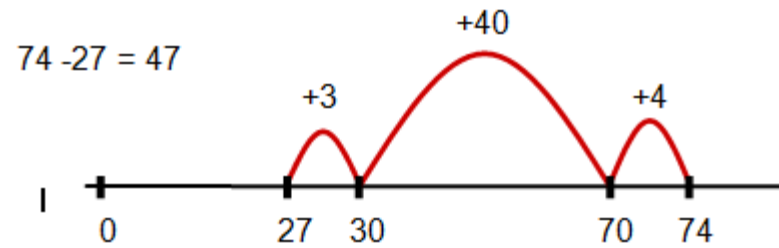
Note: Finding the difference is often the most efficient way of solving a subtraction problem,

e.g. $61 - 59$

$2,003 - 1,997$

Subtraction Continued...

4. **Subtracting TU – U and TU – TU:** use of an **unstructured number line**.
Use empty number lines to find the difference by bridging through multiples of ten.



Subtract by starting with the first number and partitioning the second, i.e.

$$74 - 27$$

$$74 - 20 = 54$$

$$54 - 4 = 50$$

$$50 - 3 = 47$$

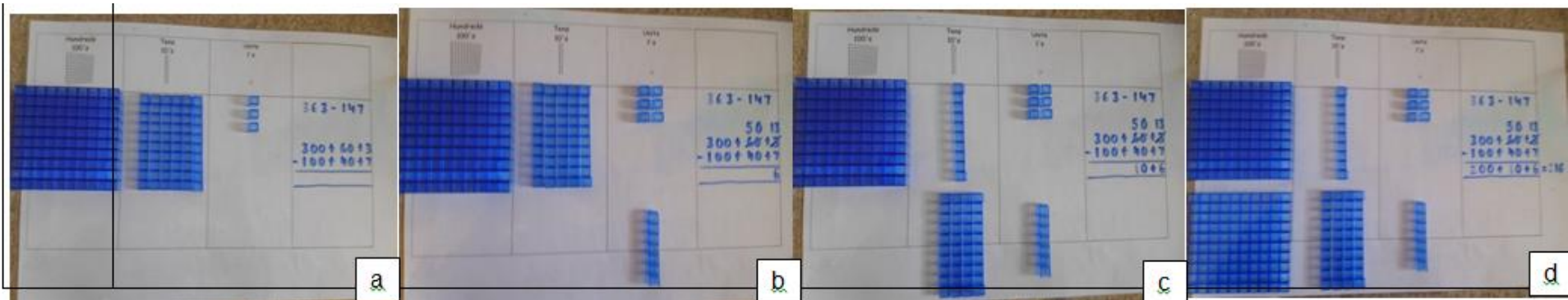
Subtraction Continued...

5. First stage of column method, including expanded method:

- Written recording should follow teacher modelling around the size of numbers and place value using a variety of concrete materials, e.g. straws, Numicon, Dienes and place-value cards.

$$\begin{array}{r} 363 - 147 = 216 \\ \quad 50 \quad 13 \\ \underline{300 + 60 + 3} \\ \underline{100 + 40 + 7} \\ 200 + 10 + 6 = 216 \end{array}$$

Illustration of how to use Dienes equipment to ensure children understand transference of numbers when using columnar subtraction.



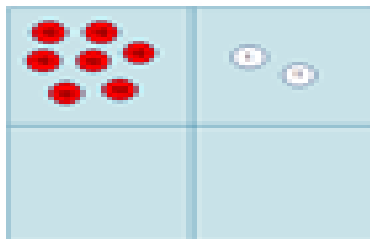
Subtraction Continued...

6. **Second stage of column method:** the concept of exchange is introduced through continued use of practical equipment (manipulatives).

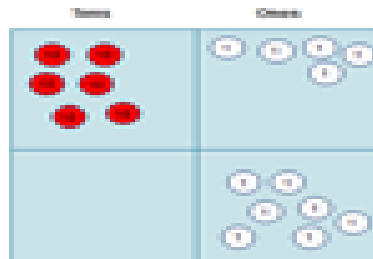
Children will eventually move on to subtracting larger numbers as well as decimal numbers.

Formal columnar:

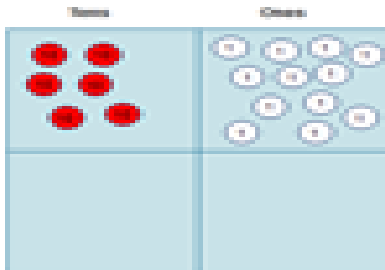
$$\begin{array}{r} 72 \\ - 47 \\ \hline \end{array}$$



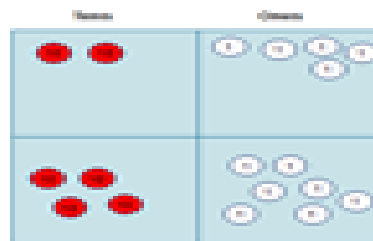
$$\begin{array}{r} \cancel{7}2 \\ - 47 \\ \hline 5 \end{array}$$



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



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

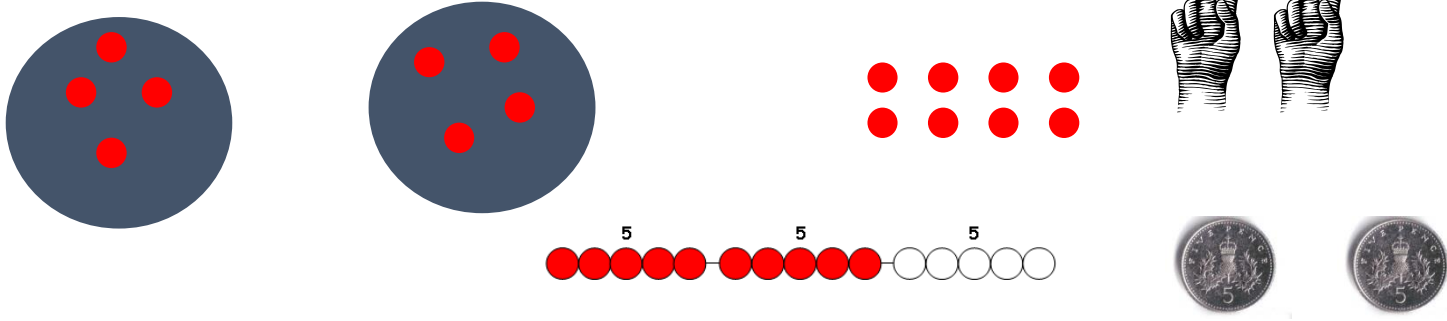


$$\begin{array}{r} 4 \quad 12 \quad 1 \\ 533 \\ - 187 \\ \hline 346 \end{array}$$

The aim is for all children to reach this stage.

Multiplication

1. Developing early conceptual understanding of multiplication: practical multiplication - 2×4 2 lots of 4.

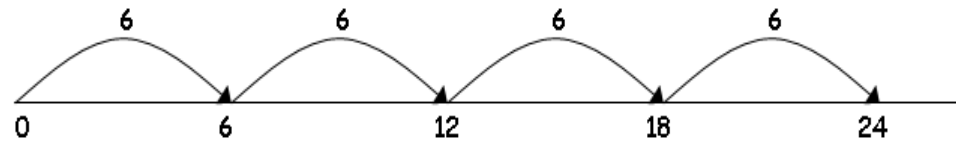


2. Understanding multiplication as repeated addition: use of arrays and number lines. 4×5



Number lines:

$$6 \times 4 = 24$$



So: 'Six taken four times'

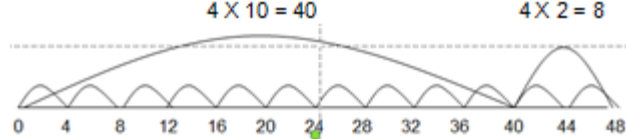


Multiplication continued...

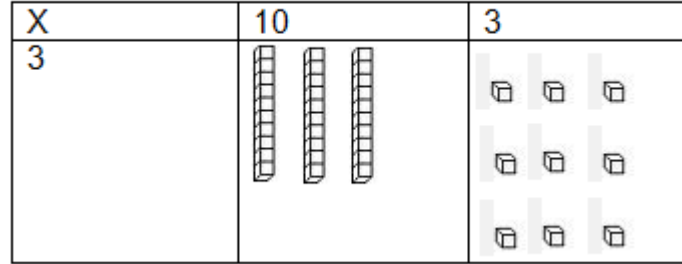
3. Relate multiplying a 2-digit by 1-digit number using repeated addition and arrays to represent

Children use an empty number line to chunk efficiently:

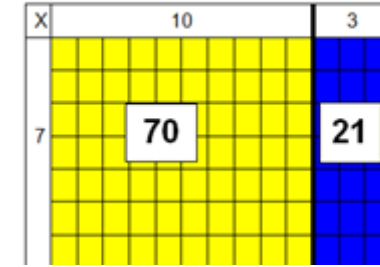
$$4 \times 12 = 48$$



$$3 \times 13 = 39$$

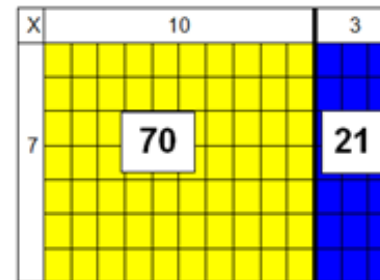


$$7 \times 13 = 91$$



4. Relate multiplying a 3/2-digit by 1-digit number with arrays towards using long/short multiplication

Relate multiplying a 3/2-digit by 1-digit number, now also setting it out as short multiplication.



$$7 \times 13 = 91$$

$$7 \times 10 = 70$$

$$7 \times 3 = 21$$

$$= 91$$

Multiplication continued...

5. Relate multiplying a 4/3/2-digit by 1/2-digit number with grid to using long multiplication.

	10	8
10	100	80
3	30	24

$$\begin{array}{r} 18 \\ \times 13 \\ \hline 24 \\ 30 \\ 80 \\ \hline 100 \\ \hline 234 \end{array}$$

6. Relate multiplying a 4/3/2-digit by 1/2-digit number with grid to using short multiplication.

	10	8
10	100	80
3	30	24

$$\begin{array}{r} 18 \\ \times 13 \\ \hline 54 \\ 2 \\ 180 \\ \hline 234 \end{array}$$

Children will eventually move on to multiplying larger numbers as well as decimal

Division

1. **Sharing or Grouping** – Division is initially represented pictorially.

$$6 \div 2 = 3$$

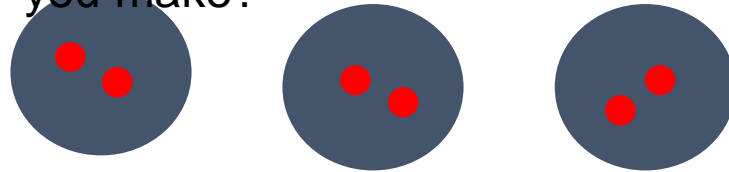


Sharing and grouping are two totally different concepts that children need to understand.

6 sweets **shared** between 2 people. How many each?



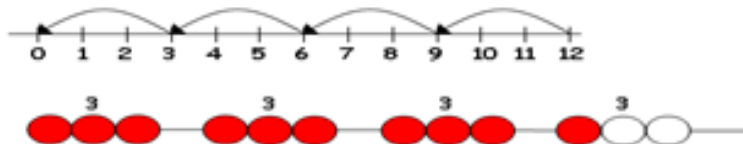
There are 6 people in a room. Put them into **groups** of 2. How many groups can you make?



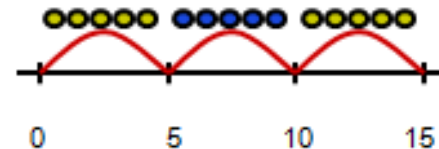
2. **Using a number line and arrays to show division.**

Number lines and arrays:

$$12 \div 3 = 4$$



$$15 \div 5 = 3$$

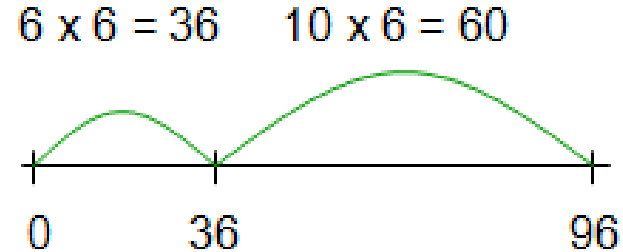


Division continued...

3. Dividing a 2-digit by 1-digit number, representing this efficiently on a number line.

Children use an empty number line to chunk efficiently.

$$96 \div 6 = 16$$

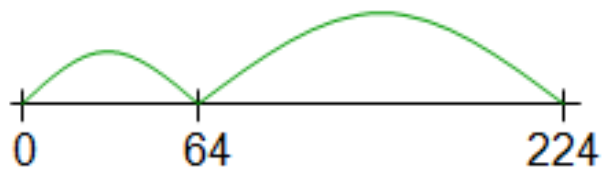


4. Dividing a 3/2-digit by 1-digit number, representing this efficiently on a number line, also in relation to long division

Children use an empty number line to chunk efficiently.

$$224 \div 8 = 28$$

$8 \times 8 = 64$ $20 \times 8 = 160$



$$\begin{array}{r} 28 \\ 8 \overline{) 224} \\ - 160 \quad (8 \times 20) \\ \hline 64 \\ - 64 \quad (8 \times 8) \\ \hline 0 \end{array}$$

...or...

$$\begin{array}{r} 28 \\ 8 \overline{) 224} \\ 20 \times 8 = 160 \\ \hline 64 \\ 8 \times 8 = 64 \\ \hline 0 \end{array}$$

Division continued...

5. Dividing a 4/3/2-digit by 1-digit number, in relation to long division.

Remainders should be interpreted in the following ways when long division is used:

- as whole numbers
- as fractions
- through rounding in an appropriate way to the context

Long division:

$$415 \div 9 = 46 \text{ and } 1/9$$

$$\begin{array}{r} 46 \text{ and } 1/9 \\ 9 \overline{) 415} \\ - 360 \quad (9 \times 40) \\ \hline 55 \\ - 54 \quad (9 \times 6) \\ \hline 1 \end{array}$$

Division continued...

6. Dividing a 4/3/2-digit by 2/1-digit number, in relation to long and then short division

Remainders should be interpreted in the following way when short division is used:

- through rounding in an appropriate way to the context

Long division:

$$432 \div 15 = 28 \frac{4}{5}$$

$$\begin{array}{r}
 28 \\
 15 \overline{) 432} \\
 \underline{30} \\
 132 \\
 \underline{120} \\
 12
 \end{array}$$

15×20

15×8

$$\frac{12}{15} = \frac{4}{5}$$

Answer: $28 \frac{4}{5}$

Short division:
 $138 \div 6 = 23$

