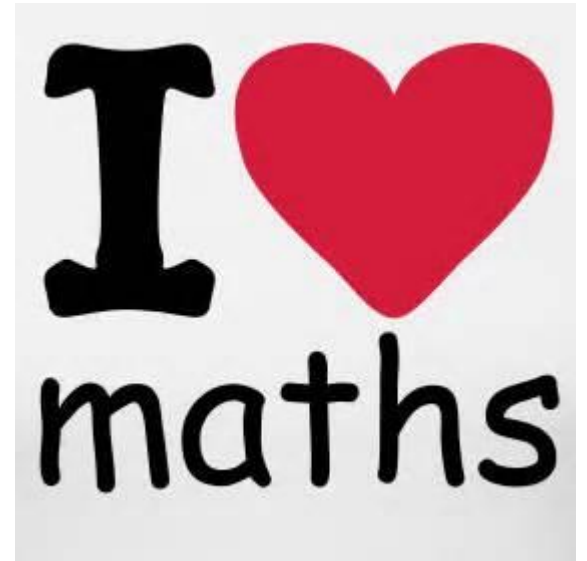# Frances Olive Anderson's calculation policy

24th November 2016

Kathryn Malone

Step 1 – Enactive (action based):

The success of an activity is based on whether it represents the maths in a way the child understands and is explored as a physical experience first:

- **Enactive definition:** internalised *action* with objects

    e.g. moving 3 cars and 2 cars beside each other

    creating/making arrays from counters/cubes/real life objects
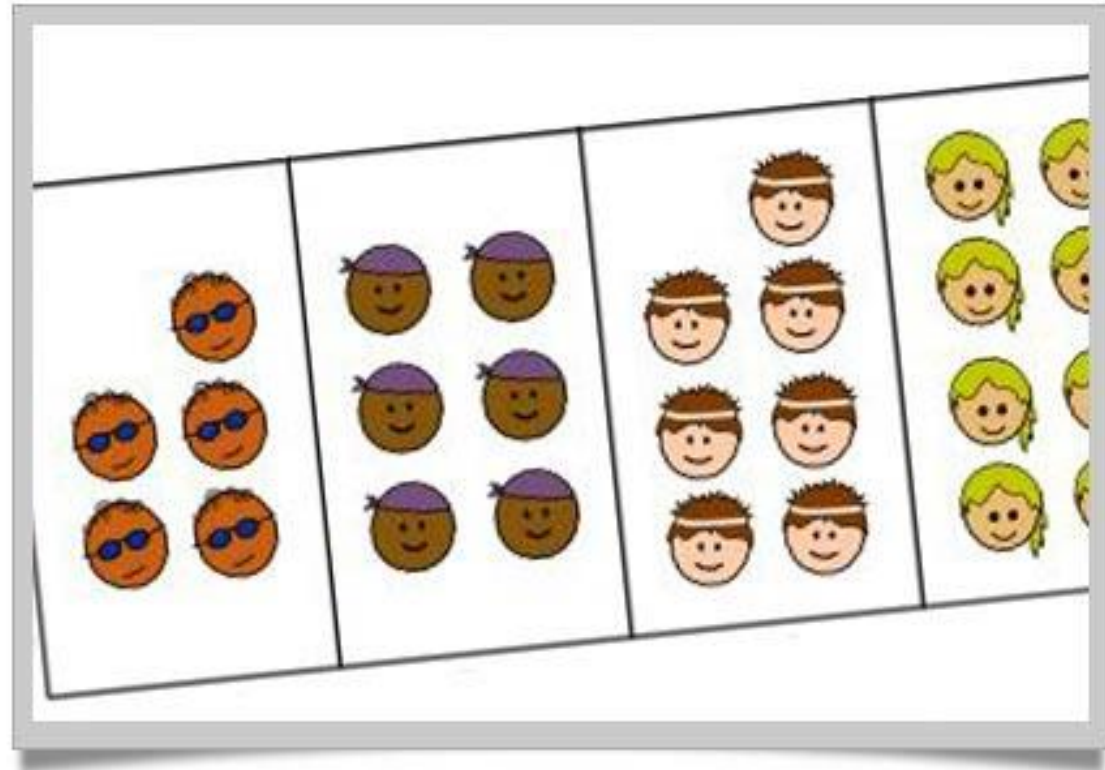
    physically halving/quartering objects

Step 2 – Iconic (image based):

The success of an activity is based on whether it represents the maths in a way the child understands and is linked to the experiences first explored physically:

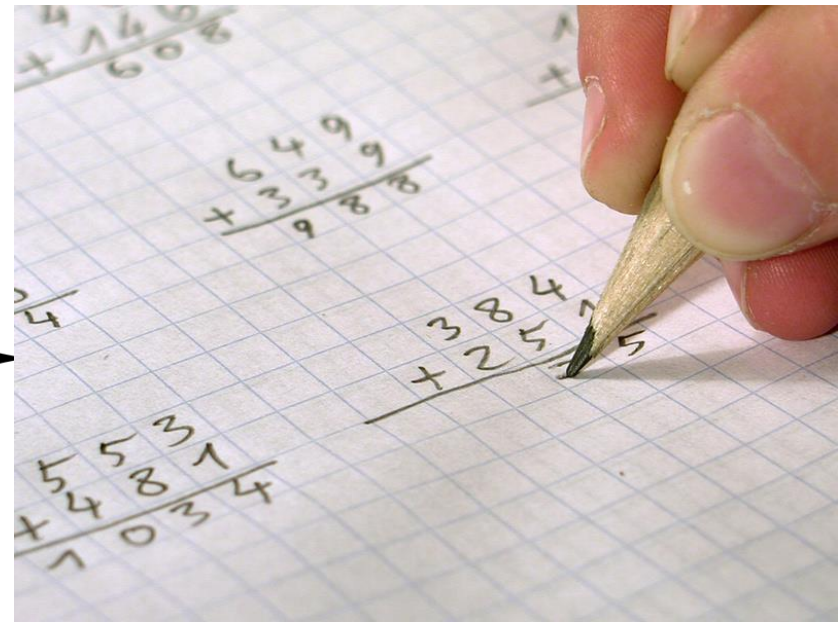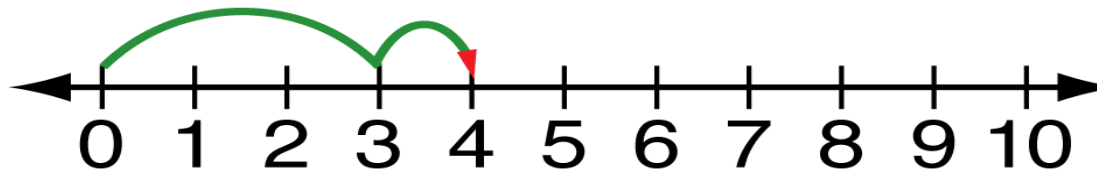- **Iconic definition:** sensory imagery or pictures/photographs
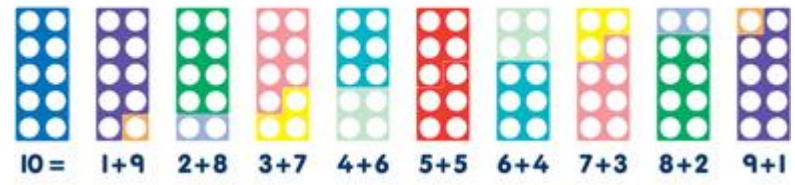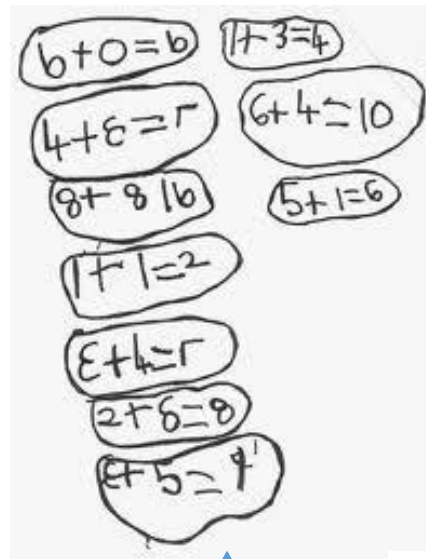
  e.g.

Step 3 – Symbolic (number/word based):

The success of an activity is based on whether the symbolic/arbitrary symbols have meaningful experiences and mental images attached to them and therefore make sense to the child:

- **Symbolic definition:** arbitrary (abstract) symbols
  e.g. 'three plus two' or '3 + 2'
      word problems
      + X - ÷ = <   >

$$3 + 1 = 4$$
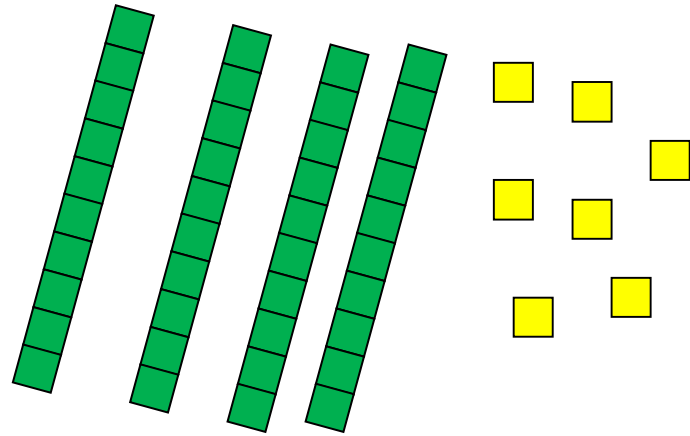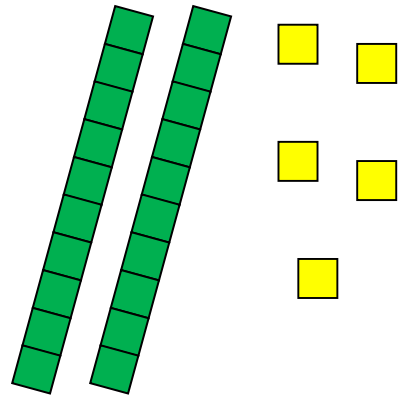
and
add
plus
makes
altogether
equals
pair

$6 + 0 = 6$ $1 + 3 = 4$

$4 + 6 = r$ $6 + 4 = 10$

$8 + 8 \, 16$ $5 + 1 = 6$

$1 + 1 = 2$

$\varepsilon + 4 = r$

$2 + 6 = 8$

$\varepsilon + 5 = 4$

10 =   1+9   2+8   3+7   4+6   5+5   6+4   7+3   8+2   9+1

Principle of exchange - grouping

The number we call 'ten' (10 in numerals) is the most important in our naming system because when we are counting collections, as soon as we have a group of ten we call them something else.
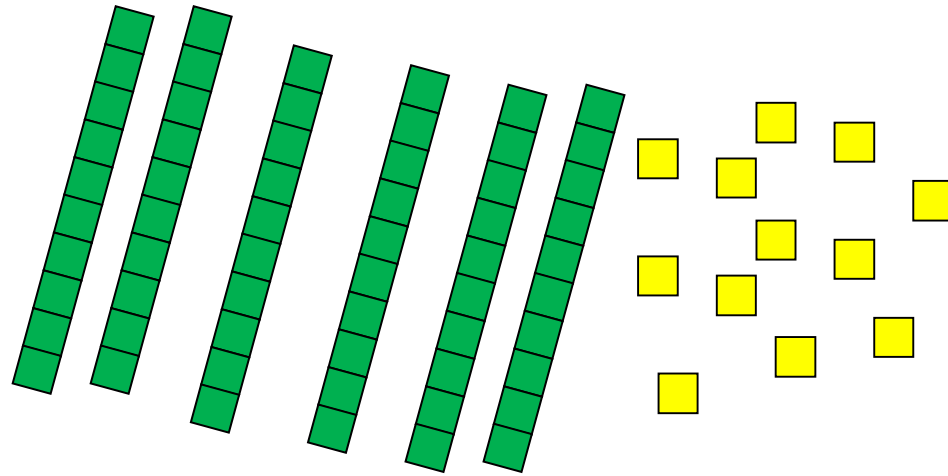
So

- ten *ones* are called one *ten*
- ten *tens* are called one *hundred*
- ten *hundreds* are called one *thousand*

25 + 47

25 + 47

25 + 47

Compacted 25 + 47

Compacted 25 + 47

or

leading to

Difficulties with subtraction

Subtraction Structures

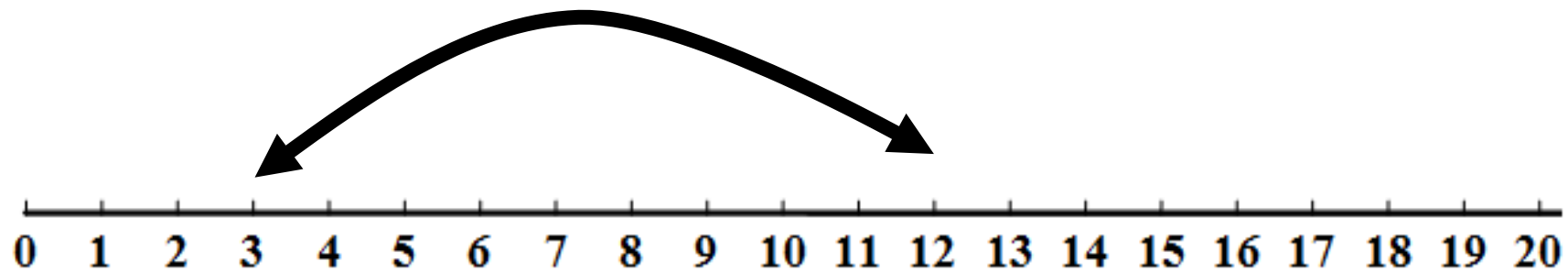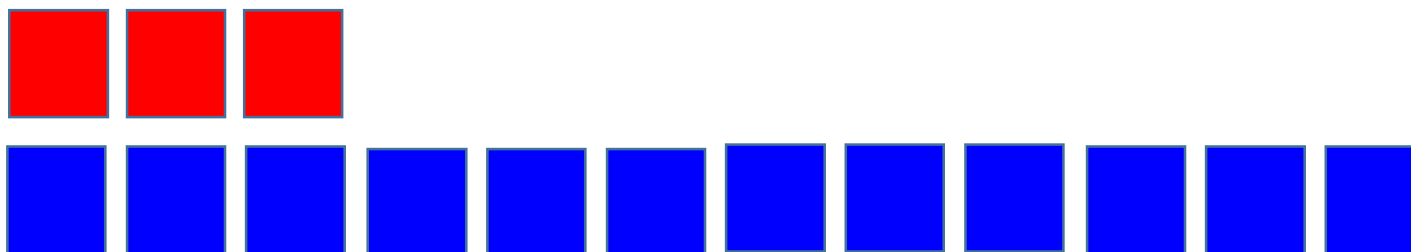The partitioning structure (take away)

The comparison structure (difference)
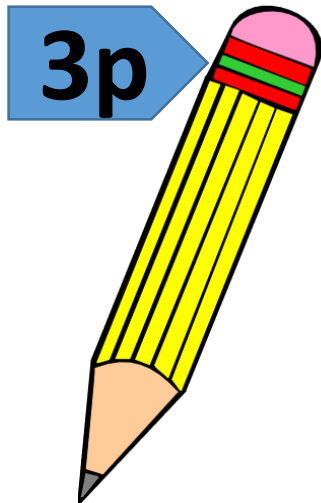
The complement of a set structure

The reduction structure (counting back)

The inverse of addition structure
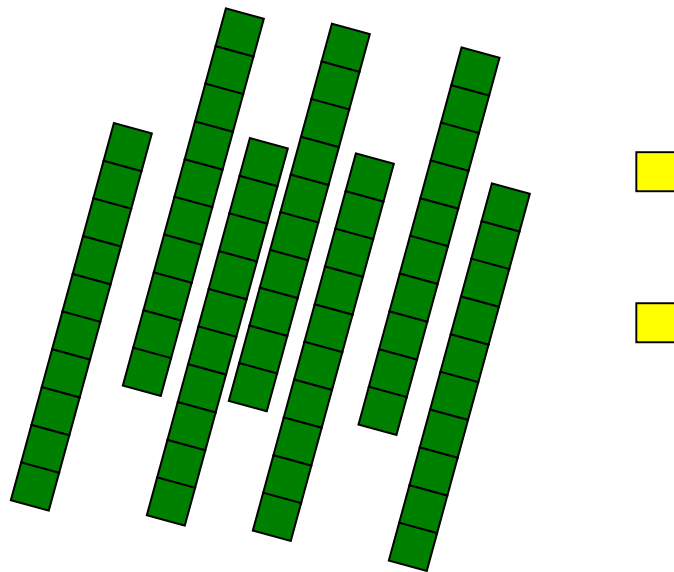
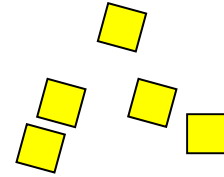# Difficulties with subtraction

Difficulties with subtraction

3p

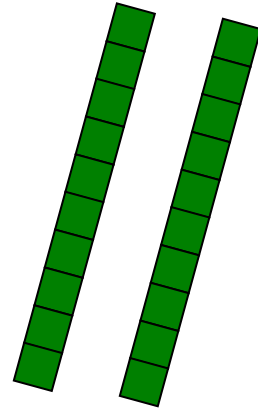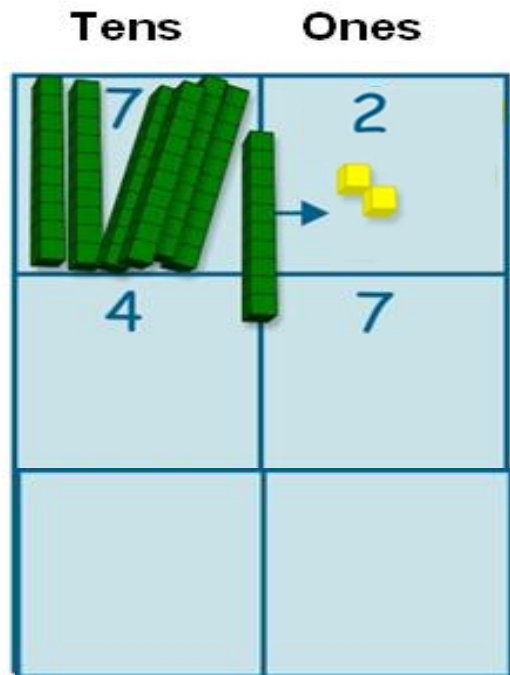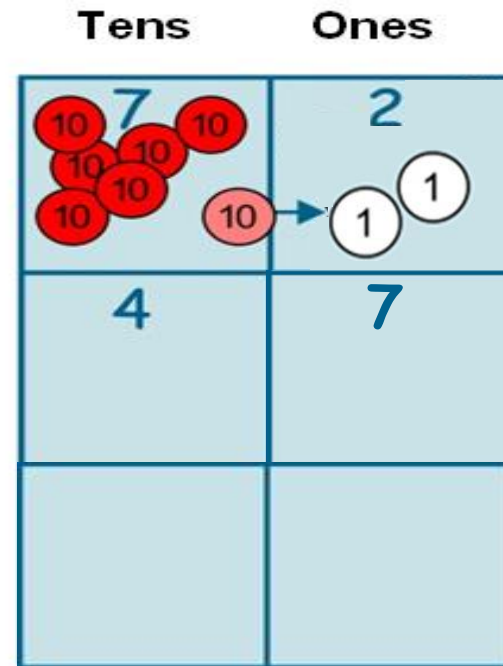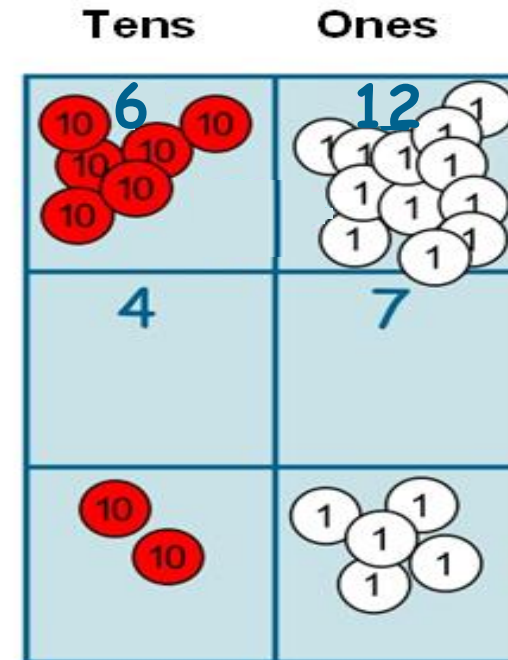8p

You
£12

Me
£7

72 - 47

72 − 47 = 25

Compacted 72 - 47

or

leading to

Compacted

Tens | Ones

6   12

4   7

or

leading to

$$
\begin{array}{r}
\overset{6}{\cancel{7}}\;\overset{1}{2} \\
-\;4\;\;7 \\
\hline
2\;\;5 \\
\end{array}
$$

Tens | Ones

6   12
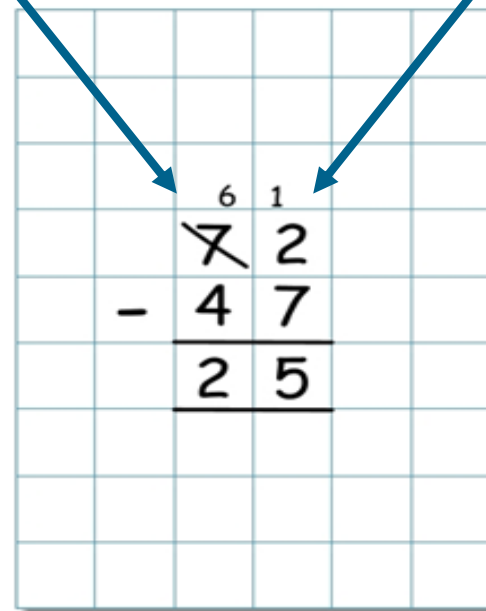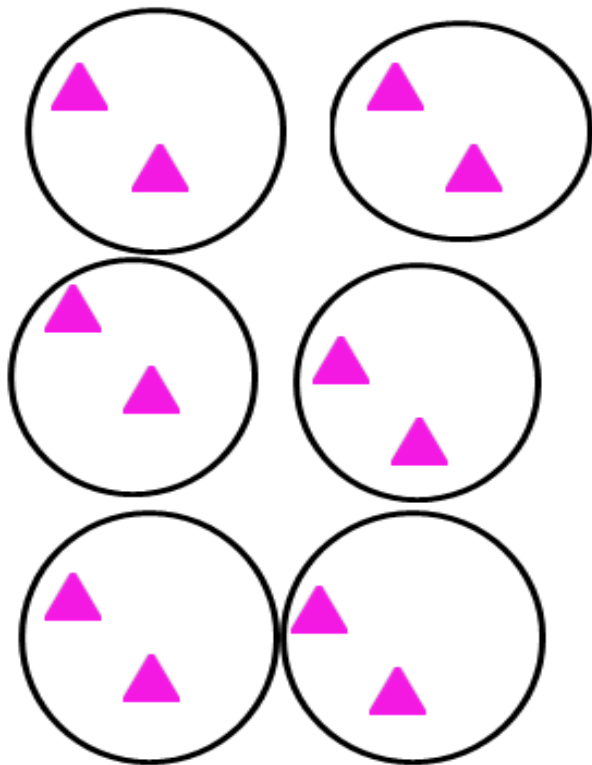
4   7
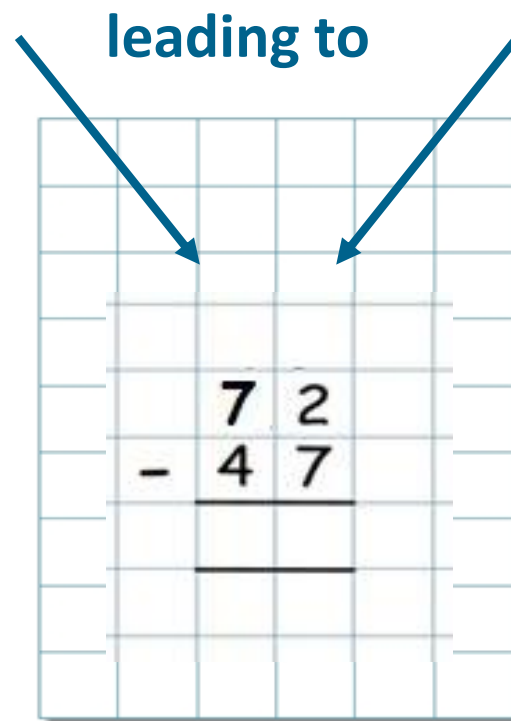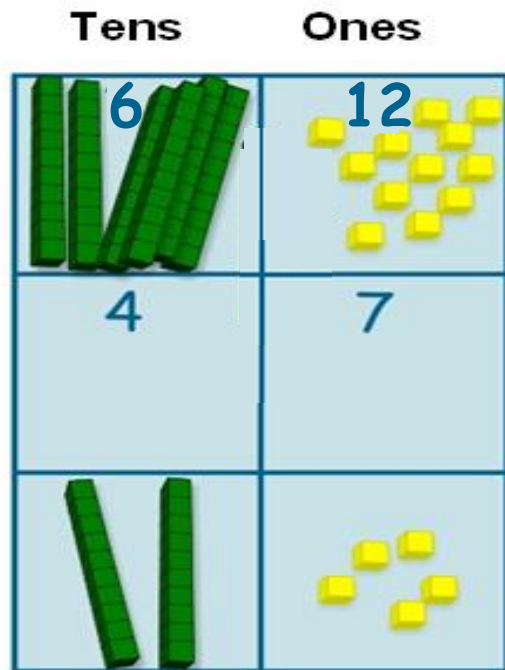
Multiplication - Discuss
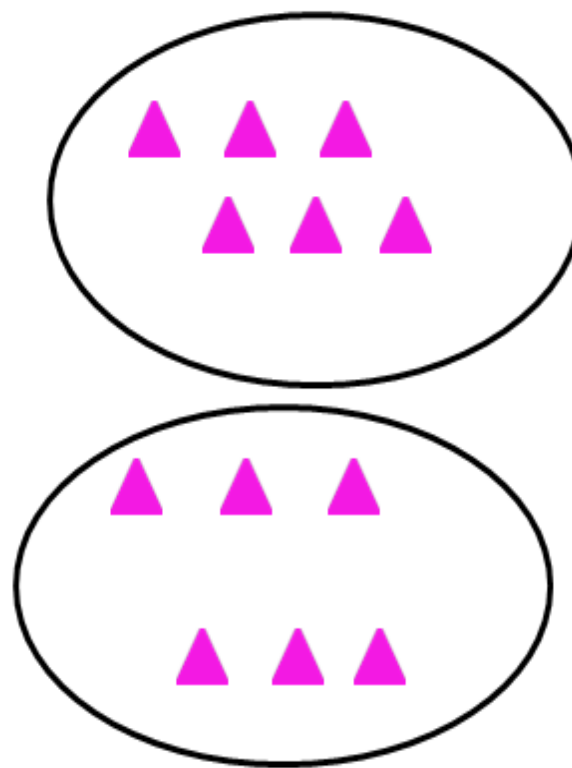
- What is multiplication?

$$6 \times 2 = 12$$

- How do children interpret this calculation?

- What barriers do children encounter?

Activity:- How would you present this calculation?
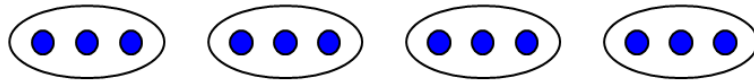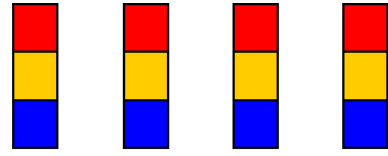Draw your representations.

6 of one

6 sets of 2

2 sets of 6

Repeated Addition

3 + 3 + 3 + 3

3 x 4 = 12
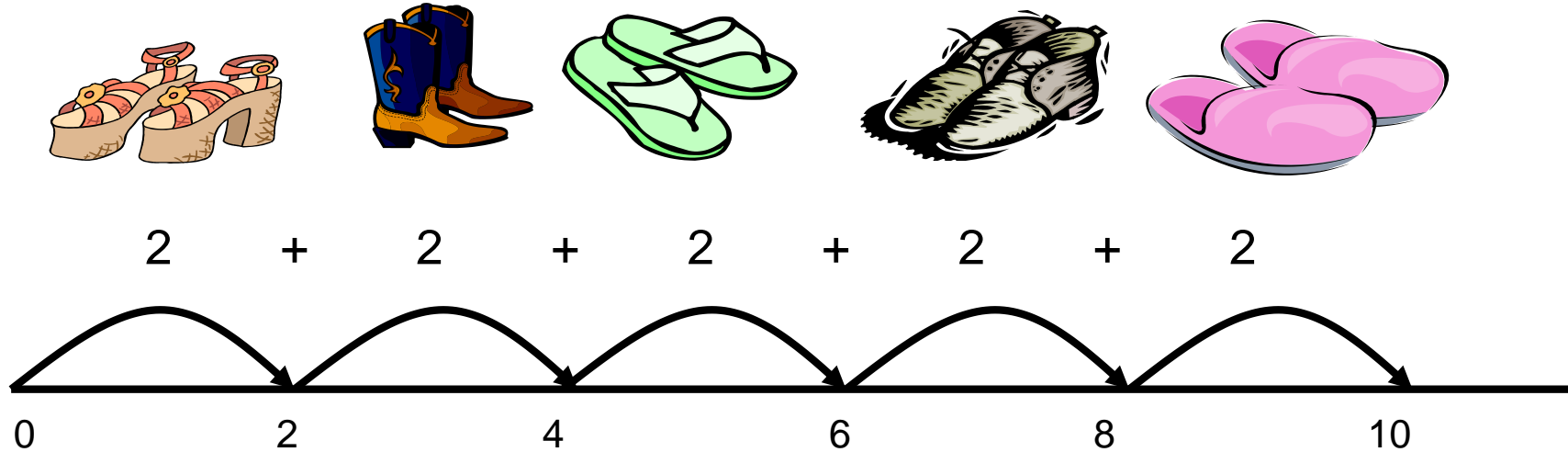12 = 3 x 4

3 + 3 + 3 + 3 = 12

3 added together 4 times

3 multiplied by 4

4 groups of 3

4 lots of 3

4 hops of 3

Number Lines

2 + 2 + 2 + 2 + 2

0   2   4   6   8   10

- This image can be expressed as 2 multiplied by 5
- two five times
- 5 groups of 2
- 5 lots of 2
- 5 hops of 2 on a number line

Scaling

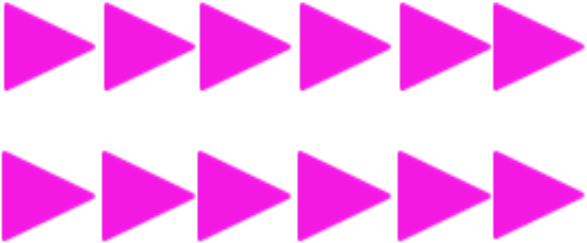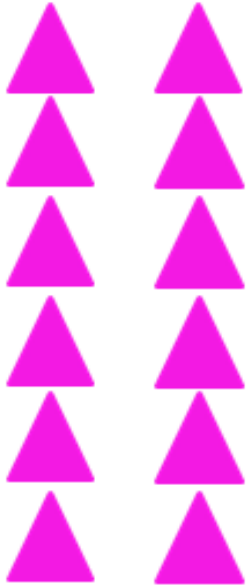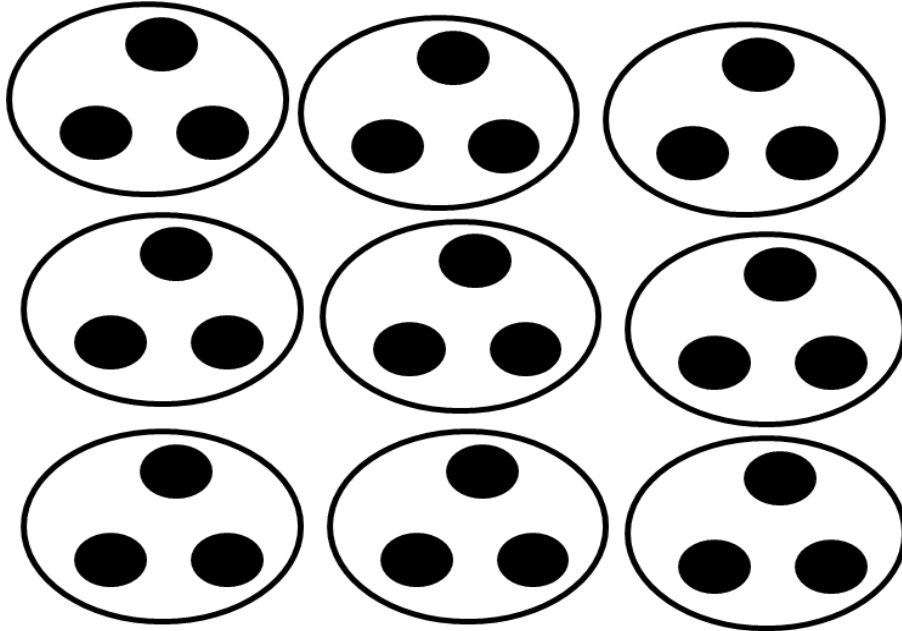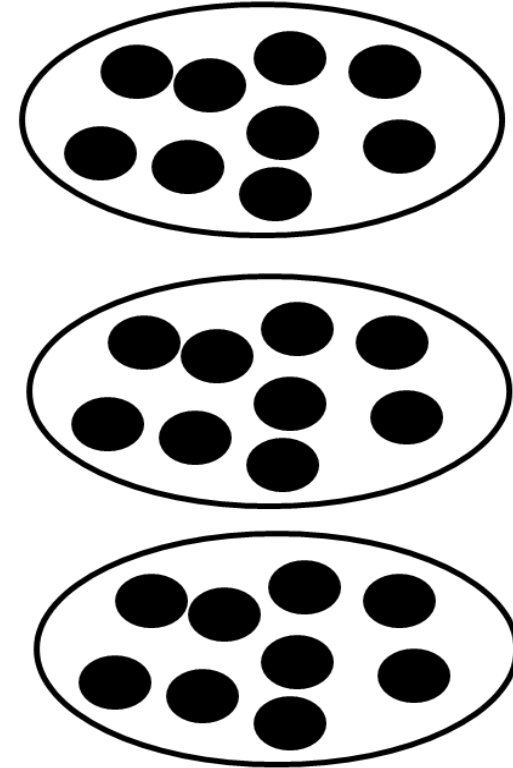Discuss:- What would children tell you about these lengths of ribbon?

5cms
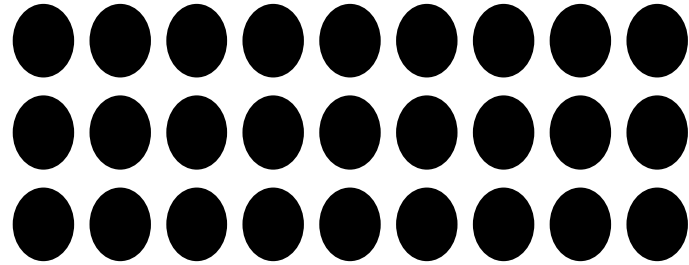
20cms

Rectangular Arrays
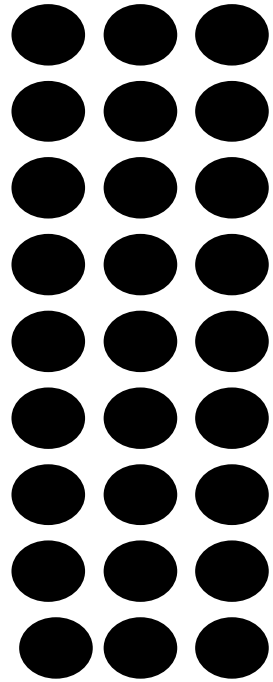
Commutativity

9 sets of 3

3 sets of 9

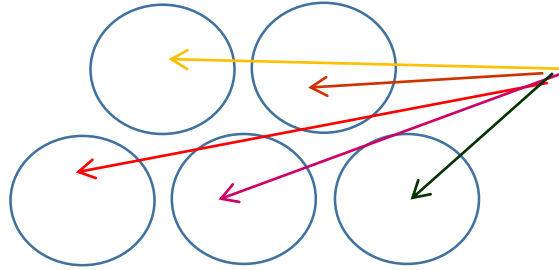# Rectangular Arrays

Division

- What is division?

$$67 \div 13 =$$

What is Division?

There are two principle structures:

- equal sharing

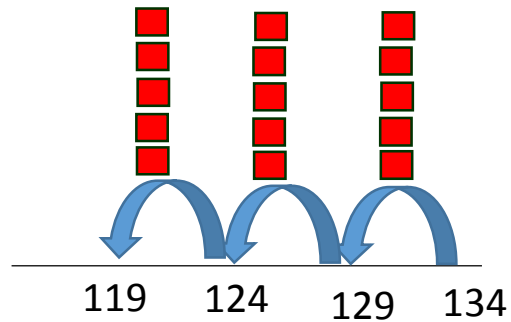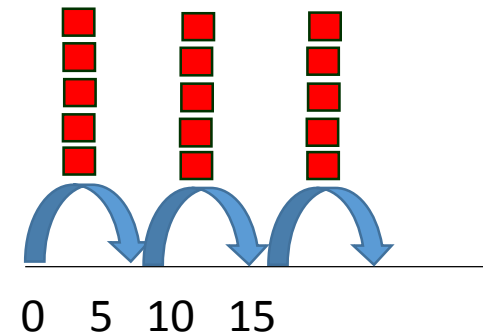- inverse of multiplication (or grouping)

to share 134 between 5 (sharing)

to find the number of groups of 5 we can take from 134 (repeated subtraction)
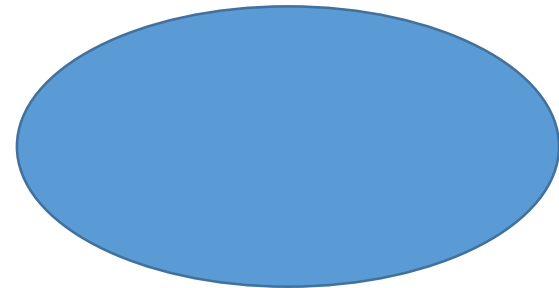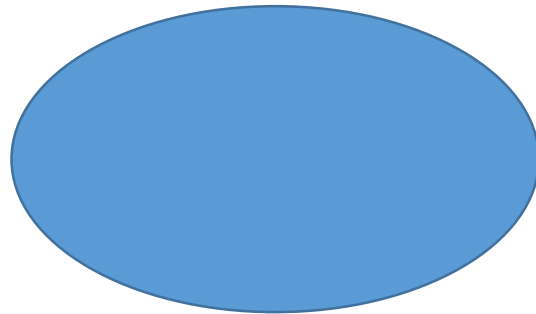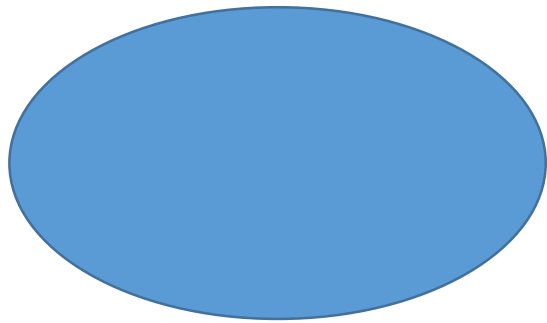
134÷5

to find the number of groups of 5 in 134 (grouping)

to find the number that we need to multiply 5 by to get 134

(division as the inverse of multiplication)

119   124   129   134

0   5   10   15

Sharing – How can we show 18 divided by 3?

Grouping