Numicon Training

Numicon is a practical approach to 'introduce, consolidate and embed concepts of number'.

What is the Numicon Approach and what does it do?

What is the Numicon Approach?

▶ The Numicon approach is 'based on a proven concrete-pictorial-abstract approach'.

▶ 'Numicon encourages children to explore maths using structured imagery and apparatus, in order to understand and explain mathematical concepts'.

What does it do?

▶ 'Gives children confidence through demonstrating how and why they have arrived at their answer'.

▶ Makes it easy to 'assess understanding by watching and listening to what children say and do'.

Making Mathematics real

For children to be successful in Mathematics, they need to be:

▶ Fluent – children need to learn key mathematical facts and methods, and be able to recall and apply knowledge rapidly and accurately.

▶ Develop mathematical reasoning – children need to be able to 'follow a line of enquiry to predict relationships, develop an argument, and justify their answer using mathematical terms.

▶ Problem Solving – children need to be able to apply their maths to a number of different problems, breaking the question down into simpler steps, in order to reach a solution.

What is a number?

Children are first introduced to numbers as words, used as a sequence of sounds...

For example, 'one', 'two', 'three', and so on.

Then they learn to use those same words as adjectives...

For example, 'two' cars, 'six' rulers, etc.,

Finally they start using those numbers as nouns…

For Example, 'six' add 'two' equals 'eight'.

It's all so CONfusing!

There are 2 cars in the race. Car number 24 is 1st.

24 is a Cardinal number — it tells us how many cars there are.

1st is an Ordinal number— it tells us the order of the cars.

60 is a Nominal number —it's tells us the name of the car.

Bruner's Three Modes of Representation

Modes of representation are the way in which information, or knowledge are stored and encoded in the memory.

Bruner's three modes of representation, for development of children are:
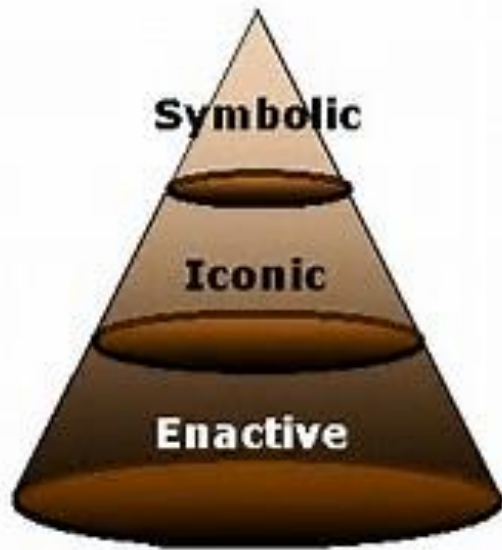
1. Enactive representation – (action based)
   The first stage involves a hands-on method of learning, and requires learning through doing.

2. Iconic representation – (image based)
   The second stage is pictorial, where children can see images, for example, by looking at a number, shape, diagram, or graph on paper.

3. Symbolic representation – (language based)
   The third stage is the abstract stage, where numbers and symbols can be imaged by a child in their head.

McLeod, S. (2008)

The Numicon Approach

Exploring Relationships

Communicating Mathematically

Generalising

For teaching of mathematics to be successful, children need to:

Explore Relationships:
Children need to be provided with opportunities to explore relationships through investigation.

Communicate Mathematically:
Children need to learn how to communicate mathematically, by using the correct language, and to be able to apply that knowledge in 'real-world' situations, for example, using money.

Generalise:
Children need to be able to make a generalisation about how number operations work. For example, knowing that the reversal of an addition sum produces the same answer (2+4=6, and 4+2=6 too), whereas the reversal of numbers in a subtraction changes the answer (4-2=2, but 2-4=-2). This is called the commutative law.
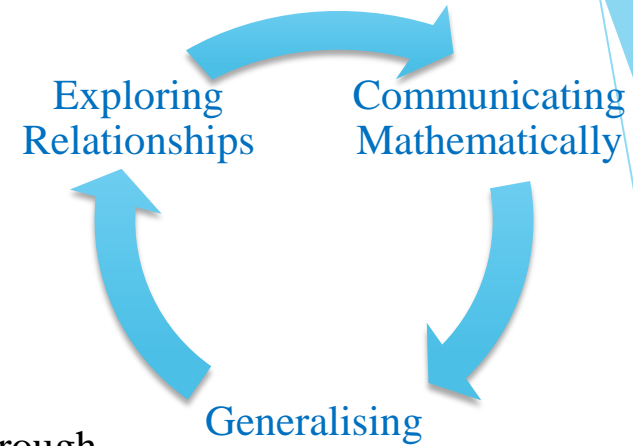
Understanding Number

How can the Numicon Shapes and the Numicon Approach help?

What is in the bag?

You can help your children to learn about numbers using Numicon, through playing games, for example:

Which Numicon shape do I have in the bag?

Using good mathematical questions try to generalise about what possible combinations I could have in the bag, for example:

You could use questions, such as:

Is it an 'odd' or an 'even' number?

Is it bigger than the number….?

If you are using two plates in the bag, is one bigger than the other?

This teaches the children to think about the number and its properties, helping to build their understanding of number.

Make a square using Numicon shapes

Use good mathematical questioning to teach your child about square numbers, for example:

- ▶ How do you know that it is a square?

- ▶ How many different sized squares can you make?

- ▶ Can you put the squares in order from smallest to largest?

- ▶ What if you only had odd Numicon plates?

- ▶ What if you can only use each plate once to make each square?

- ▶ Put the squares in order from smallest to largest. Is there a number pattern?

- ▶ What do you think the next square number will be?

- ▶ Can you predict what the next three square numbers will be without making them, by looking to see if there is a pattern with the square numbers that you have already made? Then make the square to check your prediction.

Numicon Shapes   1-10

Structure of the number system

The correct way to use the Numicon shapes is to show that each plate is one bigger than the last. This can be done by laying the plates down to create a staircase. This is so that the children have a visual image that each number is one bigger than the previous one.

Generalising about consecutive numbers – one more than

Many words that are crucial in number work are relative terms:
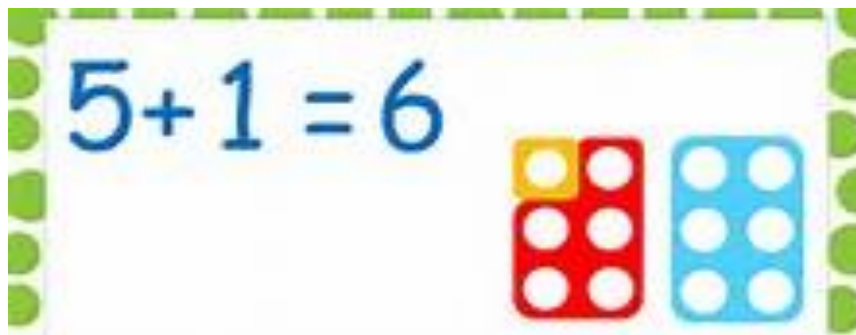
Big, bigger, biggest

Small, smaller, smallest

More, most

Few, fewer

Less, least

Before, after, next

The words all depend on context.

$$5 + 1 = 6$$

The word banana is an absolute term; it always refers to a yellow, slightly bent fruit.

By using a number 'one' orange Numicon plate, you can add it on to a plate to show that you can make a number that is one bigger; placing the plate that you are making next to it.

Giving Numicon a cardinal value, by placing them on a number line.

0	1	2	3	4	5	6	7	8	9	10
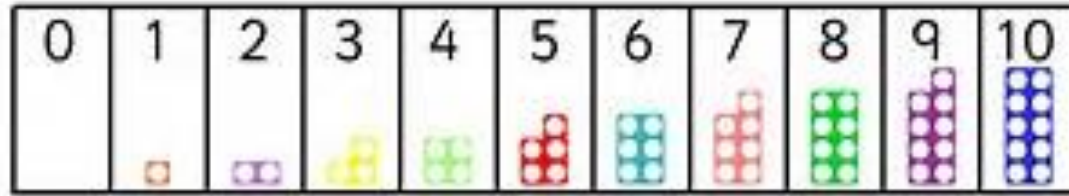
By putting the Numicon plate on to a number line, it helps the children to recognise the cardinal value of the number and to start to recognise the written number associated with it.

Build a plate in pegs

▶ Build the number 4 plate using pegs on a peg board (do not use green pegs for this), because the child will start to think that four is always green.

▶ Take a peg in each hand and build the shape using both hands from the bottom up.

▶ Check that the pattern has been built correctly by placing the shape on top.

▶ This can be used for any of the Numicon shapes.

▶ Use a variety of objects to build different number plates, for example, buttons, or shells, or marbles over the holes.

▶ By building them using two hands, it starts to help with the understanding of odd and even.

Pattern and Algebra (describing shapes)

Suggest ways to describe the Numicon shape.

▶ It is red?

▶ It is an odd number?

▶ It is 'five' smaller than the 'ten' shape?

▶ It is bigger than the 'three' shape?

▶ It is between the 'four' shape and the 'six' shape?

▶ It is 'one' more than 'four'?

▶ It is 'one' less than 'six'?

Develop strategic thinking

Use mental imagery of Numicon patterns to develop strategic thinking.

Play 'Hunt the lost peg' game

▶ Use a peg board and build the Numicon shapes, then get the child to close their eyes while you remove a peg; see if the child can spot which peg you have taken.

Find the missing Numicon Shape

▶ Get your child to order the Numicon shapes, then get them to close their eyes while you remove a Numicon plate; see if the child can spot which plate you have taken.

Find the Missing Numicon Shape
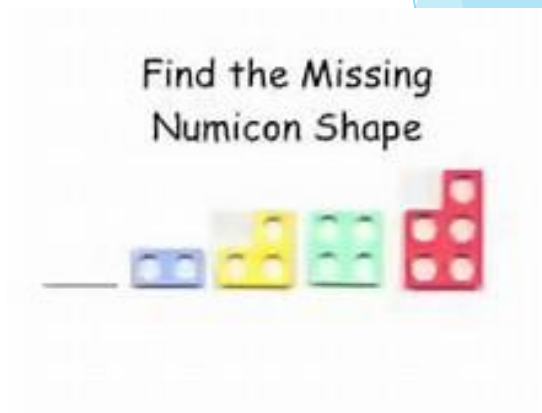
Counting

The structure of our number system.

Gelman and Gallistel's Five Principles Of Counting

▶ 1:1 – this involves giving just one counting word to each item to be counted (only counting each object once).

▶ Stable order —To be able to count also means knowing that the list of words used must be in a repeatable order.

▶ Cardinal Order — following on from 1 and 2; the final number name given to the final number in the count, is the number in the set.

▶ The abstraction principle — children understand that they count non-physical things e.g. sounds, unseen or imaginary objects and therefore they can 'count on'.

▶ The order-irrelevance principle — so long as every item in the group is included, they can be counted in any order.

Counting
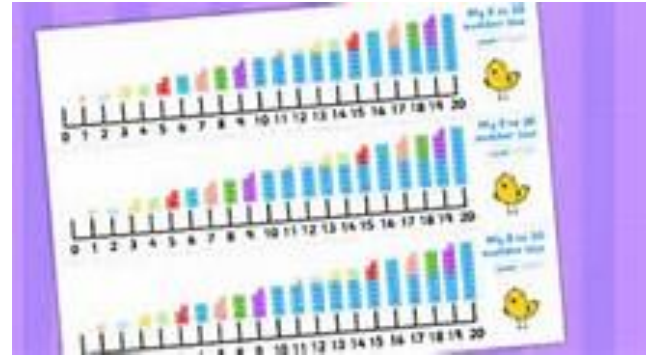
- Knowing the number names in order.

- Recognising that the number associated with the last object touched is the total number of objects (cardinal)

- Recognising small numbers of objects without counting them (subsidising)

- Counting things you cannot move, touch or see, or objects that move around

- Recognising that if a group of objects already counted is rearranged, the total number stays the same (conservation)

- Making a reasonable estimate of a number without counting

- Recognising that if objects are added or removed, the number of objects changes

Pattern

The ability to represent sequences of numbers using mathematics.

Generalising

In mathematics, we learn to make situations predictable by generalising. To do this we need to have the ability to think ahead and to see how things would be if they carried on in a repetitive way. This is a crucial skill to be able to understand our number system and to be able to master calculation.
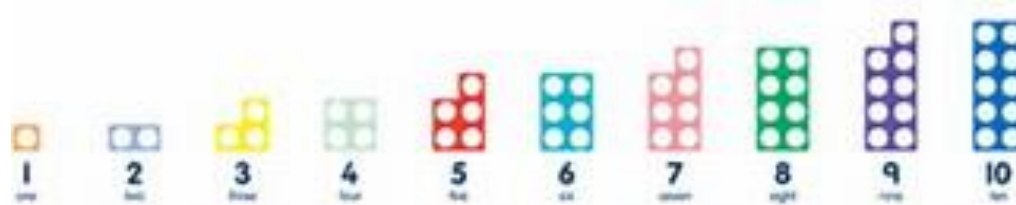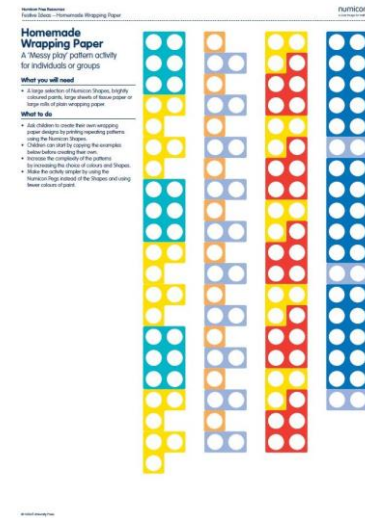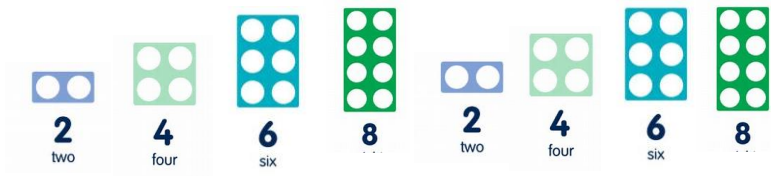
Firm foundations for all learners

- Ordering Numicon Shapes, giving them number names and attaching numerals

- Grouping objects into Numicon patterns without counting

- Combining Numicon in addition

- Using Numicon Shapes to show subtraction Confidently using the language of addition and subtraction.
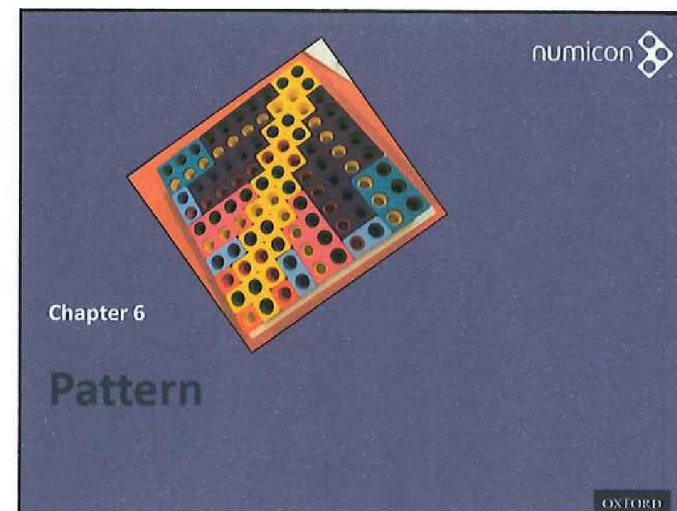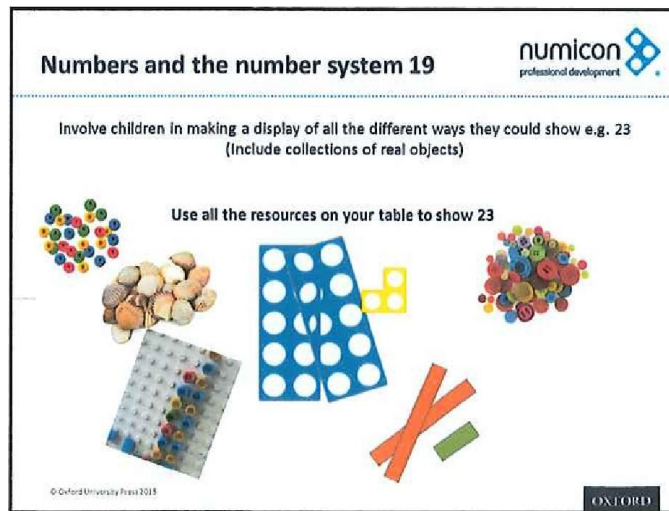
Algebra

a   a+2   a+4   a+6   a   a+2   a+4   a+6

a   2a   4a   6a   a   2a   4a   6a

▶ The Numicon plates can be used to show algebraic patterns, such as the one above.

▶ It is great for providing a visual image of the pattern.

Pattern –
'number trios' or 'number families'

If I know two variables, I can work out the third – Algebra (empty box questions)

2 + ☐ = 6
4 + ☐ = 6
6 – ☐ = 2
6 – ☐ = 4

Six

Two ↔ **Four**
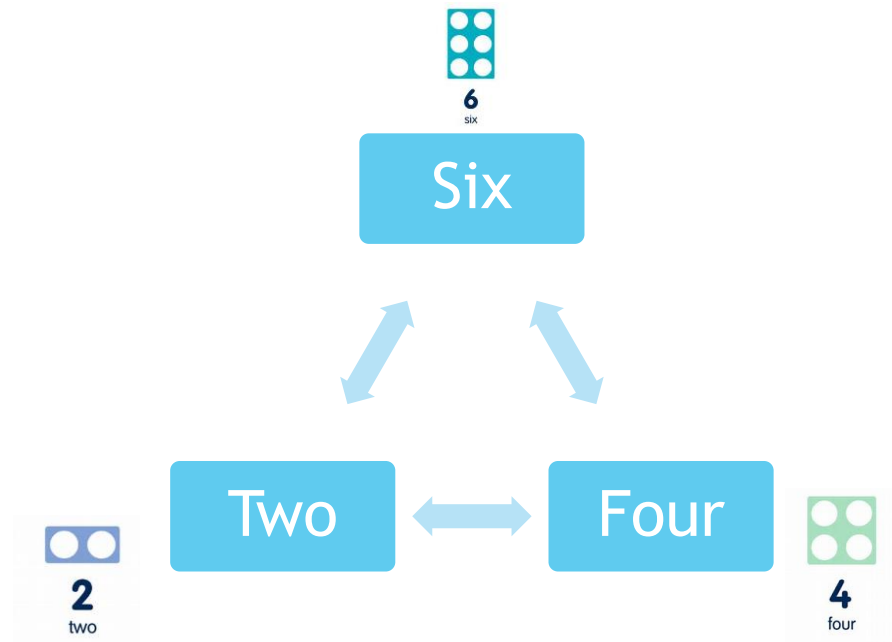
2 + 4 = 6
4 + 2 = 6
6 – 4 = 2
6 – 2 = 4

Equivalence

The whole is 8.
The number of equal parts is 4.
The size of each part is 2.

Mind your language!

Sometimes we use the word 'same' instead of 'equivalent'. This is really confusing for children as '6 cars' is not the same as '6 fish'. There are an equivalent number of each, but they are not the same!

Equivalence

- For mental arithmetic strategies to make sense, children have to be able to see the decompositions of any number as equivalent to each other.

- Numicon Shapes and Cuisenaire are weighted, so children that are not secure in numbers can weigh them to help them find the equivalent number.

- Scales can also be used to find numbers that are greater than, or smaller than a number.

Oxford University Press (2014)
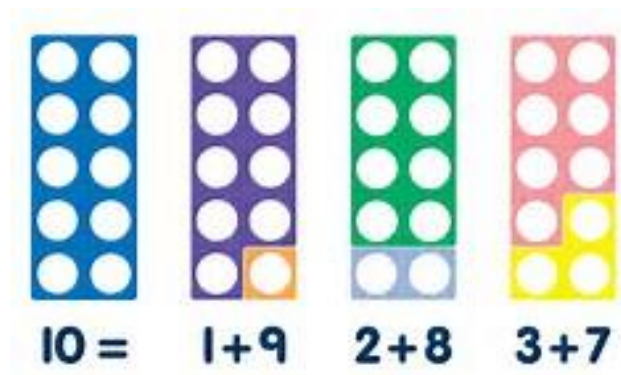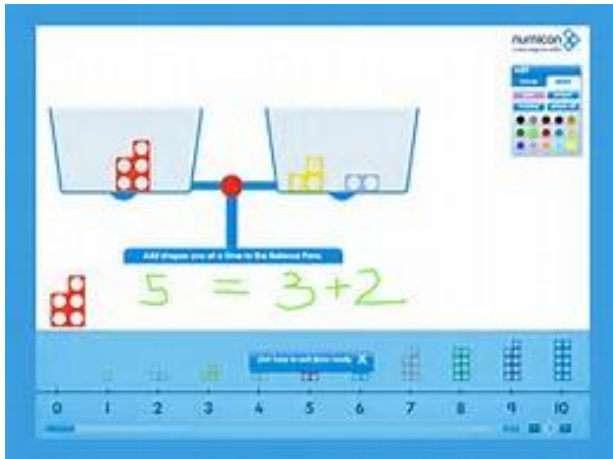
Partitioning into tens and units

There are 14 people waiting at the bus stop. When the bus comes there are only enough seats downstairs for 10 people.

How many people would have to go upstairs?

What if there were 17 people waiting?

What If 10 people went downstairs and 5 went upstairs, how many people altogether?

If there is space for 10 people downstairs and 18 people are waiting, how many Will have to sit upstairs?
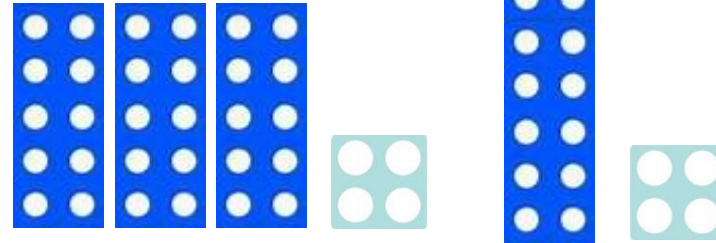
Calculation

Adding and Place Value

▶ Numicon can be used to show children addition, for example:
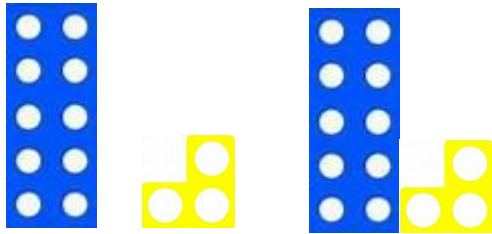
10 + 3 = 13

They can also be used for place value:

10 + 10 + 10 + 4 = 30 + 4

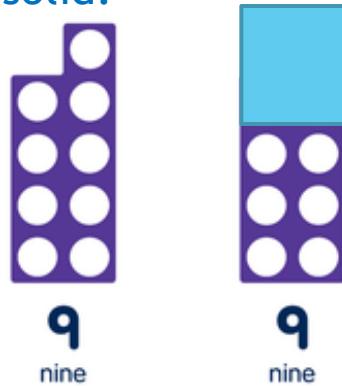30 + 4 = 34

Subtraction

The structure of subtraction:

- Take away – something is lost, or taken from another.
- Decrease – A reduction of the number, for example, a quarter off.
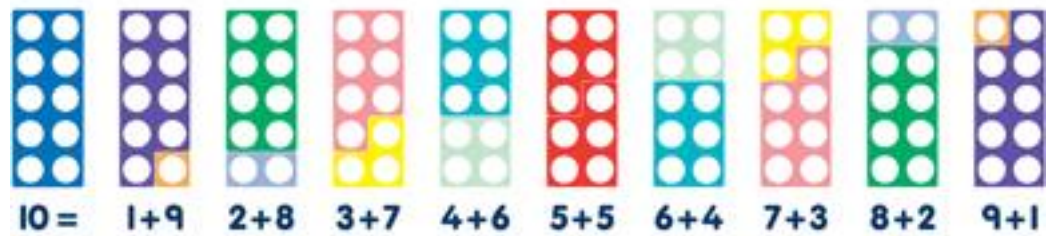- Comparison – the difference.
- It is the 'inverse' of addition.

To demonstrate to children, take a Numicon plate and cover a number of the holes that you are taking away with something solid.
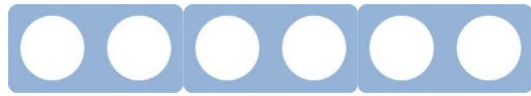
9   -   3   =   6

Number Bonds

▶ Both Cuisenaire and Numicon can be used to show children number bonds.

Time

The Numicon shapes can be used on a clock to help the children to learn time.
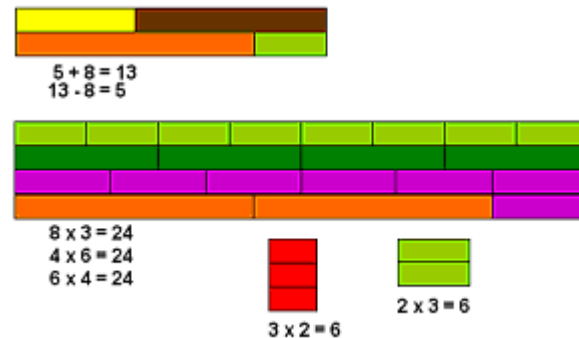

Oxford University Press (2014)

Multiplication

Language of multiplication

Introduce as '3 times 2',this is equivalent to '2 times 3'.

Cuisenaire is particularly good for showing children equivalent times tables, and helping the children to understand that once they have learnt one operation, for example 3x2=6, then they also know the inverse operation, which is 2x3=6.
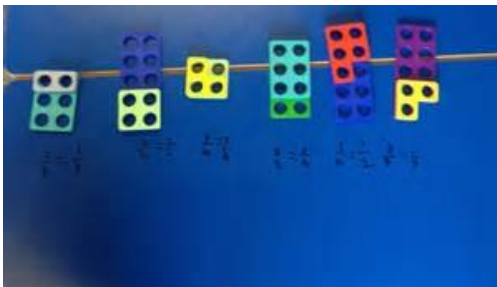
Fractions

▶ Numicon can be used to show fractions to children:

$\dfrac{4}{10}$

Using the number 1 plates, you could also demonstrate by getting the child to separate them into groups, for example:

12 x 1 plates the children can divide into 3 equal groups, they would then know that 1/3 of 12 = 4.

Cuisenaire

- Cuisenaire can be used exactly the same as for Numicon.

- The colours are different to Numicon, so that children do not associate, for example, the colour red with the number 5.

- They are measured in cm, so children can also use them for measuring, for example area, but you must ensure that the corners meet and do not overlap.

number of units
1 (white)
2 (red)
3 (lime green)
4 (purple)
5 (yellow)
6 (dark green)
7 (black)
8 (brown)
9 (blue)
10 (orange)

What does an effective maths lesson look like?

- The context is meaningful

- There are opportunities for communication, through generalising and active engagement.

- A multi-sensory activity is offered.

- It is a challenge for all participants (low threshold, high ceiling).

- Trust.

- Risk taking.

- Investigation

References

▶ Department for Education (2013), *The National Curriculum in England: Key Stages 1 and 2 framework document*. Available at: https://www.gov.uk/government/publications/national-curriculum-in-england-primary-curriculum (Accessed: 19th November 2017).

▶ Oxford University Press (2014), *Numicon, 'Primary School Maths Resources'*. [Online]. Available at https://global.oup.com/education/content/primary/series/numicon/?region=uk (Accessed 19th November 2017).

▶ McLeod, S. (2008). *Bruner - Learning Theory in Education, Simply Psychology*. [ONLINE] Available at: https://www.simplypsychology.org/bruner.html. [Accessed 19 November 2017].

Oxford University Press (2014)