Section 3 – Counting, sequences, patterns and algebraic reasoning

Commonly, particularly with older learners, number sequences and patterns are explored purely numerically. But by simply looking at strings of numbers you are missing a trick. Investigating and representing patterns such as Fibonacci using Cuisenaire brings to us a whole new level of awareness and depth of understanding.

In this section, the ideas are arranged broadly from less to more 'difficult' in terms of the mathematics involved.

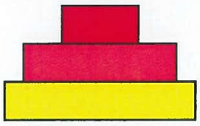
3.1 Assigning numerical values

At first some adults express discomfort that the rods are not marked in some way to indicate their value. In fact, you begin to realise this is their very power. To find what the *y* rod is worth we have to relate one rod to another, for example, by encouraging children to place other rods next to the *y* rod until they are sure what each is worth. Later we might work 'as if' the white (*w*) rod was worth 1. Even later we may want to call other rods "1", e.g. the orange (*o*) = 1 or the pink (*p*) = 1. I can ask: *"What does that make the other rods worth and how do you know?"* This idea is developed further in Section 4.

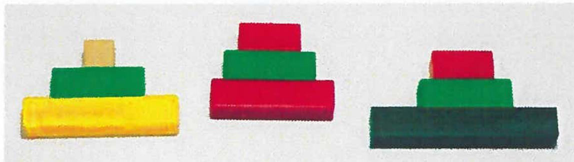
Roll and name: Each player takes it in turns to roll a 1-6 die. They read the number shown on the die roll and take that many *w* rods, laying them as a train (line). They say the colour of rod that they think matches the length of their *w* train ***before*** taking it from the tray to check. If they are correct, they return the *w* rods to the tray and keep the coloured rod. Maybe the longest train after five turns each wins?

Developments: Roll two dice and collect in the same way. The object is to make a staircase to ten. Or roll three dice and make a staircase to 18.

Boats (With thanks to Janine Blinko): A 'boat' is made of any three rods on top of each other, with the shortest on the top and the longest on the bottom.



What different boats can we make? Can we use all the colours? What is the same about any two boats? Now tell me what is different?



Boat Race: Consider *w* to be equal to 1. Take it in turns to roll a die and take the matching rod. Start to build a boat from the bottom up. You can only keep the rod if it fits on top of the rod(s) you already have (to make a boat consisting of three different lengths of rod) or you can start a new boat. The winner is the first to make five perfect boats. Talk about and compare the boats.

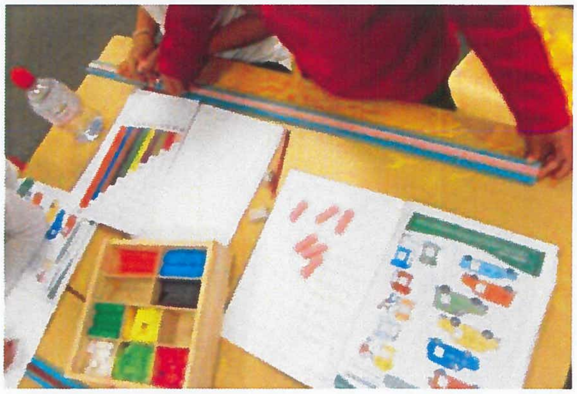
3.2 Counting in tens

Putting lots of orange rods end-to-end in a train is a strong image to support counting in 10s up to and over 100. Then count backwards by removing the rods. Implicit in this removal of rods is the concept of subtraction. To count in 10s from different starting points, start your train with one shorter rod and add on orange (*o*) rods; e.g. 2, 12, 22, 32, 42 …

3.3 Cuisenaire with tracks or metre sticks

Try laying numbers of one colour of rod into a Cuisenaire track:

https://www.youtube.com/watch?v=jl-FhxDXaRQ



Alternatively, lay them alongside a metre stick, to illustrate multiplying a number of reds to make, say, 20; then relate to division by asking questions such as, "*So, how many 2s are there in 20?*" Encourage children to write the related equations:

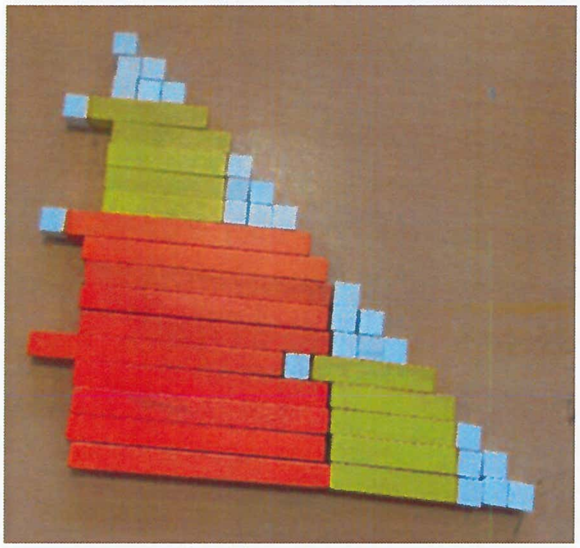
10 × 2 = 20

20 ÷ 2 = 10

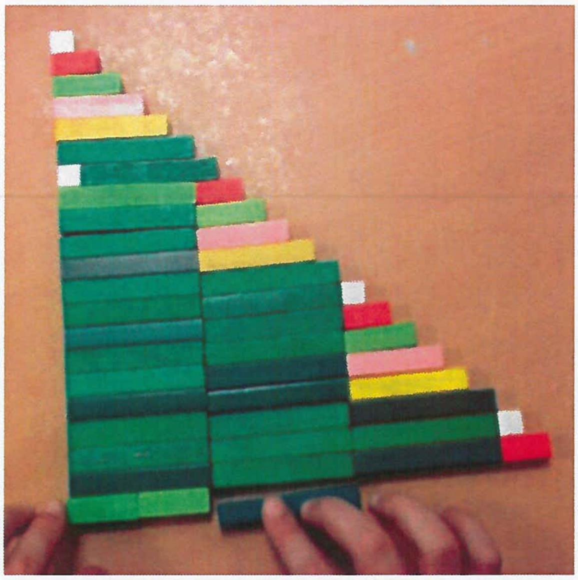
3.4 Building and interpreting a growing pattern

How, with a staircase, could you show the way the Romans wrote numbers?

Here's one way an 8-year-old child chose to show it:



As part of an exploration of different base systems, children could build a staircase that shows how numbers would be counted in base 6, 7, 8 or 9. For instance, here is another 8 year-old's pattern in base 6:



Create a growing pattern of Cuisenaire rods: This is an invitation that can be interpreted widely by learners. Keep each step of the sequence. Label them Step Number 1, Step Number 2, ...