

[Representations in our primary video lessons](#) (NCETM, December 2020)

Mathematical structure, manipulatives and myth-busting.

Representations are used in lessons to expose the mathematical structure being taught. They are not new – we can probably all remember using counters when we were children. The history of mathematics uncovers many examples of objects, pictures or symbols used in early maths to represent concepts.



Nowadays it's not unusual to find tens frames, Dienes blocks, Cuisenaire® rods, bar models and other representations in frequent use in primary classrooms.

In recent years, teaching for mastery has encouraged the use of representations to deepen understanding, encouraged teachers to question their purpose and which representation to use and when.

In this piece, we bust some myths about representations and encourage you to watch them being used in a teaching for mastery context. Can you see what each representation used in the video below exposes about the mathematical structure of multiples of two?

[Secondary maths teachers may find [Using mathematical representations at KS3](#) helpful.]

Myth: Manipulatives and pictures are for younger children and low prior attainers

Representations are useful for all learners, whatever their age. Research mathematicians often use representations to explain their thinking. Teaching for mastery suggests that representations should be used throughout primary and secondary school to promote a deep understanding of mathematical structure. Once learners have a deep understanding of the maths being represented, the aim is to work with the maths without recourse to the representation, though they will often continue to work with visuals in their mind's eye.

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Myth: Representations help children to do calculations

Objects can assist children in performing calculations (eg a child might use three groups of five counters to then count all the counters to find the product 15). However, using the representations in this way can encourage a child to become dependent on them. Teaching for mastery encourages the use of representations to demonstrate the structure (eg three groups of five counters). The child's understanding of the structure is then built on to teach efficient calculation methods.

Myth: Children should be able to choose their own representations

When teaching for mastery, the teacher will have a clear idea of the particular structure s/he is trying to illuminate and will choose the most appropriate representations for doing this. Children given free rein with manipulatives may use them to do, rather than see, the maths.

Myth: A particular concept calls for a particular representation (eg fractions as pizzas)

Teaching for mastery uses multiple representations of a concept to expose different aspects of the structure.

Watch the video lessons below and see how the teacher uses many different representations to build the concept of units of two. You might like to see if you can identify the purpose of each representation, before you check in the dropdowns.



[Numicon](#)

Numicon is used to expose the pairs and evenness in multiples of two. The 'non-example' (five) is used to expose how this is different from even numbers.

The ten Numicon is greyed out to expose the '10 and' nature of the teen numbers.

[Number line](#)

The number line is used alongside the Numicon to help the transition to a more abstract representation.

The number line shows the linear relationship of odd and even numbers.

The odd numbers are shown in grey to expose the alternateness of even numbers. Skip counting out loud in twos embeds this. Skip counting is chanted backwards and forwards to develop fluency, so the knowledge of adjacent multiples of two is easily retrievable for use.

[The bicycles](#)

The bicycles are used as familiar concrete objects, to group the wheels into units of two so that children can start to unitise two. The bikes can be counted in ones; the wheels, pedals, brakes etc in twos.

[Pairs of shoes](#)

The pairs of shoes are used to help identify groups of two and connect the word 'pair' with groups of two.

They are arranged in the layout of a tens frame to make a connection the children may be familiar with.

[Two-dot counters](#)

The counters with two dots are a more abstract representation of units of two than the bikes or shoes. This representation connects with future lessons in the sequence where pre-money tokens are used to represent 2p coins.

The subsequent video in the sequence goes on to introduce other representations to deepen children's understanding of 'wo-ness'.

[Hedgehogs](#)

The hedgehogs are objects that don't generally come in pairs but are used to show that any group of objects can be grouped into units of two. Again, they are arranged in the familiar tens-frame format.



[Pebbles](#)

Pebbles are then used to show that two-ness can be used with any group of objects, and children are encouraged to go and find their own objects and identify the groups of two by circling them, to then count in twos.

The representations, now familiar from the lessons, can then be used to enable counting on in twos from a multiple of two and beginning to touch on the two times table.

Teachers may want to use the slides in these videos to teach their own lessons. These are available, along with teacher guides, on the [KS1 Multiplication 1 page](#).

However, our Primary Team warns against teaching individual lessons in isolation. "Each lesson is part of a carefully planned sequence" says the NCETM Director for Primary Debbie Morgan. "The learning builds over the sequence of lessons".

The lesson sequences were collaboratively planned by groups of Mastery Specialists and members of the NCETM Primary Team for the purpose of home learning, during the first lockdown in 2020.

You can [watch all 17 lessons in the Multiplication 1 sequence](#) or [find other lesson sequences for all year groups](#).