What is mastery?

The 'mastery approach' to teaching maths is the underlying principle of Mathematics Mastery. Instead of learning mathematical procedures by rote, we want pupils to build a deep conceptual understanding of concepts which will enable them to apply their learning in different situations.

"In mathematics, you know you've mastered something when you can apply it to a totally new problem in an unfamiliar situation." Dr. Helen Drury, Director of Mathematics Mastery

The Mathematics Mastery curriculum is cumulative - each school year begins with a focus on the concepts and skills that have the most connections, which are then applied and connected throughout the school year to consolidate learning. This gives pupils the opportunity to 'master maths'; by using previous learning throughout the school year, they are able to develop mathematical fluency and conceptual understanding.

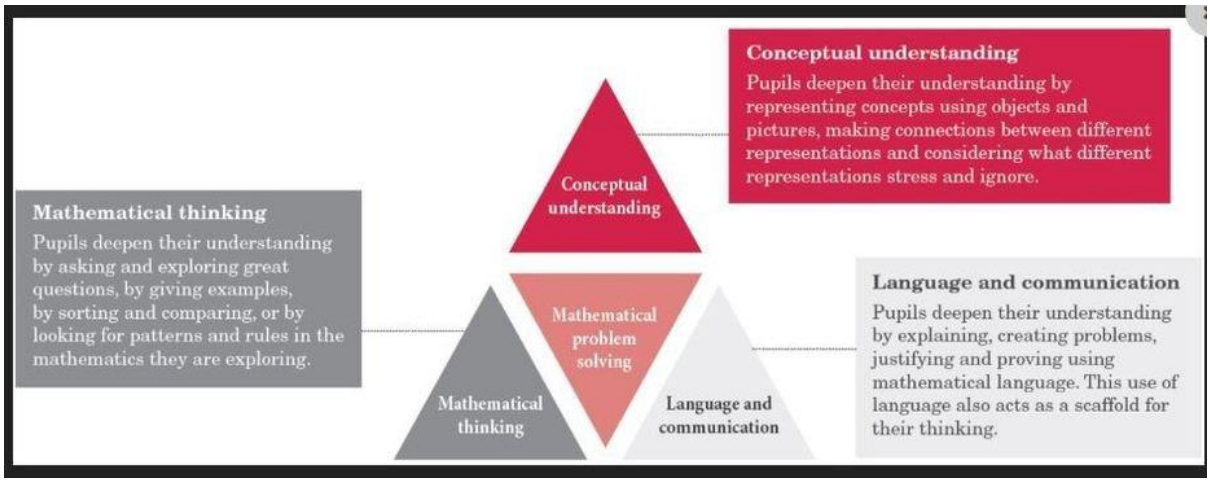
So how do we avoid teaching procedures and instead get pupils to develop a deep understanding in mathematics?

We use our Dimensions of Depth to deepen pupils' understanding. These are:

1. Conceptual understanding

2. Language and communication

3. Mathematical thinking



Problem solving is at the heart of the mastery approach, so we make sure to dedicate sufficient time to each new concept so every pupil can gain the reasoning they need to solve new problems in unfamiliar contexts.

In Mathematics Mastery, our pupils are expected to all solve the same investigations by the end of the lesson, meaning the key concepts and objectives are met by all pupils. Instead of accelerating higher attainers onto new content, we differentiate through depth, to develop pupils' conceptual understanding.

Curriculum

The Mathematics Mastery curriculum is cumulative - each school year begins with a focus on the concepts and skills that have the most connections, and this concept is then applied and connected throughout the school year to consolidate learning. This gives pupils the opportunity to 'master maths'; by using previous learning throughout the school year, they are able to develop mathematical fluency and conceptual understanding.

Our curriculum is designed to make sure that the requirements of the 2014 National Curriculum for England are fully met. Each year's curriculum includes all of the National Curriculum objectives for that year, plus a small number from the year above – usually from number – where we feel these will help pupils make connections with their learning.

Mathematical understanding

A crucial part of a 'deep understanding' in maths is being able to represent ideas in many different ways. Using objects and pictures to represent abstract concepts is essential to achieving mastery.

Jerome Bruner, a pioneer of the cognitive psychology movement in the United States, proposed three modes of representation necessary for pupils to develop understanding of a concept (1966). These were action-based, image-based, and language-based.

At Mathematics Mastery, we have taken on this approach by developing Concrete-Pictorial-Abstract (CPA) representations. Reinforcement of learning is achieved by going back and forth between these representations, building pupils' conceptual understanding instead of an 'instrumental understanding'.

- **Concrete - the doing: A pupil is introduced to an idea or a skill by acting it out with real objects. This is a 'hands on' component using real objects and it is the foundation for conceptual understanding. 'Concrete' refers to objects such as Dienes apparatus, fraction tiles, counters, or other objects that can be physically manipulated.**
- **Pictorial - the seeing: A pupil may also begin to relate their understanding to pictorial representations, such as a diagram or picture of the problem.**
- **Abstract - the symbolic: A pupil is now capable of representing problems by using mathematical notation, for example: 12 ÷ 2 = 6. This is the most formal and efficient stage of mathematical understanding. Abstract representations can simply be an efficient way of recording the maths, without being the actual maths.**

We believe the meaning of symbols must be firmly rooted in experiences alongside real objects and pictorial representations, otherwise this becomes rote repetition of meaningless memorised procedures. Concrete and pictorial representations support with the development of a deep conceptual understanding.

Mathematical thinking

We believe it is essential for pupils to develop mathematical thinking in and out of the classroom in order to fully master mathematical concepts.

We want children to think like mathematicians, not just DO the maths.

We believe that pupils should:

- **Explore, wonder, question and conjecture,**
- **Compare, classify, sort,**
- **Experiment, play with possibilities, vary an aspect and see what happens,**
- **Make theories and predictions and act purposefully to see what happens, generalise.**

It is important that we support all pupils in developing their mathematical thinking, both in order to improve the way in which they learn, as well as the learning itself. Good questioning can be used to develop pupils' ability to compare, modify and generalise, all building a deeper understanding of mathematics.

Mathematical language

We believe that pupils should be encouraged to use mathematical language and full sentences throughout their maths learning to deepen their understanding of concepts.

The way pupils speak and write about mathematics has been shown to have an impact on their success in mathematics (Morgan, 1995; Gergen, 1995). We therefore use a carefully sequenced, structured approach to introducing and reinforcing mathematical vocabulary throughout maths lessons, so pupils have the opportunity to work with word problems from the beginning of their learning.

Every Mathematics Mastery lesson provides opportunities for pupils to communicate and develop mathematical language through: * Sharing the key vocabulary at the beginning of every lesson in the Do Now section, and insisting on its use throughout;

- **Modelling clear sentence structures and expecting pupils to respond using a full sentence;**
- **Talk Task activities, allowing pupils to discuss their thinking and reasoning of the concepts being presented;**
- **Plenaries which give a further opportunity to assess understanding through pupil explanations.**

Pupils should revisit mathematical language from previous years and explore the concepts in greater depth. There should be opportunities for pupils to clarify vocabulary and explore activities that develop an understanding of the different concepts.

Problem Solving

We believe that a problem-solving approach is the key to mathematical success, and should be used continually throughout lessons to build on depth of understanding.

At Mathematics Mastery, problem solving is at the heart of our curriculum as the essence of everything we do as mathematicians. Problem solving should not be an add-on at the end of a maths lesson or a weekly investigation lesson.

Pupils must be given every opportunity to explore, recognise patterns, hypothesise and be empowered to let problem solving take them on new and unfamiliar journeys. Even the most straightforward tasks can be an opportunity for pupils to investigate, seek solutions, make new discoveries and reason about their findings.

Growth Mindset

At Mathematics Mastery, we believe that everyone can get better at maths, when they put in the effort and work at it.

Mindset is defined as a set of beliefs that determine somebody's behaviour and outlook in life, and can be split into two types – a fixed mindset and a growth mindset.

Fixed mindset - this is someone who believes ability and intelligence are things that you are born with. They believe natural talent alone creates success and one doesn't need to put much effort into achieving things they are naturally good at. People with a fixed mindset tend to give up easily with tasks, as they get upset by mistakes, and are afraid of challenges and failure.

Growth mindset - this is someone who believes intelligence and ability can be developed over time through effort, dedication and hard work. They tend to persevere with tasks and enjoy challenges due to the belief that effort needs to be expended to learn. People with a growth mindset believe they can be successful if they apply effort and hard work, and are more likely to continue working hard despite setbacks.

So how does this relate to maths? In the UK, our attitude towards maths is very much in a fixed mindset. We often hear people say they are 'rubbish at maths', but if children hear this, it could encourage them to believe that maths isn't important.

At Mathematics Mastery, we promote a growth mindset belief – that all children can achieve regardless of their background. To encourage children to develop a growth mindset around maths, the way in which we speak to pupils is very important.

The MM Lesson Structure for Key Stage 1 and 2

Mathematics Mastery lessons follow a 6 part structure. This keeps the lesson pacey, gives flow and allows more opportunities to teach creatively, give feedback and assess learning.

1. **Do Now**

This is a quick task all pupils can access without any teacher input as an introduction to the mathematics lesson.

2. **New Learning**

The New Learning segment introduces the main mathematical concepts for the day's lesson.

3. **Talk Task**

The Talk Task segment of the lesson practises the new learning by talking about maths with key vocabulary.

4. **Develop Learning**

The Develop Learning segment builds on the new learning and develops a deeper understanding of the maths concepts of that lesson.

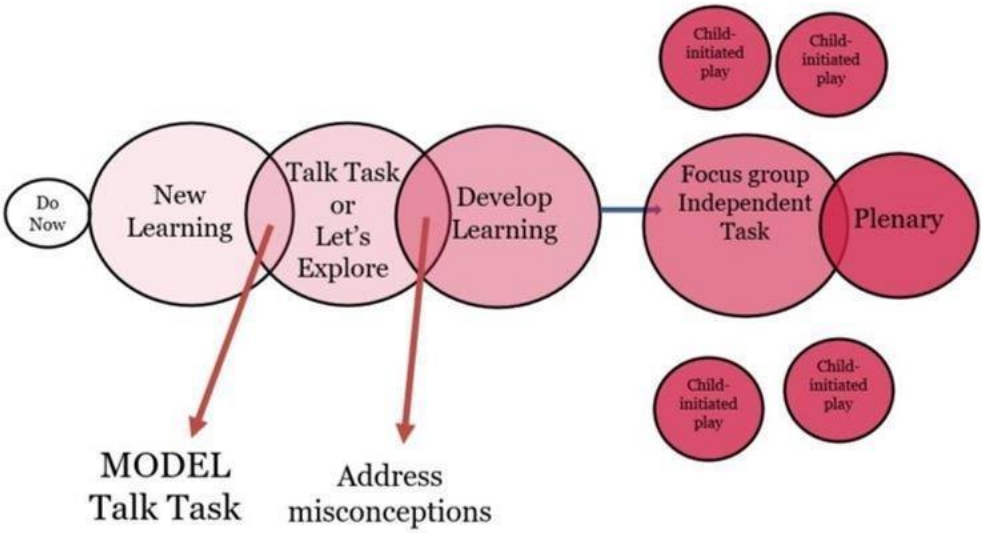
5. **Independent Task**

The Independent task practises learning independently through solving problems.

6. **Plenary**

The Plenary segment recaps on the lesson, checking understanding and celebrating success.

The MM Lesson Structure for Foundation Stage 2


Child-initiated play
Child-initiated play
Do Now
New Learning
Talk Task or Let's Explore
Develop Learning
Focus group Independent Task
Plenary
Child-initiated play
Child-initiated play
MODEL Talk Task
Address misconceptions