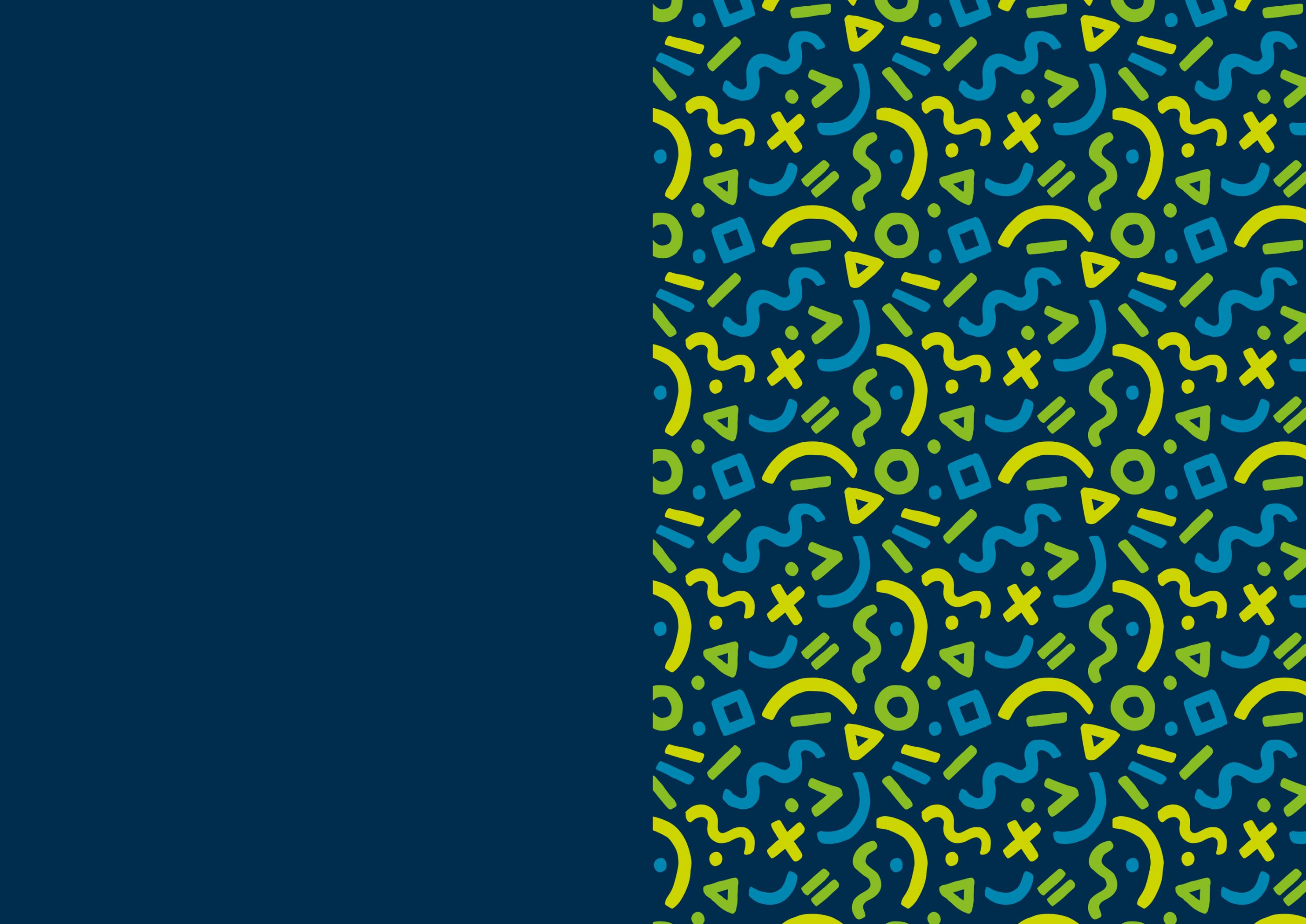


The Handy Little Guide to...

Maths Mastery

A practical guide to making sense of
maths mastery in your school





Making sense of mastery

Since the Department for Education (DfE) in England, announced their plans to support primary schools with implementing a teaching for mastery approach, mastery has become synonymous with maths teaching.



What is mastery?

Whilst mastery has captured the attention of teachers, it's carried with it a number of different definitions.

The National Centre for Excellence in the Teaching of Mathematics (NCETM) in England, is working with maths experts across the country to develop a consistent understanding of the key principles behind maths mastery. At its core, a mastery approach rejects the idea that some children can't do maths. It recognises that by nurturing positive attitudes and building confidence in mathematics, all children can achieve.

Concepts are built in small, logical steps and are explored through clear mathematical structures and representations. Children are taught together as a whole class and the focus is on depth - not acceleration - so that all children have a chance to embed learning. Teaching is supported by high-quality resources which present the flow of lessons coherently and provide opportunities for plenty of intelligent practice.

A new way of thinking about maths...

It's not until you explore these ideas further that maths mastery comes to life and starts to make sense! Our experience is that practitioners refer to mastery in slightly different ways - not because they don't understand it, but because they themselves are on a journey of discovery.

We've worked closely with teachers and experts to pull together this guide as a summary to help you unpick some of the key ideas and to experience mastery for yourself

“Teachers following a mastery approach plan carefully, ensuring that no child's understanding is left to chance.”

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Setting the scene

Back in 2014, the Department for Education's (DfE) Maths Hubs programme launched with the aim of helping schools and colleges in England lead improvements in mathematics education. There are now 35 Maths Hubs across England and they are coordinated by the National Centre for Excellence in the Teaching of Mathematics (NCETM). Each Hub acts as a leadership network involving schools, colleges and other maths education organisations from the surrounding area.

The government's commitment to developing maths education in England was brought further into focus in 2016 when they announced their plans to inject £41 million into mathematics education across more than 8,000 primary schools (half of the number in England). This funding is being released over the next few years to help schools to embed maths mastery teaching approaches.



Why the mastery approach?

Teaching for mastery in maths is fundamental to the government's education reforms and is reflected in the 2014 English national curriculum for mathematics. NCETM, DfE and OFSTED have all endorsed this evidence-based approach which is inspired by some of the leading performers in mathematics education (including Shanghai and Singapore).

The government holds high aspirations for primary mathematics in England, and wants to ensure children are equipped with the knowledge and skills they need to succeed. South East Asian countries rank highly in international mathematics tests, so over the past few years the Maths Hubs have been working closely with partner schools from these high performing jurisdictions. This exchange programme has been incredibly successful and has provided opportunities for teachers to come together to share best practice.



The essentials

Need to know

- A mastery curriculum is supported by extensive international evidence and endorsed by the Department for Education (DfE), OFSTED and National Centre for Excellence in the Teaching of Mathematics (NCETM) in England.
- The English National Curriculum 2014 has been developed to support mastery
- A mastery approach is characterised by whole class teaching
- High expectations are crucial – all children can achieve
- Depth should be valued over speed



Jargon buster

Whole class teaching	This method of teaching involves all children working together on the same lesson content at the same time.
Procedural fluency	Is the ability to apply mathematical procedures accurately, efficiently and flexibly to different contexts and problems, and to identify the most efficient procedure.
Conceptual understanding	Is the ability to understand the structure of the mathematics, represent concepts using a variety of representations, make connections between different representations, and apply concepts to new contexts.
Intelligent practice	Refers to precisely designed activities and practice questions that integrate the development of procedural fluency with deepening conceptual understanding. The arrangement of these tasks and exercises draws children's attention to mathematical patterns, structures and relationships.
Same-day intervention	This involves intervening quickly to tackle any key misconceptions so that children keep up and don't have to catch-up!
Concrete-Pictorial-Abstract (CPA)	CPA is a learning framework that helps children to develop a deep and secure understanding of abstract concepts. The concrete stage encourages children to physically explore mathematical concepts by handling and moving objects and apparatus. The pictorial stage involves working with pictures of concrete apparatus and visual representations. In the abstract stage, children represent concepts with symbols, numbers and mathematical notation. Whilst there is a progression between the three stages, children may move back and forth to help them tackle new mathematical concepts.

Principles of teaching for mastery

In their document, *The Essence of Maths Teaching for Mastery*, the National Centre for Excellence in the Teaching of Mathematics (NCETM) have pinpointed the key principles behind maths mastery:

- Maths teaching for mastery rejects the idea that a large proportion of people 'just can't do maths'.
- All pupils are encouraged by the belief that by working hard at maths they can succeed.
- Pupils are taught through whole-class interactive teaching, where the focus is on all pupils working together on the same lesson content at the same time, as happens in Shanghai and several other regions that teach maths successfully. This ensures that all can master concepts before moving to the next part of the curriculum sequence, allowing no pupil to be left behind.
- Significant time is spent developing deep knowledge of the key ideas that are needed to underpin future learning. The structure and connections within the mathematics are emphasised, so that pupils develop deep learning that can be sustained.
- Key facts such as multiplication tables and addition facts within 10 are learnt to automaticity to avoid cognitive overload in the working memory and enable pupils to focus on new concepts.
- If a pupil fails to grasp a concept or procedure, this is identified quickly and early intervention ensures the pupil is ready to move forward with the whole class in the next lesson.
- Lesson design identifies the new mathematics that is to be taught, the key points, the difficult points and a carefully sequenced journey through the learning. In a typical lesson, pupils sit facing the teacher and the teacher leads back and forth interaction, including questioning, short tasks, explanation, demonstration, and discussion.
- Procedural fluency and conceptual understanding are developed in tandem because each supports the development of the other.
- It is recognised that practice is a vital part of learning, but the practice used is intelligent practice that both reinforces pupils' procedural fluency and develops their conceptual understanding.

NCETM, *The Essence of Teaching for Mastery*, 2016



High expectations for all

It is not unusual for people to say 'I can't do maths' but you rarely hear people say this about reading or writing. The mastery approach recognises the value of thinking and learning rather than just doing.

Global research and best practice shows that learning is greatly affected by what individuals perceive they can (or cannot) do. Teaching for mastery rejects the idea that some people can't do maths - all children can achieve with hard work! Parents, carers and teachers all have a huge part to play in conveying this message to children. If children hear the people around them saying they can't do maths, or that they don't like maths, this is likely to have a negative impact on their learning.



Tips

- **Encourage growth mindsets:** Praise motivates children, but remember to pick your language carefully. Reward children for their effort rather than by telling them they're 'clever' or 'smart'. This will help children see the value in learning and will encourage them to take risks, to try harder and to persist with problems.
- **Learn from mistakes:** Remind children that mistakes can help them learn. Try not to dismiss errors if they arise in class - instead, talk about mistakes and explore them together. Mistakes are valuable opportunities to understand more deeply and help to build resilience.



Whole class teaching

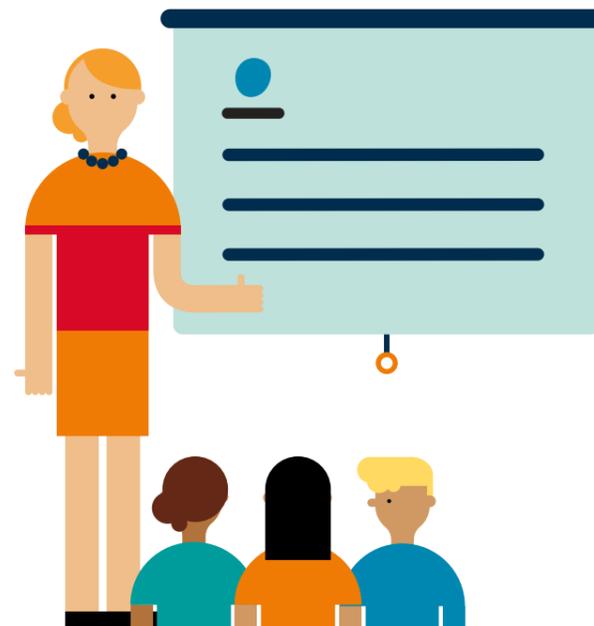
In a mastery approach, children are taught as a whole class. The teacher engages the class through interactive back-and-forth questioning and all children tackle the same concept in small, cumulative steps. The teacher does not move to the next stage until all children demonstrate that they have a secure understanding of the concept.

In English primary schools, lessons have traditionally followed a set structure: starter activity, main teaching input, differentiated group work (with children working on different activities depending on how able they are perceived to be) and a plenary. Because mastery rejects the idea that some children can't do maths, it's important that children are taught together as a whole class. All children should work on the same learning objective and activity, but tasks that explore concepts in greater depth should be provided for children who have grasped the topic more rapidly and strengthening activities should be provided to support children who may find the concept more challenging.



Tips

- **Mix it up:** Do not group children by perceived ability or stick to set groups at each table. Changing table groupings may feel like an unnecessary inconvenience, but the benefits are vast. It's important for children to explore, discuss and share their maths experiences with others.
- **Explore maths together:** Reflect on the way you currently structure your maths lessons. Do they give all children the opportunity to access the same tasks and achieve the same learning goals? Low-threshold, high-ceiling tasks are great for getting all children working together.
- **Build in time to talk:** Encourage children to talk about the different strands of mathematics so that they appreciate how diverse the subject is. Talk about your learning preferences as a class, reinforcing how together you have the skills to tackle any problem!



Lesson design

In teaching for mastery, teachers think differently about the structure of their maths lessons and carefully design each lesson to build step-by-step, strong foundations of cumulative knowledge and understanding.

Each lesson is focused on one learning objective, representing a small step in learning and building on the step that came before. Mathematical ideas are explored deeply and children are exposed to a range of different structures and representations.

Common misconceptions are identified in advance of the lesson so that they can be teased out and tackled together as a class. By moving slowly through the curriculum, teachers are able to explore common errors in detail. In this way, misconceptions and difficult points become an essential part of lesson design and planning.



Tips

- **Develop a toolkit of structures and representations:** Ensuring children can work flexibly with different structures and representations is a great way to strengthen and deepen learning. Take time to agree as a school on the core mathematical structures you are going to use to explore concepts with children. Bar models, part-whole models and number lines can all be used to represent similar concepts.
- **Tackle misconceptions together:** Embrace answers that reveal a misconception - these are great learning opportunities for the whole class.
- **Mathematical conversation:** When children talk purposefully together about maths, barriers of fear and anxiety are broken down. Children should be encouraged to use full sentences when reasoning, explaining or discussing maths. Key vocabulary should be used precisely. Don't feel you need to dilute language for children - most children will embrace the challenge of learning new maths words!

Procedural fluency and conceptual understanding

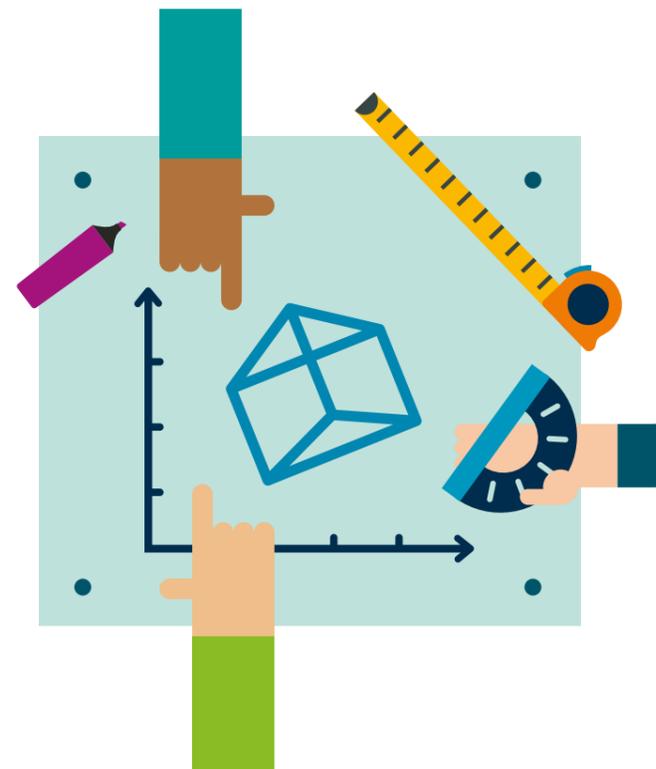
If a child has developed procedural fluency, they will be able to work confidently and fluently with mathematical procedures and operations. If a child has developed conceptual understanding, they will understand the ideas that underpin the procedures. A child who has developed both skills will, for example, be able to choose the most efficient method to complete a set of multiplication calculations and also explain their answers by referring to mathematical concepts such as equal groups.

It's crucial that procedural fluency and conceptual understanding are taught in tandem. This can be achieved by thinking carefully about the nature, structure and sequence of activities. Tasks and exercises should expose the underlying structure of concepts and the mathematical relationships between the current and prior learning. Not all tasks and exercises lead to a single answer - some should require children to comment on answers and results, reason, explain how they know, or to say what they have noticed.



Tips

- **Plan varied activities:** Think carefully about the activities and tasks you give to children so that both procedural fluency and conceptual understanding are developed in tandem. Ensure that tasks are varied: rote repetition may build speed, but it is unlikely to move children on or reveal misconceptions.
- **Use varied representations:** Use the Concrete-Pictorial-Abstract approach to help children understand the concepts that underpin procedures. When introducing formal addition and subtraction methods, for example, it can help to model calculations in place-value grids using base 10 equipment.



Same-day intervention

In a mastery approach children build their understanding in small, logical steps. Each step must be secure before moving on to the next. It is critical that no gaps in understanding are left unfilled.

Same-day interventions – either within or after a lesson – are crucial. They act as a safety net, ensuring that children are keeping up and not catching up.

Tackling gaps and common misconceptions as they arise means that children are able to continue on their learning journey with the rest of the class.



Tips

- **Identify who needs intervention:** Whilst a child may grasp one concept quickly, they may grasp another more slowly. Your 'speedy learners' will not always be the same, and the children requiring intervention are likely to differ depending on the topic you're teaching!
- **Intervene promptly:** Whilst it can be challenging to find the time to intervene on the day, it's important to tackle misconceptions head on. This can be done in the lesson, or after the lesson, but avoid taking children out of another maths lesson for extra support. Remember, it's important for the whole class to learn and progress together!
- **Develop your approach to intervention:** It often helps to present the same problems tackled in lessons, with a variety of concrete materials to help develop understanding.

Learning deeply

The national curriculum in England places emphasis on depth and breadth, not speed and acceleration:

“Pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content.”

National Curriculum: *Mathematics Programmes of Study, 2013*

Traditionally, children who have learnt a concept quickly have been accelerated through the curriculum. As a consequence their learning may be superficial – children may understand how to use a method or procedure, but not understand why or how it works. This often leads to difficulties as maths becomes more challenging.

A mastery curriculum requires that right from the start, children are given time to think deeply about maths so that they understand the concepts as well as the procedures. Whilst it may feel like you don't have enough time to cover all of the curriculum, this slower pace actually leads to greater progress because it ensures that children are secure in their understanding and teachers don't need to revisit topics once they've been covered in depth.



Tips

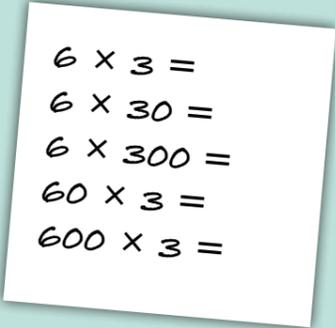
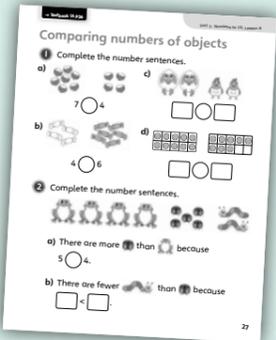
- **Misconceptions as challenges:** Misconceptions can provide great depth tasks for children who have grasped a concept. For example, children can be given incorrect solutions and challenged to identify how and why errors have been made.
- **Explore sophisticated problems:** Explore problems together as a class, making sure these are situated in both familiar and unfamiliar contexts. Encouraging children to reason and explain how they know is a great way to build depth.



Intelligent practice

Intelligent practice is a key feature of teaching for mastery. It involves the precise and careful design of questions which require children to think deeply, explore structures, patterns and relationships, and make mathematical connections.

In intelligent practice, repetitive and mechanical exercises are avoided. Variation is one aspect of intelligent practice. It draws children's attention to the important features of a concept and deepens learning by revealing underlying mathematical structures. Variation can be either procedural or conceptual.

<p>Procedural variation</p>	<p>Procedural variation can be introduced by varying:</p> <ul style="list-style-type: none"> • the numbers, the unknown or the context (see example) • The processes for solving a problem • The problems by applying the same methods to a group of similar problems 
<p>Conceptual variation</p>	<p>Conceptual variation can be introduced by varying the representation (see example).</p> 



Tips

- **Find support in high quality resources:** You may choose to access resources online, create them in school or purchase materials which suit your needs. Whatever you decide, make sure the resources you choose provide opportunities for children to reason, make connections, and move their thinking on.

Number facts

Whilst children should be given time to solve mathematical problems, as their learning journey progresses they should also start to know key facts such as multiplication tables and addition facts within 10 automatically.

Alongside their mastery reforms in mathematics, the English government are trialling assessments which target fluency in younger children (specifically a times table test in Year 4). Whilst mastery is not about rote learning, an ability to recall key facts avoids cognitive overload in the working memory and frees children up to work on more complicated mathematics.



Tips

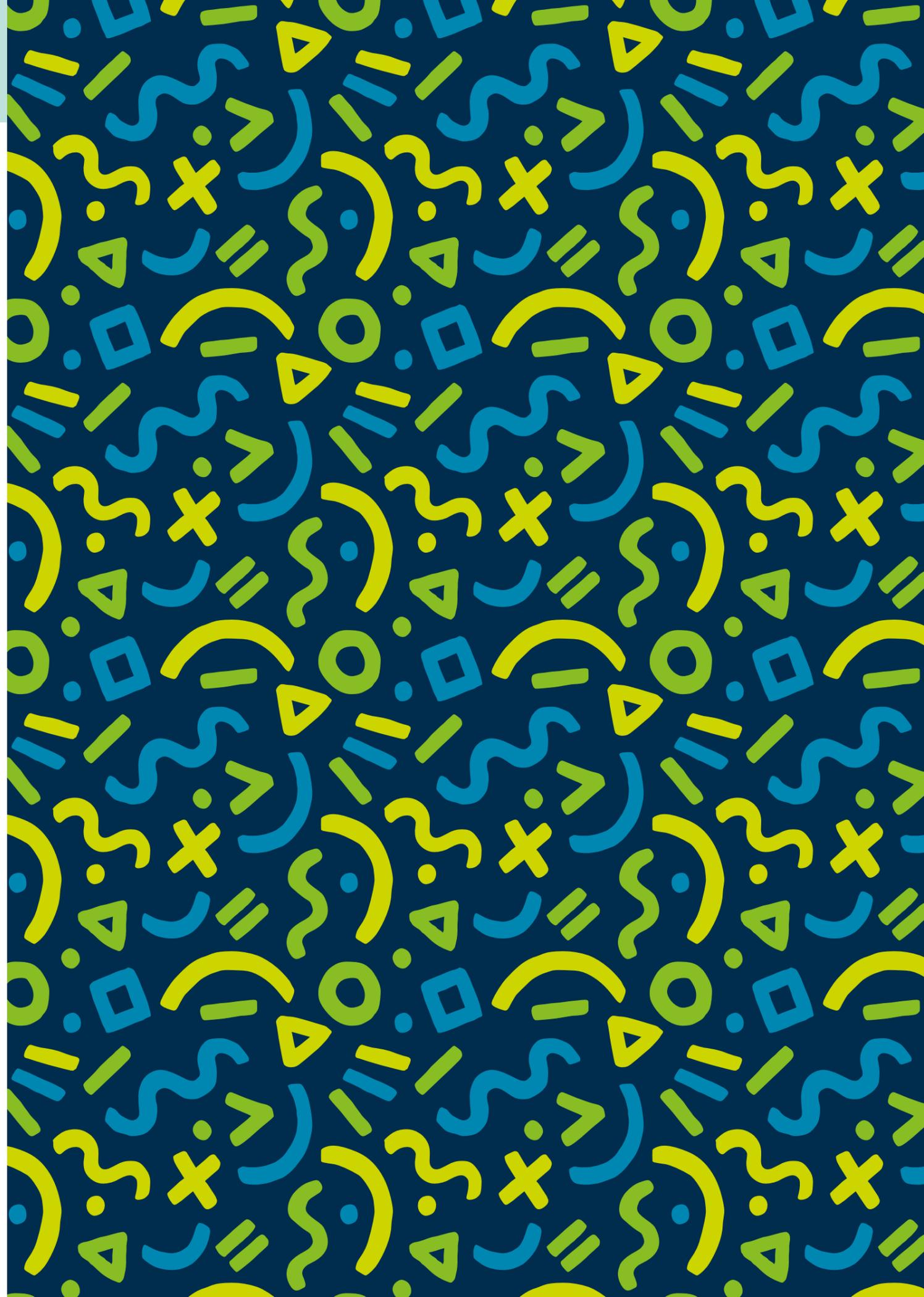
- **Frequency develops fluency:** Build in opportunities to rehearse key number facts. Transitions throughout the school day can provide useful opportunities to keep key number facts on the boil.
- **Use your classroom creatively:** Think about how you can use the displays and wall space in your classroom creatively to provide reminders of the key facts children need to know.

Where can I access resources and training to help me teach for mastery?

There are a range of resources to help you teach for mastery. A variety of tools and materials can be accessed through the NCETM: www.ncetm.org.uk



If you're looking for a high-quality teaching resources and training for your school, Pearson offer a range of solutions to meet your needs. Power Maths has been developed specifically to support schools with implementing a mastery curriculum, find out more at: pearsoninternational-schools.com/powermaths



Want to find out more about mastery?

If you've found this guide useful, you can access more mastery support from Pearson on our website. You can sign-up to receive mastery updates and articles via email too!

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