Primary & Early Years Magazine 98

**National Centre for Excellence in the Teaching of Mathematics**

Hello and welcome back to a new school year! Now that the long summer is a distant memory and the early mornings have a distinct chill to them, we take a look at the curriculum areas covered by this summer's KS2 SATs and point out It's not just about Year 6 content! We also offer a peek at the first chunk of the soon-to-be-published NCETM Mastery PD Materials, that will track a mathematical learning journey from Y1-Y6.

Don't forget all previous issues are available in the Archive.

This issue's featured articles
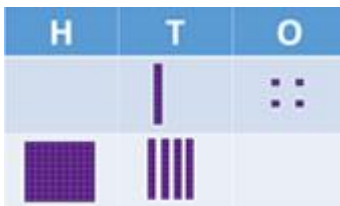
KS2 SATs – it's not just about Year 6 content

If you're teaching Y6 this year, no doubt you have paused for a moment to consider the content of the KS2 Maths SATs. However, are you aware that what children have learned before they reach Y6 forms a substantial part of the SATs content? This article looks at the curriculum content covered by this summer's SATs papers and offers classroom ideas for some of the key teaching points.

Introducing the Mastery Professional Development project

What are the steps and processes a child goes through when learning to subtract 3 from 5? We can teach a child a procedure, but how do we ensure that children gain 'number sense' and understand concepts deeply? This is what the team behind an NCETM/Maths Hubs project, have been addressing. The project is now beginning to publish exemplification materials for classroom use but with important professional development commentary explaining the pedagogy behind each small step. In this feature, we explain the project and allow a peek into the materials

This year's primary projects in Maths Hubs

Maths Hubs are gearing up for new projects on a range of themes this year, including several focusing on primary mathematics. Alongside the continuing work, led by Mastery Specialists, in nearly two thousand schools, each Maths Hub is now recruiting teachers and schools for separate, smaller professional development projects (Work Groups) in a number of related areas, including:

- Intervention to help pupils keep up
- Lesson design and showing evidence of understanding at greater depth
- Continuity in maths between Year 5 and Year 8
- Transition between primary and secondary school
- Maths in Early Years, including early language development

If you or your school would like to take part in any of these funded projects, contact your local Maths Hub to find out which ones they are running this year.

And here are some other things for your attention:

- You may remember reading, in a recent issue of this magazine, about a research project, into the teaching of times-tables, completed by a group of teachers in one of the Maths Hubs in London. Well, they've committed their findings to print in a 54-page book, *Talk Times Tables.* More details and purchase information from admin@eleanorpalmer.camden.sch.uk.
- On the subject of times tables, the Education Secretary has stated that from 2019, Y4s will sit times tables tests (not Y6s as originally planned). In the same statement to Parliament, she announced a number of reforms to primary assessment including introduction of a 'base line' test in reception

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(from Sept 2020) to replace end of KS1 SATs (becoming non-statutory in 2023).

- A report into how disadvantaged children can be helped in maths has identified and commended a number of schools participating in the Maths Hubs' Teaching for Mastery programme. The report, from the Fair Education Alliance makes a number of recommendations to schools including 'a whole class approach', teachers planning together, and developing a culture of 'everyone can do maths'. Many of the schools cite teaching for mastery as pivotal to their success.

KS2 SATs – it's not just about Year 6 content

Now the dust has settled on 2016-17, it is time to gather our thoughts as we start a new year. Much analysis will already have been done on the 2017 Maths SATs papers; you will know by now where your children did well and where they perhaps did not do so well. Although those children have now left, we can use this information to amend planning for next year to allow for time to check and go deeper into those aspects of maths which may have caused problems over the last couple of years.

From looking at the Maths SATs papers over the last two of years, it is clear that there is an emphasis on new aspects of the curriculum such as calculating with fractions and the ability to multiply and divide by two-digit numbers. There is also a need for children to know mathematical facts and to have a good understanding of mathematical language in order to solve problems on the reasoning papers.

These crucial aspects of mathematics are not just from the Year 6 curriculum and therefore we must ensure that children are secure with maths from Years 3, 4 and 5 as well as with the new material introduced in Year 6.

The DfE has published its overview of the KS2 maths curriculum content involved in each of the questions in the 2017 KS2 SATs Papers. As would be expected, the majority of the questions towards the end of each paper are derived from Year 6 content, but there is a clear requirement for children to have mastered content from previous years as this is heavily focused on, in earlier parts of all three papers. Indeed, more than 50% of the marks available come from questions based on the Year 3-5 curriculum.

Marks awarded by year curriculum content
Total number of marks: 110

	Paper 1 (40)		Paper 2 (35)		Paper 3 (35)		Total (110)	
Year 3	3	7.5%	0	0%	3	9%	6	5%
Year 4	10	25%	10	29%	7	20%	27	25%
Year 5	7	17.5%	12	34%	9	25%	28	26%
Year 6	20	50%	13	37%	16	46%	49	44%

Key elements of mathematics from the other year groups are listed below and we have highlighted a few key teaching points from particular questions from the Arithmetic paper linked to aspects of the Year 3, 4 and 5 curriculum. Fluency in these areas of maths is vital if children are going to be able to apply them when tackling less routine problems on the reasoning papers. Having key skills in their long-term memory allows children to draw on them easily in different situations and mathematical contexts.

Year 3

- Arithmetic based on Year 3 place value understanding
- Calculation in context including informal and early formal methods for all four rules

From Paper 1 (Arithmetic)

5 | $345 - 60 =$

Key teaching point – counting across boundaries

This question is one which it would be hoped that children would solve mentally, as the time allowed for the arithmetic paper is tight if they use written methods for all questions. The squared paper can lead some children to think that they have to write down their working out for all questions and this is something that needs to be discussed with the children – which method is the most efficient?

In order to be able to solve this mentally, children will need to be fluent in counting across boundaries, in this case counting backwards in tens across the hundreds boundary. This can cause problems for some children as the verbal/auditory pattern breaks down 345, 335, 325, **315, 305, 295,** 285. If they use their number bonds knowledge and regroup the 60 into 40 and 20, they still need that counting experience to be able to subtract 20 from 305.

Children need the opportunity to count on and back from different starting points in different step sizes right across KS2. One idea is to give different tables/groups a different step size and starting point. After a certain amount of time everyone stops and their final numbers are shared. Questions such as *'Explain why this number does/doesn't fit into this count'*, or *'If you carried on, would 236 be in your count?'* will give the children the opportunity to reason about the sequence they have generated.

Year 4

- Arithmetic based on Year 4 place value understanding
- Formal calculation methods including multiplying and dividing by single digits
- Calculating with money and decimals
- Times table knowledge and its application
- Properties of shape
- Rounding

From Paper 1 (Arithmetic)

21 | $9 - 3.45 =$

Key Teaching Point – Arithmetic Including Equivalent Calculations

This calculation as a column subtraction can lead to errors caused by children ignoring the numbers after the decimal point or in regrouping from the 9 ones to the hundredths. If children are fluent in their understanding of the structure of subtraction as difference, knowing that 9 – 3.45 = 9.55 – 4 then the calculation is simplified and there are far fewer opportunities for errors in applying a formal written method. Do we encourage children to look at the numbers in a calculation before diving in with a written method? A few moments looking and thinking can often reveal a more efficient way of arriving at an answer.

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Using equivalent calculations may not be a strategy that comes naturally to us as adults as it is unlikely to be the way we were taught. Fluency in calculations and the ability to select the most efficient method relies on a deep understanding of the structure of the calculation. Once the structure of subtraction as difference is understood, then creating a simpler equivalent calculation becomes an efficient strategy. The Teacher Guides to Addition and Subtraction in the forthcoming NCETM Mastery PD Materials use representations to reveal the structure of calculations and how this supports the understanding of strategies, including equivalent calculations.

Year 5

- Using place value to multiply and divide by multiples of 10, 100 and 1000
- Decimal place value
- Rounding larger numbers
- Calculating with mixed numbers
- Formal calculations with larger numbers
- Angles
- Roman Numerals
- Time and measures
- Properties of numbers – squares and primes
- Calculating area

From Paper 1 (Arithmetic)

16 $\quad 30 \times 40 =$

18 $\quad 0.04 \div 10 =$

19 $\quad 2,345 \times 1,000 =$

Key Teaching Point – Using Place Value to Multiply and Divide by Multiples of 10, 100 and 1 000

This mental skill is so important and links to children's understanding of Multiplicative Reasoning – understanding multiplication as scaling 'times bigger' rather than just as repeated addition. Understanding that moving the digits is making them ten times bigger or smaller is vital, both in questions testing their fluency, but also for application in more complex problems, often involving measures.

Children need to be able to explain what is happening as digits move between columns. Using place value sliders can help children to see that it is the position of the digit which determines its value. The 'Moving Digits' ITP (originally from *The National Strategies*, now part of *The National Archives*) is a resource which allows you to model this to a whole class. Involving children in moving themselves on a place value chart (holding digit cards) is another powerful way to emphasise that moving the digit changes its value. The chart could be chalked on the playground, hung on a washing line or a line of labelled chairs. Place value resources such as Dienes can be used to model the numbers as they change so that children can see that when a 3 moves from the tens to the hundreds column, the value changes from 3 tens to 3 hundreds – the digit is now worth ten times more, as illustrated here:

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H	T	O

14

140 = 14 X 10
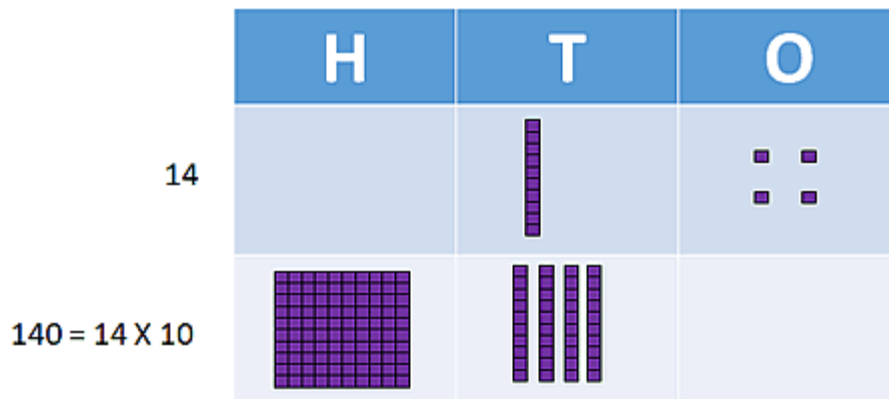
From Paper 1 (Arithmetic)

35 $1\frac{1}{2} \times 57 =$

Key Teaching Point – Calculating with Mixed Numbers (Fluency in Halving and Doubling)

Do all our children understand that multiplying by a half is the same as halving? This problem becomes simple when it is just adding half of 57 to 57 as long as children are fluent in halving numbers where both digits are odd.

Do we spend enough time rehearsing mental strategies such as recalling doubles and halves and making the link to fractions? If children are fluent in these strategies and have made the links with fractions, then this, the penultimate question on Paper 1, is really quite simple.

Assumed in all the KS2 work is the fact that the children have mastered the KS1 Curriculum with its vital components of number, place value and understanding of the structure of calculation.

Looking at this breakdown and taking into account what you know from looking at your own children's SATs papers, what are the key messages that you need to share with staff? What areas of mathematics need to be a focus in your school over this next term and throughout the year? Is there a particular year group which may need support?

The NCETM is publishing a set of Professional Development Materials later this term, to support teachers in planning the coherent, small steps of learning needed to ensure that children develop a deep understanding of the maths curriculum. Your local Maths Hub may be running Work Groups or hosting training which could help you to develop areas of the curriculum which you have highlighted for development.

Introducing the Mastery Professional Development project

Can every primary teacher confidently subtract 3 from 5? Of course. How about listing the multiples of 10 up to a hundred? Yes, naturally. But can every primary teacher confidently describe the mental process that a child goes through in initially understanding and securing knowledge of this kind for themselves? And can they put in order all the small steps necessary for a child to acquire a secure and lasting mathematical understanding to make them ready for Key Stage 2 maths, for example? Now those are different questions. And they lie behind an NCETM/Maths Hubs project that is soon (later this term) to bear fruit.

It's called the **Mastery Professional Development** project and the materials being produced aim to help primary teachers develop the subject and pedagogical knowledge necessary to underpin teaching maths in a way that will support pupils' incremental mastering of the subject.

It's a major project, with input from classroom teachers, Mastery Specialists, university academics-all coordinated by the NCETM's Primary team. Materials will be published in phases during this school year and next, initially in draft form as part of a trialling process.

The first wave of the materials, covering Number, Addition and Subtraction will appear later this term, but here we are giving you an early preview of some of the content. We hope it might prove useful for staff discussions, or even contribute to the thinking behind lesson planning.

The examples below come from a segment of the materials linked to the stage in Year 1 when children are introduced to addition, through a real-life situation where a quantity is augmented, or increased. Similarly, for subtraction, pupils see quantities reduced, or decreased.

The segment, covered in a 20-page Teacher Guide, is divided into four Teaching Points:

Teaching point 1:

An addition context described by a *'first…, then…, now…'* story is an example of augmentation. We can link the story to a numerical representation – each number represents something in the story.

Teaching point 2:

A subtraction context described by a *'first…, then…, now…'* story is an example of reduction. We can link the story to a numerical representation – each number represents something in the story.

Teaching point 3:

Given any two parts of the story we can work out the third part; given any two numbers in the equation we can find the third one.

Teaching point 4:

Addition and subtraction are inverse operations.

The first teaching point envisages pupils first discussing and thinking about a story where augmentation happens. And, at the outset, the words **'first…then…and now'** are introduced:

'First, three children were sitting on the carpet.
Then, two more children sat on the carpet.
Now, five children are sitting on the carpet.'

Next, a similar story is represented pictorially:

First   Then   Now
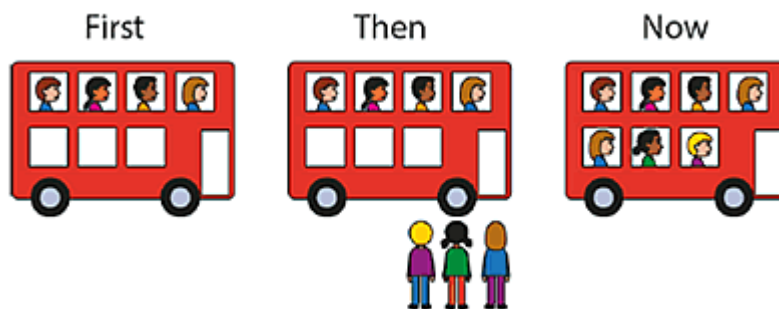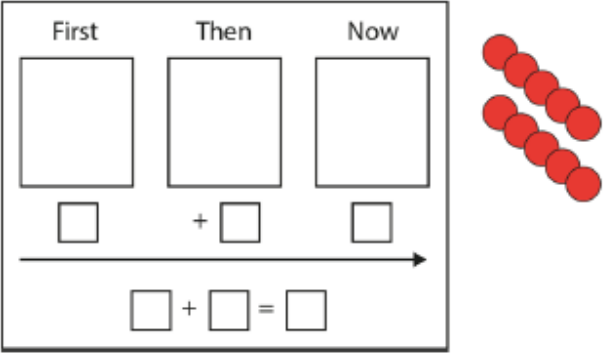
And then, first using an arrow and then the 'plus' and 'equals' signs, the abstract notation is introduced:

First   Then   Now

4   + 3   7

$$4 + 3 = 7$$
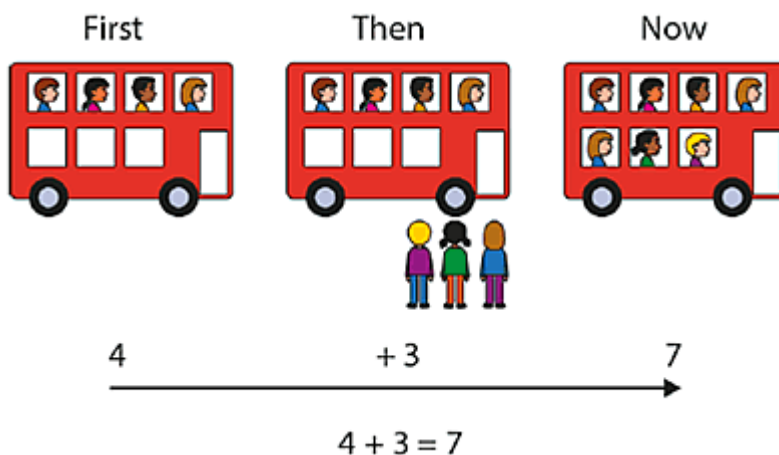
These stages are included in a set of animated slides that will be published alongside each teacher guide.

Each teacher guide is designed with two columns, one with guidance for the teacher and the other with suggestions for representations:

1:5	To deepen children's understanding and strengthen the links they are making between the abstract representations and each part of the story, provide them with a *'first…, then…, now…'* card and ten counters.	First Then Now

To deepen children's understanding and strengthen the links they are making between the abstract representations and each part of the story, provide them with a **'first…, then…, now…'** card and ten counters.

Children can use the resource to tell and record their own stories, for example:

- **'First**, three children were sitting on the carpet.' Place three counters in first box.
- **'Then**, two more children sit on the carpet.' Move the three counters across and add two more.
- **'Now**, there are five children on the carpet.' Move all five counters to the final box.

Question children on each part of their story, for example (referring to the 'first' box), 'How many sweets did the boy have at the beginning?' or (referring to the 'then' box) 'How did the number of sweets change?'

In a similar way, question children on the meaning of each number at different points in their stories.

Each teacher guide also suggests ways in which a teacher might set more challenging tasks for pupils, as is common in Shanghai where such tasks are called dòng nǎo jīn problems, as in this section of the teacher guide:

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| 3:4 | To provide further challenge and promote depth of understanding, you can use a dòng nǎo jīn problem: given only one part of the story, can children find a way to satisfy the missing parts? Can they find another way? | *'Can you write a story which ends with six children on the bus?'* First Then Now |

You'll gather, having seen the limited excerpts from just one of 30 teacher guides in the Number, Addition and Subtraction section of the materials, which will cover learning from Years 1 to 6, that, in total these professional development materials will form a substantial resource to strengthen the pedagogical subject knowledge of primary teachers.

In the coming year, once the first tranche is published, we'll be open to feedback and suggestions as to how they can most profitably be used by teachers in schools, alongside their other responsibilities.