Introduction

We designed our ‘unfair’ curriculum
as explained by Tim Oates, Group Director of Assessment at
Cambridge Assessment and Chair of the expert panel that informed the
New Curriculum. We see these as essential ingredients to be planned for and
probed in calculation lessons. It’s essential that we ask questions that are sometimes
practise and learn from each other’s reasoning.

fast recall, reasoning must be a part of every maths lesson. Moreover, all children deserve the opportunity to
sail to a new year group. For our lowest attainers to develop connections between different areas of the maths
curriculum – linking thinking – and for our highest attainers to develop depth in mathematics rather than just

The New Curriculum aims to be a mastery curriculum: all the children should be on the boat before setting

Reasoning is the magic ingredient that gives mathematics purpose, direction and depth. If a child can reason,
they can justify, generalise, prove, explain and explore; in essence, they can

Why is reasoning so important?

With the aims of developing reasoning in children, and developing questioning in teachers in mind, we developed
questions we ask!

During the academic year 2013-14, a group of teachers met several times after school to examine how to place reasoning at

- Articulate mathematicians
- Logical thought
- A sense of injustice
- Flexibility with the inverse
- Awareness that there’s more than one way to skin a cat
- Articulate mathematicians
- Teachers who can explain connections and processes to help them to explain their reasoning;
- Confidence to talk and ask challenging, higher level questions.

What are question stems?

Give me an example of . . .

A common factor of 66 and 24

A multiple of 3 over 200 (using the rule that multiples of 3 have digits that add to 3, 6 or 9)

A multiple of 6 over 1000 (using the rule that multiple of 6 must be even multiples of 3)

What’s in the empty box?

Give children 2 ‘clouds’ of numbers and get them to fill the empty boxes:

What is the same / different about . . .

Which of these numbers/calculations are trickier? Why?

Do you agree or disagree that . . .

Is it always sometimes/never true that . . .

Spot the pattern, explain the pattern.

Find an equivalent for . . .

The answer is . . ., what’s the question?

What is the empty box?

If we know . . . what else do we know?

Spot the mistake . . . explain the mistake

Prove by drawing/using dienes/using algebra that . . .

If we know . . . what do you know?

What’s in the empty box?

What’s in the empty box?

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What’s in the empty box?

The NCETM has published progression documents laying out the New Curriculum objectives in strands so that teachers can see how expectations progress
across year groups. We matched each calculation objective with several question stems and examples that can be reasoning to get the free or it doesn’t stay
inside our heads!

Kate from Holy Trinity NW3 on Give me an example of...

136 - 3 = 45 r1 so when would the answer be 45 and when 46?

Can you make up/draw a story/real situation for this equation . . .

Create stories for a division where you round up/ down after you find the remainder.

Can you make up/draw a story/real situation for this equation . . .

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The MTCF has published progressive documents laying out the New Curriculum objectives in strands so that teachers can see how expectations progress
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Natalie from Eleanor Palmer on The empty box!

Kate from Holy Trinity NW3 on Give me an example of...

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25
16
28
12 x = 60
32
22
9
1
3
10
2

What is the empty box?

The New Curriculum and we want these to be strong threads that
weave together in our mathematics teaching. However, although the New Curriculum is clear about the end of year expectations for children's
calculations, there is no explicit guidance about how to build a culture of reasoning in the classroom.

Problem solving, reasoning and fluency are the key areas of the New National Curriculum and we want these to be strong threads that
measurability in our mathematics teaching. However, although the New Curriculum is clear about the end of year expectations for children's

We have decided that question stems are the key means by which children learn and develop the reasoning skills that we want to see
inside our heads!
helped everything click into place a lot faster, developing much more security and the ability to choose methods with thorough understanding. Can see that newer, different strategies have their advantages too. Comparing the similarities and differences is a fantastic way to transition from the past to the side-by-side – ones that the children have looked at and truly understand versus those that are upcoming or newly learnt – children can see the similarities and anything that encourages children to see a common, overriding theme in maths is going to develop confident mathematicians. By looking at calculation strategies solving the mystery of a missing number! For those children who are hungry for more, it’s great fun to use decimals or negative numbers when talking about the inverse. be used to apply to more challenging word problems. The question stems weave beautifully with the fabulous empty box and provides opportunity for code breaking and the opposite of…? What happens to a number if you…? Talking about ‘going in backwards’ to a number sentence to ‘unpick’ it, is a great approach and once grasped can algebraic calculation, using the inverse enables children to reason and discuss the effect of different operations on a number. Will my answer be bigger or smaller? What is understanding and fluency of the relationship between different functions and consequently the number system. Whether thinking about fact families or a trickier, more of questions require children to use and understand inverse operations, or ‘doing the reverse’! Understanding the concept of inverse, enables children to develop a clear ‘I am thinking of a number’ …an opening phrase with which we are all familiar! Whether as a starter, or cropping up (as they frequently do) on a SATs paper, these sorts of questions require children to use and understand inverse operations, or ‘doing the reverse’! Understanding the concept of inverse, enables children to develop a clear conclusion or solution, starting from their very first assumptions about the problem and working through methodically and logically. Any jumps of logic can be countered with yet another ‘Prove it!’ interjection, or by telling them that you are not yet convinced. This teases out further nuggets of reasoning gold! This when children tell you, ‘I just did it in my head!’ it is truly powerful to ask them to ‘Prove it!’ They have to deeply consider the reasoning that led them to their answer. ‘I can prove it by that!’ It is important to get these children to see that an answer is not just a number, it is a sentence that can be constructed with yet another ‘Prove it!’ interjection, or by telling them that you are not yet convinced. To tease out further nuggets of reasoning gold! This an opportunity to identify the actions that the children are responsible for in order to complete their thinking. Every child looks at a problem in a slightly different way and the way they approach a problem is unique. There is nothing wrong with ‘your way’ just as long as you can prove it… Then it’s just a matter of taking their reasoning, through just as less challenging, leading to developing hypotheses and testing generalizations and patterns. ‘If you have proved that… then what can you say about…?’

Lucy Foster – Eleanor Palmer, Monica Gallagher – Brecknock, Tom Gibson – Eleanor Palmer, Callum Moore – Brecknock, Rhian Mulji – Fleet, Kate Roscoe – Holy Trinity NW3, Claire Trewhella – Torriano Juniors

Developing Reasoning

The key to teaching calculation effectively

A summary of the findings of a Joint Practice Development Group of the Camden Primary Partnership Teaching School Alliance