PROBLEM SOLVING AND REASONING IN THE NEW NATIONAL CURRICULUM
NEW NC FOR MATHS – ‘PURPOSE OF STUDY’

Mathematics is a creative and highly inter-connected subject ... **It is essential to everyday life ...** and necessary for financial literacy and most forms of employment.

A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

**Great news**

This message is crucial
WHAT ARE OFSTED LOOKING FOR WHEN THEY OBSERVE MATHS TEACHING IN SCHOOLS?

The 3 aims of the new NC for maths:

Talk to those around you and see if you know them.

1. Fluency
2. Reasoning
3. Problem Solving

‘The aims of the mathematics national curriculum, fluency (that blend of conceptual understanding and procedural flexibility), mathematical reasoning and problem solving, capture the best in mathematics education that we would surely want for any pupil.’ (Jane Jones NCETM blog November 2014)

‘a common clear emphasis in training on problem solving was not reflected in trainees’ teaching or, too often, in the teaching within the school. Some trainees said that they had not observed teachers teaching problem solving’. Ofsted (2013)
Mathematics Curriculum Framework
Singapore

Numerical calculation
Algebraic manipulation
Spatial visualisation
Data analysis
Measurement
Use of mathematical tools
Estimation

Beliefs
Interest
Appreciation
Confidence
Perseverance

Monitoring of one’s own thinking
Self-regulation of learning

Reasoning, communication
and connections
Applications and modelling
Thinking skills and heuristics

Numerical
Algebraic
Geometric
Statistical
Probabilistic
Analytical

Skills
Processes
Concepts
Mathematical Problem Solving

Attitudes
Metacognition

(CPDD, 2013)
Maths in the real world

The answer could be between 6 and 9

What’s the question?
The answer is 30 ... what is the question?
Think of 3 questions to ask your class.

**SOLVERS AND POSERS?**
What opportunities do you give your children to pose the questions?
Differentiation?
‘Clearly, if children’s interests are not kindled through using and applying mathematics in interesting and engaging ways, and through learning across the full mathematics curriculum, they are unlikely to develop good attitudes to the subject’.
WHAT IS A ‘RICH’ ACTIVITY FOR REASONING?

‘Eggs in the basket’
http://nrich.maths.org/2002&part=

What do you think makes an activity RICH?

Now check this activity against the NRICH criteria

Children should ‘develop their understanding through speculating, hypothesising and exploring ideas’. (NC 2013:10)
There are 3 baskets, a brown one, a red one and a pink one, holding a total of 10 eggs.

The Brown basket has one more egg in it than the Red basket.

The Red basket has three eggs less than the Pink basket.

How many eggs are in each basket?
1. are accessible and offer opportunities for initial success and further challenges
2. offer different levels of challenge, at the learners level (low threshold - high ceiling)
3. allow for learners to pose their own problems
4. allow for different methods and different responses
5. offer opportunities to identify elegant or efficient solutions
6. have the potential to deepen conceptual understanding of maths content
7. have the potential for revealing patterns or lead to generalisations
8. reveal underlying principles or make creative connections between areas of maths
9. encourage collaboration and discussion
10. encourage learners to develop confidence, independence and become critical thinkers

Adapted from Jennifer Piggott
Roman Numerals in the new NC A problem solving approach
It’s not uncommon to see this type of maths worksheet used in classrooms.

Is it RICH?
Look at the criteria in your envelopes again
WHAT DO YOU DO WHEN YOU ‘REASON’?

Evaluate situations
Select problem-solving strategies
Draw logical conclusions
Develop solutions
Describe solutions
Reflect on solutions
WORK SYSTEMATICALLY

• Results generated randomly
• Sorted into families
• Imposed system....
• Models systematic thinking
The Cadman family have...
14 mouths to feed
9 tails to wag and wiggle
30 legs to walk on

How many goldfish, dogs and people are there in the family?
Types of reasoning:

• FINDING ALL POSSIBILITIES
• VISUAL PROBLEMS
• LOGICAL PROBLEMS
• RULES AND PATTERNS
• WORD PROBLEMS
RICH TASKS LEAD TO HIGHER ORDER THINKING SKILLS

HOTS

Bloom’s Taxonomy (Revised)


Based on an APA adaptation of Anderson, L.W. & Krathwohl, D.R. (Eds.) (2001)
1. Where can we find more problem solving and reasoning activities?

2. How can we plan for progression?

NRICH  http://nrich.maths.org/5665

Curriculum Mapping Document

NCETM  https://www.ncetm.org.uk/resources/44672

Landscape documents with reasoning
NCETM Reasoning Doc. (strategies include...)
Spot the mistake / Which is correct?
True or false?
What comes next?
Do, then explain
Make up an example / Write more statements / Create a question / Another and another
Possible answers / Other possibilities
What do you notice?
Continue the pattern
Missing numbers / Missing symbols / Missing information/Connected calculations
Working backwards / Use the inverse / Undoing / Unpicking
Hard and easy questions
What else do you know? / Use a fact
Fact families
Convince me / Prove it / Generalising / Explain thinking
Make an estimate / Size of an answer
Always, sometimes, never
Making links / Application
Can you find?
What’s the same, what’s different?
Odd one out
Complete the pattern / Continue the pattern
Another and another
Ordering
Testing conditions
The answer is...
Visualising
Andy and Sam were walking along the road when Andy’s bag of marbles spilled out!

- One third of these marbles disappeared down a slope
- One sixth of the original total disappeared down the drain
- Half of the remaining marbles were taken by other children

Andy counted all the marbles that Sam had helped him rescue

- He gave one third of these remaining marbles to Sam

He was left with 14 Marbles

How many marbles were in the bag before it split?
ICT TOOL FOR CONCEPTUAL UNDERSTANDING
THINKING BLOCKS ... HAVE A GO!

Linked to Singapore Bar Method - a progressive resource used to develop conceptual understanding

http://www.youtube.com/watch?v=7bPjWu3fluo


http://www.thinkingblocks.com/ (APP for ipad)
Openers ... in a jar/on display

I know I am right because ...
I think this because...
If this is true then......
I know that the next one is .....because....
This can't work because ....
When I tried xxx I noticed that ..... 
The pattern looks like......
All the numbers begin with.....
Because xxx then I think xxxxx
It will never work because.....
RECORDING REASONING

Consider ...

We don't expect a neat version of literacy first, so what about a ‘draft book’ for maths too for ‘Problem Solving and Reasoning’
SO GOOD MATHEMATICS TEACHING SHOULD BE...

RICH AND HOT!