

# 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



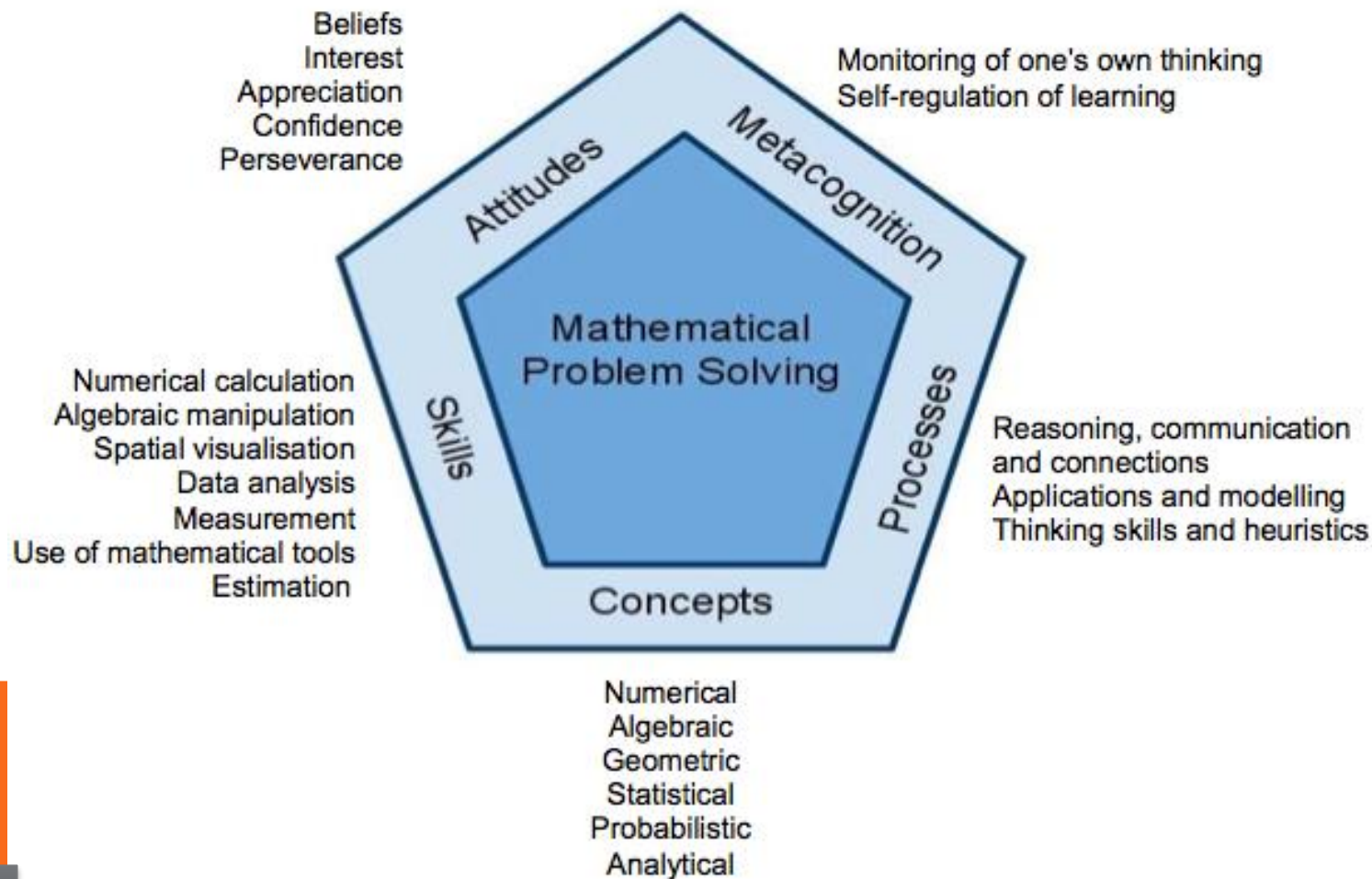
Jane Jones HMI, Ofsted  
National Lead for Maths

‘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



(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?**



## WILLIAMS INDEPENDENT REVIEW (2008:62)

*‘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?

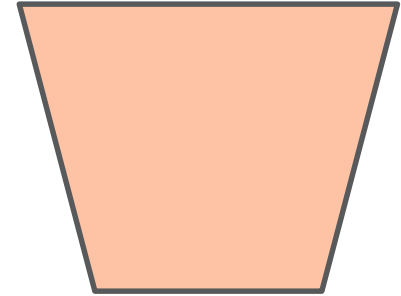
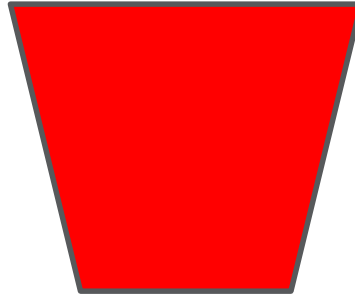
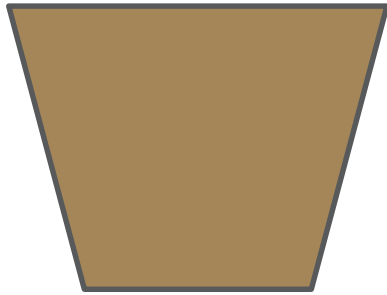
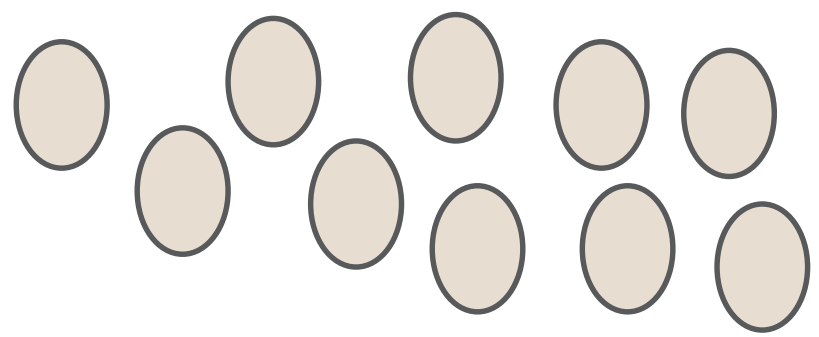
## 'Eggs in the basket'

<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?

# RICH MATHEMATICAL TASKS

[HTTP://NRICH.MATHS.ORG/PUBLIC/VIEWER.PHP?OBJ\\_ID=5662&PART=INDEX&NOMENU=1](http://nrich.maths.org/public/viewer.php?obj_id=5662&part=index&nomenu=1)

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



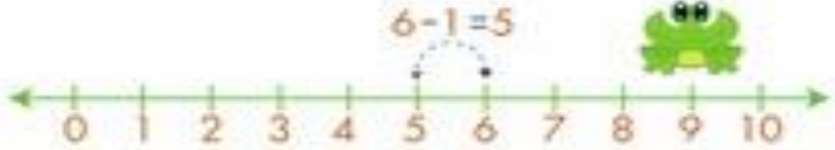
It's not uncommon to see this type of maths worksheet used in classrooms.

Is it RICH?

Look at the criteria in your envelopes again

**Number Line SUBTRACTION**

- When you take away 1 from a number the result is the number before that.
- Use the number line to **count back** to help you subtract the numbers.
- Write your answers in the space provided.



$10-1 = \square$	$8-2 = \square$	$7-1 = \square$
$8-1 = \square$	$4-1 = \square$	$3-1 = \square$
$6-1 = \square$	$5-1 = \square$	$9-2 = \square$
$1-1 = \square$	$2-1 = \square$	$9-1 = \square$

## 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?



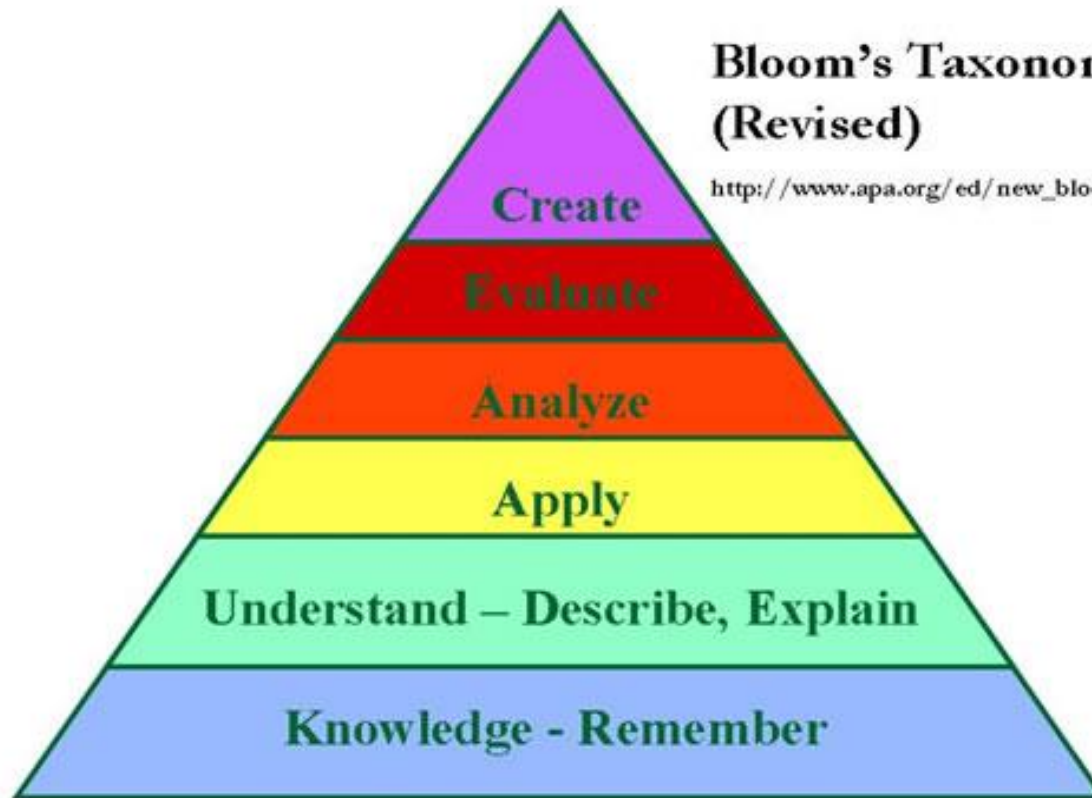
# Types of reasoning:

- FINDING ALL POSSIBILITIES
  - VISUAL PROBLEMS
  - LOGICAL PROBLEMS
  - RULES AND PATTERNS
  - WORD PROBLEMS
- 

# RICH TASKS LEAD TO HIGHER ORDER THINKING SKILLS

## HOTS

Simple-----Complex  
Concrete-----Abstract



### Bloom's Taxonomy (Revised)

[http://www.apa.org/ed/new\\_blooms.html](http://www.apa.org/ed/new_blooms.html)

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

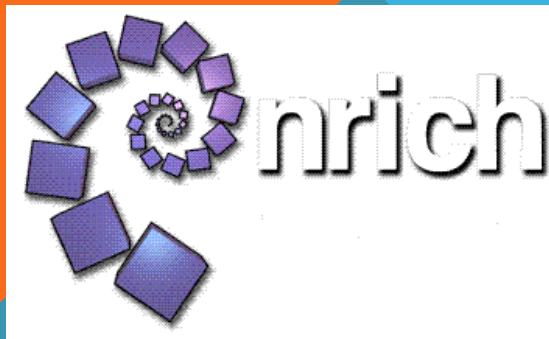
**Andy counted all the marbles that Sam had helped him rescue**



- 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?**



<http://nrich.maths.org/8112>

# 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/tb\\_modeling\\_tool/modeling\\_tool.html](http://www.thinkingblocks.com/tb_modeling_tool/modeling_tool.html)

<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** xxxx 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!**