NQT Inspiration Day: Nurturing Creative Problem Solvers

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Aims of the Workshops

- To support the nurturing of confident, resourceful and creative mathematical problem solvers.
- To support the embedding of problem solving, reasoning and fluency in all classrooms through rich mathematics.
- To understand how to make this accessible for all learners.

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Workshop 1: Engaging All Learners Through Problem Solving

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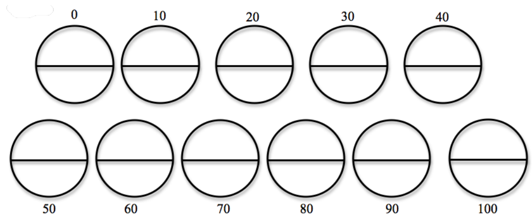
Reasoned Rounding (10945)



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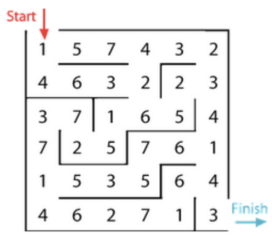
Maze 100 (91)

In this maze there are numbers in each of the cells. You go through adding all the numbers that you pass. You may not go through any cell more than once.

Can you find a way through in which the numbers add to exactly 100?



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Low Threshold High Ceiling

- Suitable for whole range
- Low entry point
- Lots of choices in
  - method
  - response
  - recording
- Learners can show what they CAN do, not what they can't
- High 'finish' possible

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Different Purposes for Recording

- Recording in the moment
- Recording as thinking
- Recording for another person/time

Recording Mathematics Feature
http://nrich.maths.org/9623

Bryony's Triangle (7392)

Rich Tasks

- Have a relatively closed start but offer different responses and different approaches
- Invite own questions
- Combine fluency and reasoning
- Reveal/provoke generalisations
- Encourage collaboration and discussion
- Are intriguing
- May be accessible to all (LTHC)

Sandwiches (522)

Start with two 1's, two 2's and two 3's:

1 1 2 2 3 3

Arrange these six digits in a line so that:

- between the two 1s there is one digit
- between the two 2s there are two digits
- and between the two 3s there are three digits.

Key Problem-solving Skills

visualise
work backwards
reason logically
conjecture
work systematically
look for a pattern
trial and improvement

The Problem-solving Process

- Stage 1: Getting started
- Stage 2: Working on the problem
- Stage 3: Going further
- Stage 4: Concluding

Problem-solving Process

1. Getting started
   - try a simpler case
   - draw a diagram
   - represent with model
   - act it out
2. Working on the problem
   - visualise
   - work backwards
   - reason logically
   - conjecture
   - work systematically
   - look for a pattern
   - trial and improvement
3. Going further
   - generalise
   - verify
   - prove
4. Concluding
   - communicate findings
   - evaluate

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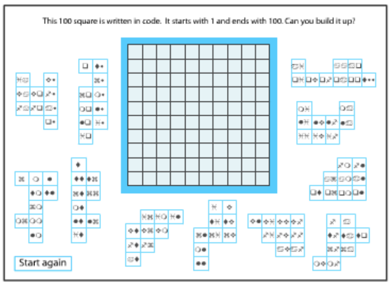
Coded Hundred Square (6554)



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Types of Task

- Finding all possibilities
- Visual problems
- Logic problems
- Rules and patterns
- Word problems

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Tour of NRICH Website

- Primary teacher homepage
- 'Meeting the Aims of the National Curriculum' page
- 'Stage 1 and 2 Curriculum' page including mapping documents, summary of features and collections
- 'Past features' link in top banner
- Similar tasks/ 'you may also like'

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Classroom Culture

What behaviours do we value and encourage?

- Valuing mathematical thinking
- Everyone's idea counts
- Valuing changing one's mind
- Honourable to be stuck
- Creative climate
- Conjecturing atmosphere
- Purposeful activity and discussion

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Problem Solving Unpacked

- Tasks
- Naming and drawing attention to PS skills
- Structuring a PS lesson
- Types of problem
- Objectives
- Recording
- Classroom culture

Problem-solving Feature

http://nrich.maths.org/10334

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‘Quick win’ or challenge?

- What could you do relatively easily now?
- What do you see as more of a challenge?

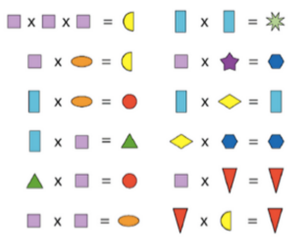
Workshop 2: Inspiring Reasoning Through Rich Tasks

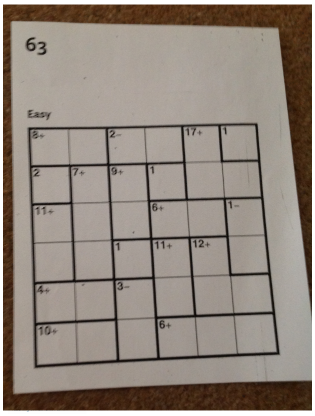
Shape Times Shape (5714)

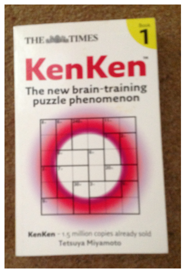
Stage: 2

The coloured shapes stand for eleven of the numbers from 0 to 12. Each shape is a different number.

Can you work out what they are from the multiplications below?







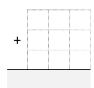
Progression in Reasoning

- Describing
- Explaining
- Convincing
- Justifying
- Proving

Dicey Operations (6606)

Find a partner and a 0-9 dice.

Each of you should draw an addition grid like this:



Take turns to throw the dice and decide which of your cells to fill. You must fill a cell before throwing the dice again.

Each time the dice is thrown, you *both* use that number in one of your cells.

When you have filled all nine cells, ***whoever has the sum closer to 1000 wins.***

What can you articulate about your reasoning having had a second go at Dicey Operations?

Delving into Proof with Dicey Operations

This time, throw the dice nine times before placing any of the numbers in the cells.

How would you place the numbers so that the total is as **close as possible** to 1000?

Could you convince another pair that your way did indeed produce the closest possible sum to 1000?

Could you prove it?

Five Steps to 50 (10586)

This challenge is about counting on and back in steps of 1, 10 and 100.

Roll a dice twice to establish your starting number - the first roll will give you the tens digit and the second roll will give you the units digit.
You can then make five jumps to get as close to 50 as possible.
You can jump forwards or backwards in jumps of 1 or 10 or 100.

Three Neighbours (8108)

Take three numbers that are 'next door neighbours' when you count. These are called consecutive numbers.

Add them together.

What do you notice?

Take another three consecutive numbers and add them together.

What do you notice?

Can you prove that this is always true by looking carefully at one of your examples?

You take your three consecutive numbers and add them together. Then you look at your answer. All the answers are multiples of 3 eg $3+4+5=12$

Then you will notice that the middle number, if timesed by 3 will equal a multiple of 3 eg $3+4+5=12, 4x3=12$

Another way to work it out, is to look at the outer numbers. Then take 1 away from the last number and add it to the first number. You will notice that all the numbers are now the same. Add them together and the answer will be the same as in the other ways eg $3+4+5$ gives $5-1=4$; $3+1=4$; $4+4+4=12$

Amrit from Newton Farm Nursery, Infant and Junior School wrote;

Let the three consecutive numbers be $a-1, a$, and $a+1$.
Thus their sum is $3a$.
Thus the sum of any three consecutive numbers is a multiple of 3.

Digging into Proof

- Visual and algebraic proof
- Four categories of proof useful for primary-aged children

Four Categories of Proof

- Proof by counter-example
- Proof by exhaustion
- Proof by logical reasoning
- Generic proof

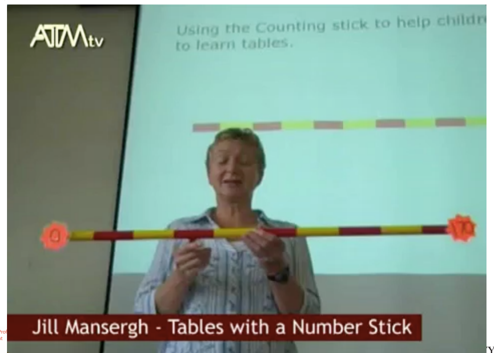
Strategies That May Help me to Communicate my Reasoning

- Modelling
- Group work
- Understanding how others work
- Personal notes and recording

Communicating Reasoning Checklist

- How clear is the reasoning? Can I follow the argument?
- How logical is the reasoning? Does it form a chain of reasoning? Is it a complete or partial chain?
- Does the argument/explanation use reasoning language, such as 'because'?
- How succinct is the reasoning? Are the sentences short and to the point?

See http://nrich.maths.org/11336



http://www.youtube.com/watch?v=yXdHGBfoqfw

Generalising, Conjecturing

Of what is this an example?
What happens in general?
Can you say why this is special?
What happened here? And here?
Can you see a pattern?
Is it always, sometimes, never …?
Describe all possible as succinctly as you can.
What can change and what has to stay the same so that … is still true?

Further NRICH Support

Reasoning Feature http://nrich.maths.org/11018

In two parts, each comprising an article and a selection of tasks:

- The first part offers opportunities for learners to reason for different purposes and in different ways.
- The second part offers support in helping learners become expert reasoners.

Reflection

What will you take away from today that will change what you do back to school?

How will you embed this in your practice?