



NQT Inspiration Day: Nurturing Creative Problem Solvers

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Aims of the Workshops

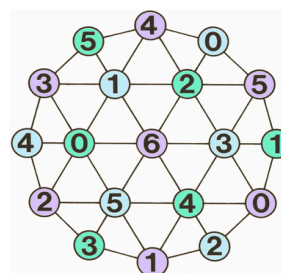
- To support the nurturing of confident, resourceful and creative mathematical problem solvers.
- To support the embedding of problem solving, reasoning and fluency in all classrooms through rich mathematics.
- To understand how to make this accessible for all learners.



Workshop 1: Engaging All Learners Through Problem Solving



Totality (1216)



Noah (136)

Noah



Noah saw 12 legs walk by into the Ark.

How many creatures could he have seen?

How many different answers can you find?



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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





Different Purposes for Recording

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

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



Two-digit Targets (6343)

You have a set of the digits from 0 - 9.

0	1	2	3	4	5	6	7	8	9
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Can you arrange these digits in the five boxes below to make two-digit numbers as close to the targets as possible? You may use each digit once only.

largest even number

--	--

largest odd number

--	--

smallest odd number

--	--

largest multiple of 5

--	--

number closest to 50

--	--



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)



Four Colours (1087)

Four Colours

You need:

8 multilink cubes - two red ones, two yellow, two green and two blue.

(Two each of any four different colours will do.)



What you have to do:

Fit them together to make a cube so that each colour shows on each face just once?



Is there more than one way to do it?

If you can do this, you might like to try 'Creating Cubes' and 'Nine Colours'.

nrich.maths.org/roadshow



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

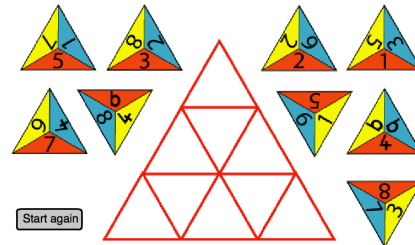


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One Big Triangle (192)

Place the 9 small triangles in the big triangle so that the numbers on the touching sides add to 10.



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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

- Early Years homepage
- 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



Ring a Ring of Numbers (2782)

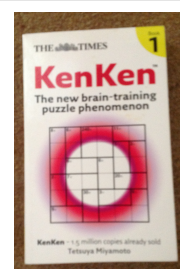
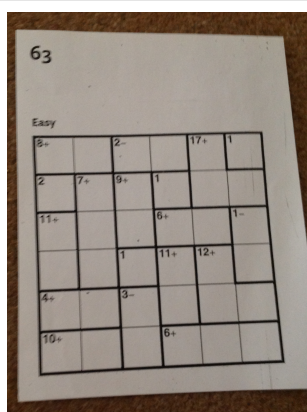


Choose four of the numbers from this list
1, 2, 3, 4, 5, 6, 7, 8, 9 to put in the squares so that
the difference between joined squares is odd.

(Only one number is allowed in each square. You must use four
different numbers.)

Can you do it another way? And another? ...

What do you notice about the numbers in the ring when the difference
between joined pairs is odd? Can you explain why?



Progression in Reasoning

- Describing
- Explaining
- Convincing
- Justifying
- Proving



Dicey Operations (6606)

Find a partner and a 0-9 dice.

Each of you should draw blank addition calculation like this:

$$\square\square + \square\square =$$

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 four cells, **whoever has the sum
closer to 100 wins.**



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



Delving into Proof with Dickey Operations

This time, throw the dice four 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 100?

Could you convince another pair that your way did indeed produce the closest possible sum to 100?

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 $3 + 4 + 5 = 12$, $4 \times 3 = 12$

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?

