A worrying trend in school was a stubbornly large group of lower achievers.
Leading on from developing self-assessment to reasoning in Maths and explaining.

“Is like….when you…..”

After many years watching and designing mathematics lessons, it has become clear to me that most of the attention is on ‘answer-getting’, not on improving the quality of the reasoning.

As soon as pupils get the answer, they are moved onto a fresh problem, they don’t reflect much on the process they went through.

Reasoning is not improved because it does not become the object of attention.

Most reasoning remains invisible; it stays inside people’s heads.

In order for students to improve their reasoning, it needs to be made visible and audible through oral or written explanations.

Malcolm Swan, NRICH, Cambridge University.

What is ________________?

Why is it ________?

Freak out!

The great Reasoning movement began...

YOU ARE ABSOLUTELY CORRECT.
WELL DONE. NOW, WHY ARE YOU CORRECT?

OR

WHY IS SHE CORRECT?

Okay, prove it!

1. Write in the missing numbers.
   \[
   \begin{align*}
   55 + & \quad = \quad 120 \\
   600 \times 4 & \quad =
   \end{align*}
   \]

I don’t care what the answer is, just tell me how to go about getting it…

No, no. Tell me what to do!
In a problem:

• Reasoning is necessary when:
  – The route through the problem is not clear
  – There are some conflicts in what you are given or know
  – There are some things you don’t know
  – There is no structure to what you’re given
  – There are different possible solutions
  – All of which require mental work….

Tip Time!

Write your tip on your whiteboard then give your whiteboard to another person to read out.

Reasoning is…

• A critical skill to knowing and doing maths
• Enabling – it allows children to make use of all the other mathematical skills – it’s the glue that helps maths to make sense.
**Progression in reasoning**

Step 1: Describing
Step 2: Explaining
Step 3: Convincing
Step 4: Justifying
Step 5: Proving

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**Scaffold for staff**

**Time for some Reasoning:**

Explain your thinking:
The time is 10:35 am. Jack says that the time is closer to 11:00 am than to 10:00 am. Is Jack right? Explain why.

**Remember:** "The answer is just the beginning!"

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**Let’s look at some activities.**

**Buying a Balloon**

Lolla bought a balloon at the circus. She gave the clown six coins to pay for it. What could Lolla have paid for the balloon? Which of your answers seems a reasonable amount to pay for a balloon?

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**‘The search for pattern’**

- Try using only 1p or 5p coins – what combinations do you come up with.
- Now try using only 1p and 10p coins – do you see a pattern?

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**Pupil premium parent group**

NRICH exposes the same weaknesses amongst the parents as we see in the classroom –

- ability to reason
- understanding written English
- choosing strategies
- simple willingness to have a go
- fear of failure – trial & improvement
- confusion
- following instructions.

NRICH tasks lend themselves wonderfully to English language training as there is so much to draw out from a problem and discuss.
Using & Applying

Q1. Liam has five coins. Three of the coins add up to 30p. Three of the coins add up to 40p. All five coins add up to £1. What are the coins that Liam has?

Reasoning - Prove it!

Q4. Here are some sentences about an amount of money. Mark each sentence with a tick (✓) if it is correct. Put a cross (✗) if it is not correct. One has been done for you.

- £1.03 can be made with exactly 1 coin. ✓
- £1.03 can be made with exactly 2 coins. ✗
- £1.03 can be made with exactly 3 coins. ✗
- £1.03 can be made with exactly 4 coins. ✗

Perseverance

Before & Now

Cycling Squares

Q1. Find two square numbers that total 45

Using & Applying

Q1: Alex has 3 types of coins in his pocket. He has 4 coins of one type, 2 coins of another type, and 1 coin of another type.

What two types of coins does he have?

Q3: Megan has 7 coins that make one pound. The coins are of only two different kinds. What are the 7 coins?
The results.

<table>
<thead>
<tr>
<th>Key Stage 1</th>
<th>From 2014-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3</td>
<td>28.9%</td>
</tr>
<tr>
<td>Level 2B+</td>
<td>83%</td>
</tr>
<tr>
<td>Level 2C+</td>
<td>93.2%</td>
</tr>
</tbody>
</table>

From 2014-2015 14% increase in children achieving Level 3 in maths.

<table>
<thead>
<tr>
<th>Key Stage 2</th>
<th>From 2014-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 4+</td>
<td>88%</td>
</tr>
<tr>
<td>Level 4B+</td>
<td>80%</td>
</tr>
<tr>
<td>Level 5</td>
<td>41%</td>
</tr>
</tbody>
</table>

From 2014-2015 19% increase in children achieving Level 4+ in maths. Exceeding or equalling national average in all three.

Parents

Fifteen Cards

I have fifteen cards numbered 1 – 15.
I put down seven of them on the table in a row.

The numbers on the first two cards add to 15. The numbers on the second and third cards add to 19.

What are my cards?

Can you find any other solutions?

How do you know you’ve found all the different solutions?

Shape Times Shape

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?

Using & Applying

Write the three missing numbers in this multiplication grid.

\[
\begin{array}{ccc}
4 & 20 & 28 \\
5 & 40 & 35 \\
3 & 24 & 15 & 21 \\
\end{array}
\]
Chocoholics

Stage: 2

George and Jim want to buy a chocolate bar.
George needs 2p more and Jim needs 50p more to buy it.
When they put their money together, it is still not enough to pay for the chocolate bar.

How much is the chocolate bar?