What is Maths Mastery?

Parent Workshop

- To gain an insight into the Maths Mastery approach and how it is taught.

- To give ideas for supporting maths at home – making it fun!

What makes a ‘good’ mathematician?

Lots of pupils believe a ‘good’ mathematician is someone who is quick and gets everything right. Do you agree?

The information that follows will hopefully open your mind to the fact that everyone can be a ‘good’ mathematician – it is not just an elite group. Also, those that are quick and get many mental maths answers correct, are not always ‘masters’ of those concepts.

How and Why did the Mathematics Mastery Approach Develop

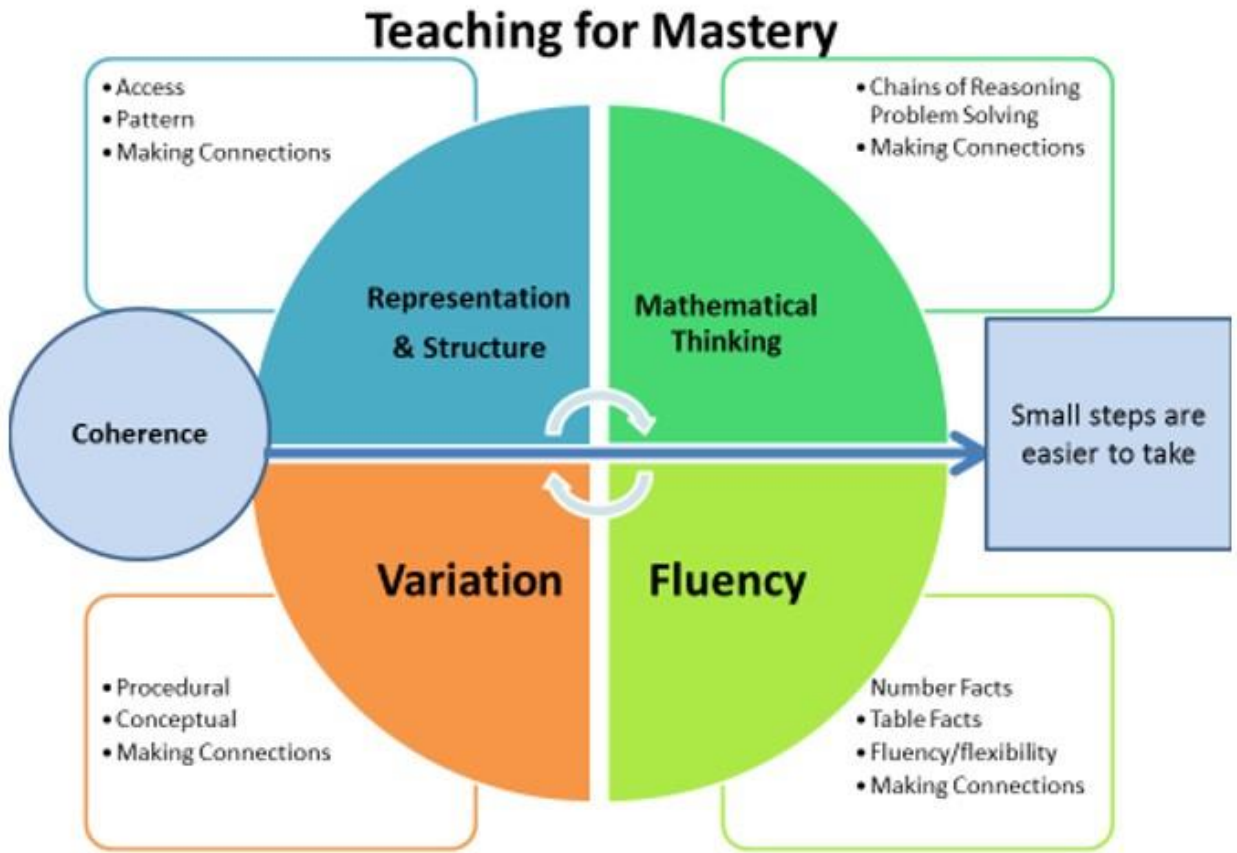
- Too many children are falling behind
- Not enough children are excelling
- Teaching has been focussed on procedures over understanding
- Negative attitudes towards maths ability and enjoyment

The Mathematics Mastery Approach

- Depth before breath – a rigorous and systematic programme that is developed to ensure every child can achieve excellence.
- It provides a deep understanding of the subject through a Pictorial, Concrete and Abstract approach.
- Mastery – when a concept or skill can be applied over time in a multiple of ways and to an unfamiliar setting

- A child’s mindset is more important than prior attainment.

The 5 big ideas



Concrete-Pictorial-Abstract (C-P-A) approach

Jerome Bruner - three steps (or representations) necessary for pupils to develop understanding of a concept.

Reinforcement is achieved by going back and forth between these representations.

Concrete- The DOING

Achild is first introduced to an idea or a skill by acting it out with real objects. This is a 'hands on' component using real objects and it is the foundation for conceptual understanding.

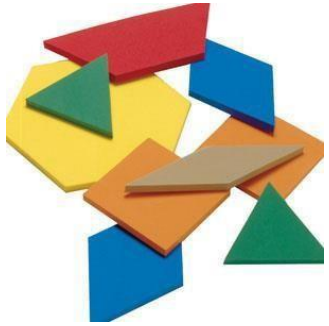
Pictorial-The SEEING

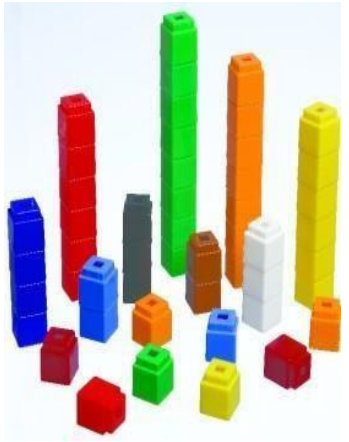
Achild has sufficiently understood the hands-on experiences performed and can now relate them to representations, such as a diagram or picture of the problem.

Abstract – The SYMBOLIC

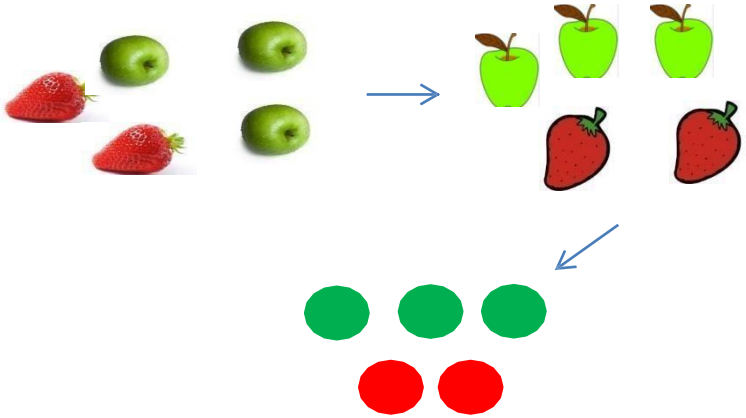
Achild is now capable of representing problems by using mathematical notation, for example: $12 \div 2 = 6$

Concrete representation

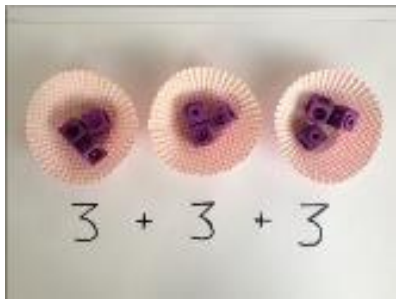


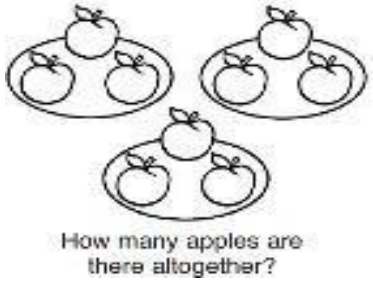


Pictorial representation



- Images of actual concrete manipulatives
- Explain the connections between the concrete and pictorial





- Don't remove or stop using concrete manipulatives

Abstract representation

- Symbolic stage

- Numbers, letters and symbols
- “I did it in my head”
- Most formal stage of mathematical understanding
- Efficient way of representing the maths

"True learning involves figuring out how to use what you already know, in order to go beyond what you already think."

Jerome Bruner

Awareness, according to Marton and Booth (1997), has a structure to it. By this they mean that the amount of sensory data that we are subject to cannot all be dealt with at once; some things have to be to the foreground of our awareness, others will not.

We must try and help learners focus their awareness on critical features.

2011, Mike Askew, Transforming Primary Mathematics, chapter 6 “Variation Theory”

Variety

- ‘Pick and mix’
- Most practice exercises contain variety

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Variation

- Careful choice of WHAT to vary
- Careful choice of what the variation will draw attention to

The application of variation always has a particular purpose

Variety vs variation questions ?

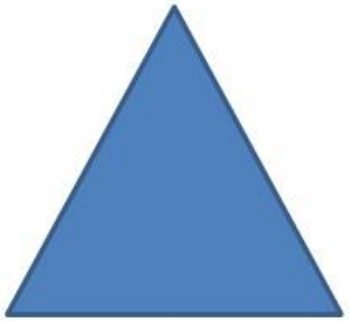
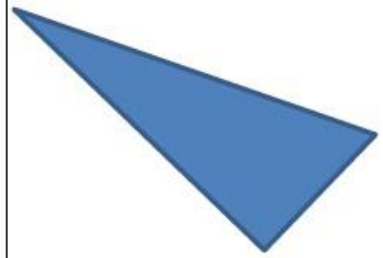
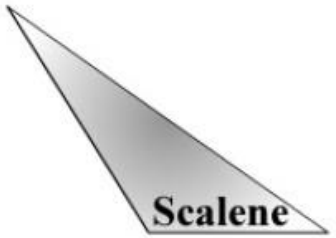
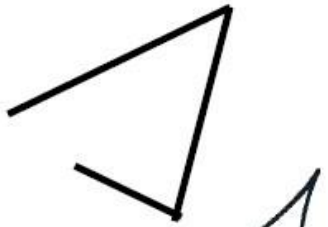
- 2 x 4 • 2 x 3
- 5 x 60 • 2 x 30
- 3 x 200 • 2 x 300
- 4 x 30 • 20 x 3
- 90 x 2 • 200 x 3
- 70 x 50 • 20 x 30

Work through…

Variation leads to Intelligent Practice

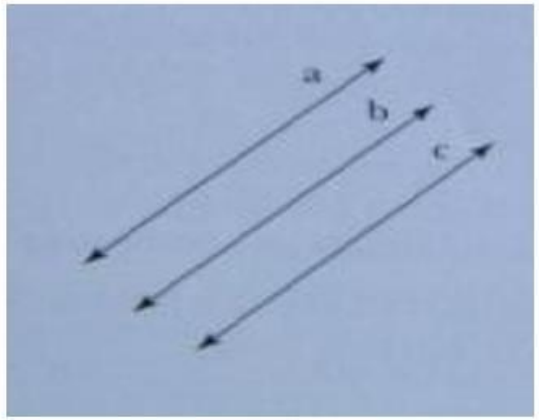
$20 + 7 =$	$16 + 128 =$
$20 + 8 =$	$16 + 228 =$
$19 + 8 =$	$26 + 228 =$
$18 + 7 =$	$126 + 228 =$
$28 + 7 =$	$136 + 218 =$
$38 + 7 =$	$146 + 208 =$
$28 + 17 =$	$156 + 198 =$
$17 + 28 =$	$166 + 198 =$
$16 + 28 =$	$66 + 98 =$

Designing conceptual variation

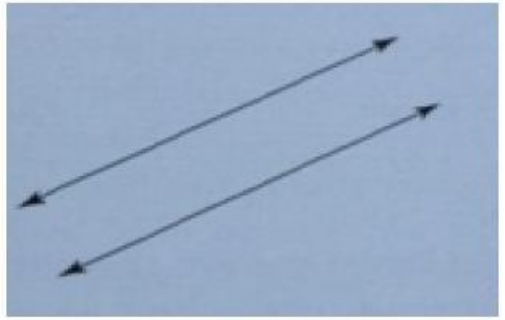
EXAMPLES		NON EXAMPLES (DISTRACTORS)	
EXEMPLARS	VARIANTS	CLEAR DISTRACTORS	DIFFICULT DISTRACTORS
	 	 	  

Standard and non-standard examples – exemplars and variants

11 year olds were asked: Is line a parallel to line c?



Most answered, 'No, because line b is in the way.'



The concept of parallel lines is almost always illustrated like this.

Boaler, Jo. (2016) Mathematical Mindsets

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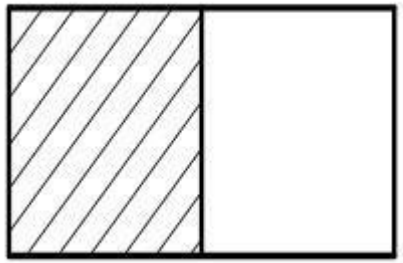
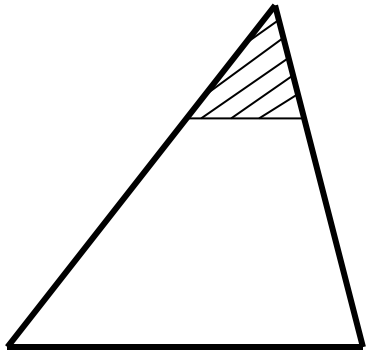


$\frac{1}{2}$



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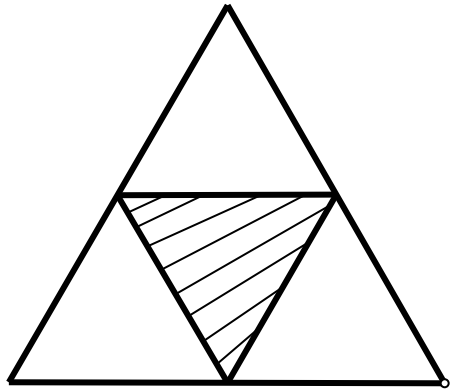
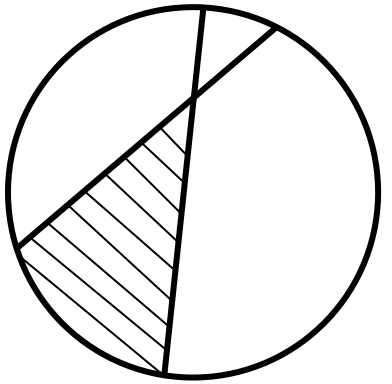


$\frac{1}{3}$



$\frac{1}{4}$

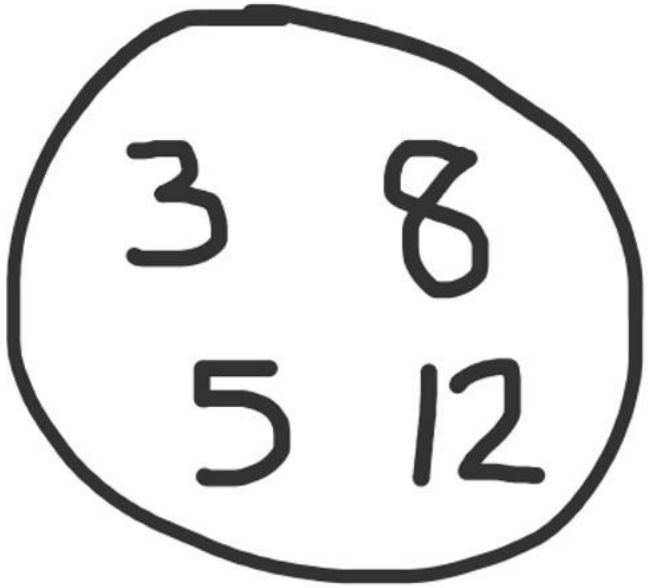
Why? Explain.

Let's try…

Complete a multiplication using the numbers from the circle

- Sort your products into this table

Multiple of 4	Multiple of 3	Multiple of 10	Odd number	Between 100 and 150
Square number	Prime number	Has a factor of 12	Leaves a remainder of 1 when divided by 4	Leaves a remainder of 1 when divided by 5



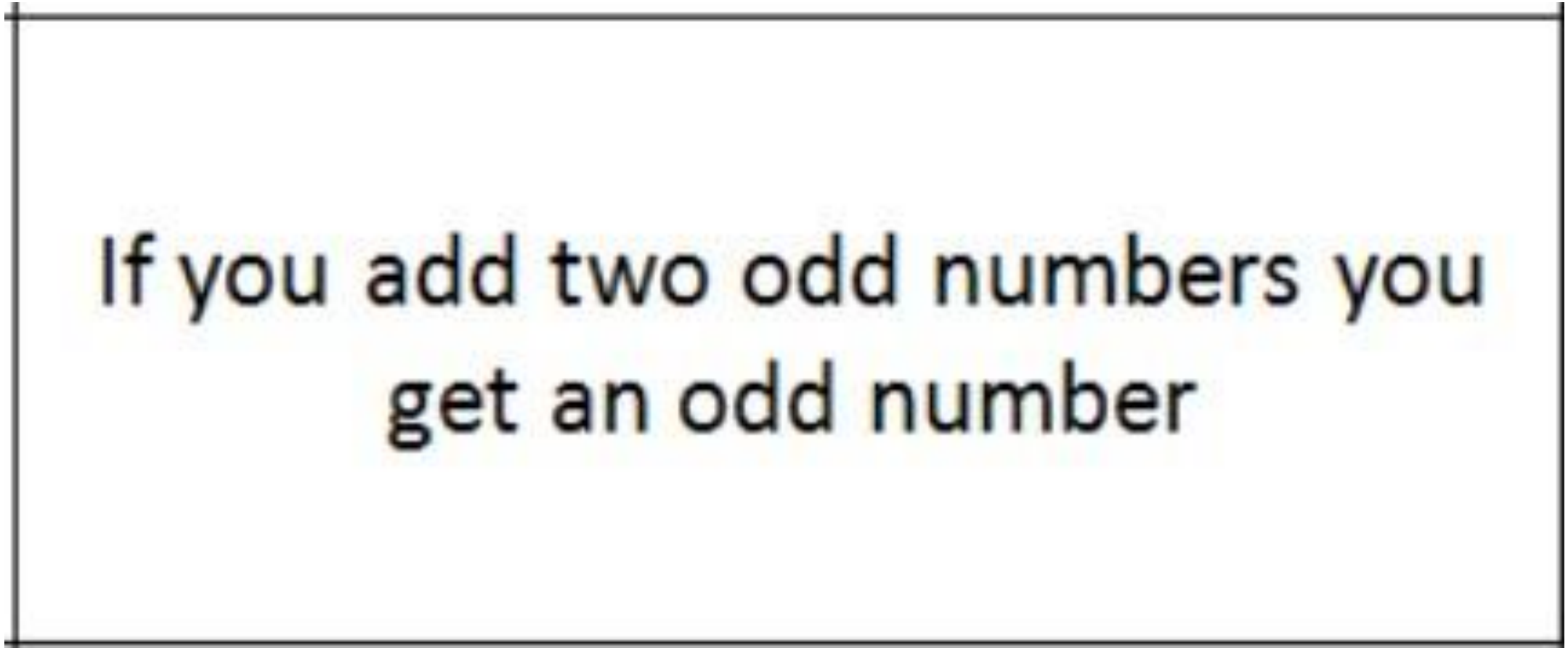
Keep it simple!

Maths is not always about ‘big’ numbers and times tables – it is about being able to apply concepts to different situations, problem solve, and find different strategies to check working.

e.g.‘12+6=18’

- *How do you know? Can you show me this as a picture? What are the parts of 18? How can you check that is correct? What would 6 + 12 be? Can you say that in a number sentence?*

Always, sometimes, never true…



Always, sometimes, never true...

The sum of three consecutive numbers is divisible by 3

Always, sometimes, never true…

A square number has an even number of factors

Remember to notice…

KS2 SATs question:

3 x 5 x 7 x 2 x 6 x 0 x 4 =

Many pupils would work it all out and fail to ‘notice’ the 0!

Challenge…what is deepening understanding?

Year 2

The place value of a digit…

Put a circle around the larger number.	Write all the 2-digit numbers greater than 40 using these digits.
1) 50 48 2) 77 81 3) 78 87	2 4 6 6 How do you know you have them all? Prove it.

The second example explores pupils abilities to work logically and systematically through a problem at the same time as testing their knowledge and understanding of 2 digit numbers. It takes this concept deeper than the first example.

Year 5

Here is part of a number square.
What is the largest number on the whole square?

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16		
19	20	21			
25	26				
31	32				

Here is part of a number square.
What is the largest number on the whole square?

3	6	9	12	15
18	21	24	27	
33	36	39		
48	51	5		
63	66			

The second example pushes this concept even further…try to notice how (ie counting in 3s moving across the rows in order, or going up in 15s down the columns. This is about sequencing numbers)

Year 5

Set out and solve these calculations using a column method.

3254 + ☐ = 7999

2431 = ☐ – 3456

6373 – ☐ = 3581

6719 = ☐ – 4562

True or False?

- 3999 – 2999 = 4000 – 3000
- 3999 – 2999 = 3000 – 2000
- 2741 – 1263 = 2742 – 1264
- 2741 + 1263 = 2742 + 1264
- 2741 – 1263 = 2731 – 1253
- 2741 – 1263 = 2742 – 1252

Explain your reasoning.

Using this number statement, 5222 – 3111 = 5223 – 3112 write three more pairs of equivalent calculations.

Pupils should not calculate the answer to these questions but should look at the structure and relationships between the numbers.

The second set of examples are ‘procedural variation.’ They are designed on purpose to ensure pupils notice links between calculations and how to balance them either side of the equals sign. The emphasis is not on calculating, but understanding what changes can balance others out and why.

A Maths Mastery Curriculum

- ✞High expectations for every child
- ✞Few topics, greater depth
- ✞Number sense and place value come first
- ✞A research based curriculum
- ✞The use of objects and pictures before number and letters
- ✞Problem solving is central
- ✞Language and Communication lead to understanding
- ✞Challenge is provided through an increased depth, rather than acceleration of content

What sorts of discussions can I have with my child at home?

What is in between the trees?

What time of day is it?

There are more orange fish than red and yellow altogether

What is beneath the bridge?

Which is greater _ the number of trees or frogs?

How many spiders altogether?

How many birds in the sky?

Are there more fish or trees?

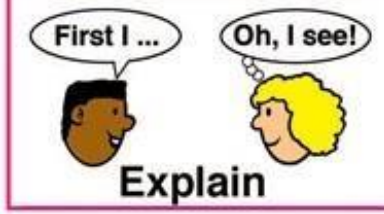
How many short red flowers are there?

What shapes can you see?

What is on top of the house?

We use this sort of vocabulary with your child in school. You can do similar at home…

Maths Challenges!

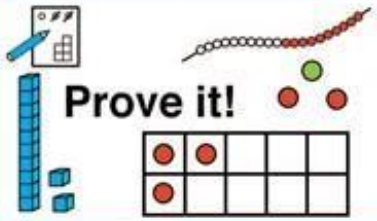


'Reason it'

Explain how you know to your partner. Remember to use the star words!

'What's the question?'

If this is the answer, what could the question have been?

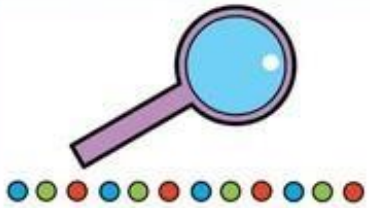


'Prove it'

Convince me that you are right.

'What's wrong with this?'

Can you explain what is wrong in the example below and correct the error?

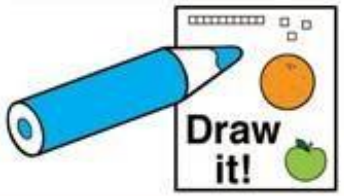


'Find a pattern'

Can you find a pattern in the numbers or the answer?

'Before and after'

What came before? What comes next? Can you explain how you know?

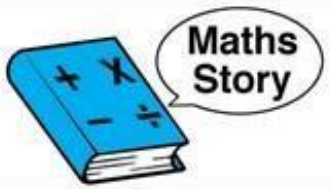


'Draw it'

Draw a picture to explain or demonstrate what you have worked out.

'Odd one out'

Find an odd one out and explain why it does not fit.



'Tell a story'

Make up a real-life story using your equation, numbers or shapes.

'Empty box question'

What goes in the empty box?

How to support at home

- Use every opportunity to ask your child questions and to explain their reasoning to you.
- Look for maths around you. Telling the time, discussing the days of the week, talking about money or the coins needed to pay for items, how long things take to cook.
- GROWTH MINDSET – everyone of us can master mathematics given the opportunity rather than 'I was rubbish at maths at school, so you might be too!'

COUNTING

- Collections of objects – shells, buttons, pretty stones.

- Cars on a journey e.g. how many red cars?
- What fraction of the cars you've counted were red?
- Animals in a field e.g. sheep, cows.
- Stairs up to bed, steps etc, times tables.
- Pages in a storybook.
- Counting buttons, shoes, socks as a child gets dressed.
- Tidy a cupboard or shelf and count the contents e.g. tins, shoes, etc.
- Counting particular vehicles on a journey e.g. Eddie Stobart lorries, motorbikes, etc.

Tips

- Keep maths practical and real life

- Money – paying for things, playing shops, purses
- Laying the table
- Dishing up dinner – problem solving
- Games (snakes and ladders, dice)
- Playing cards
- Eggboxes for a 10 frame.

Growth Mindset

- A belief that effort creates success
- A belief that skill and ability can be increased over time
- View mistakes as an opportunity to develop
- Are resilient – and don't give up easily
- Think about *how* they learn not just what

A few links to parent information/resources:

(If you would like further advice, please ask your child's teacher)

- https://www.ncetm.org.uk/features/improving-children-sconfidence-in-maths-starts-with-parents/
- https://whiterosemaths.com/homelearning
- https://mathsnoproblem.com/blog/teaching-tips/how-to-suggest-athome-primary-maths-activities-to-parents/

- https://collins.co.uk/pages/primary-mathematics-maths-mastery

Growth Mindset begins at ‘I want to do it.’

We need children to want to do it, so that they'll try, rather than believing that they can't.