

Maths mastery in KS2

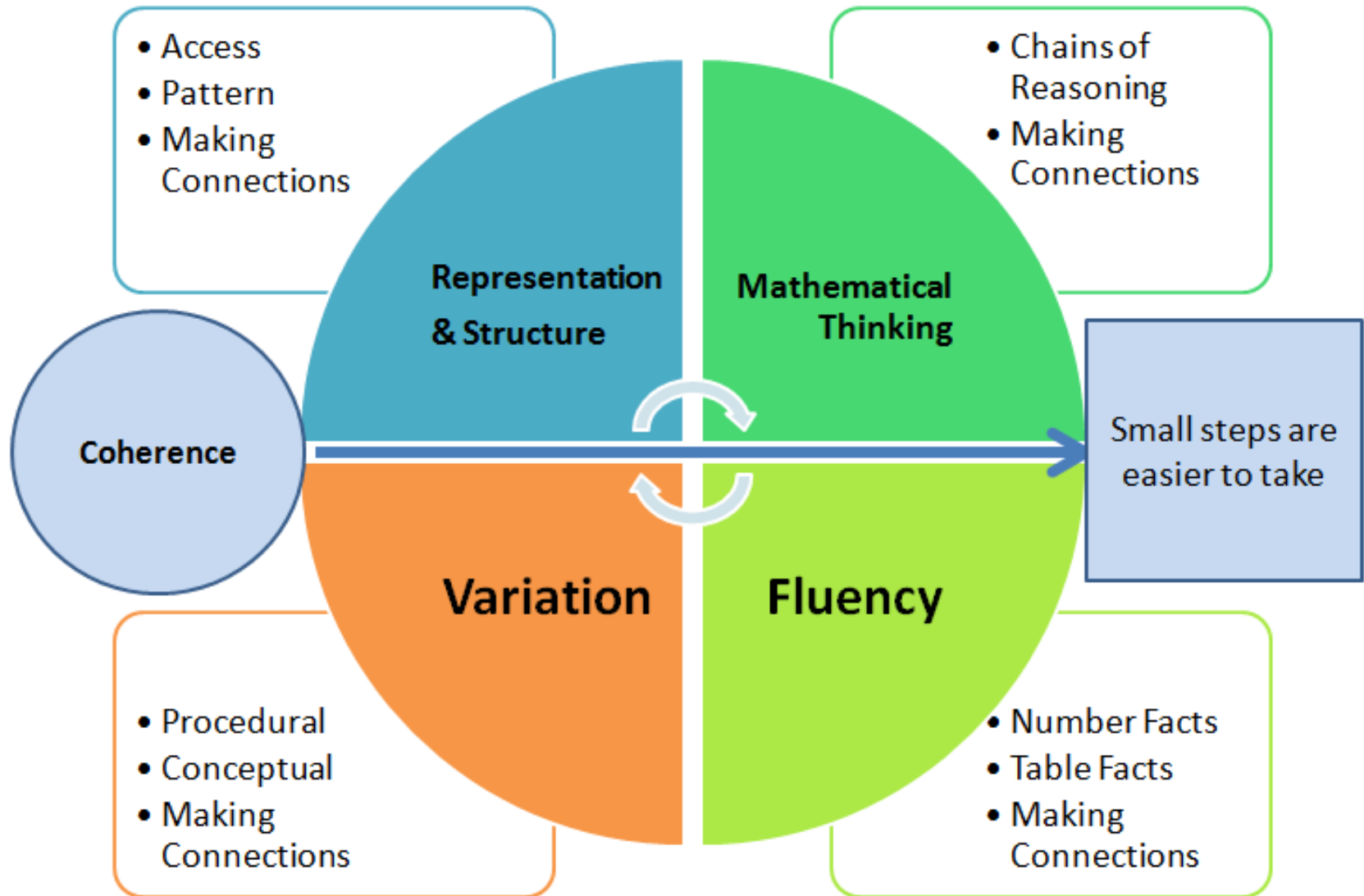
Tuesday 3rd October 2023

- Mastering maths means pupils acquiring a deep, long-term, secure and adaptable understanding of the subject.
- The phrase ‘teaching for mastery’ describes the elements of classroom practice and school organisation that combine to give pupils the best chances of mastering maths.
- Achieving mastery means acquiring a solid enough understanding of the maths that’s been taught to enable pupils to move on to more advanced material.

Our aim

- To explore the 5 key areas for teaching for mastery
- To equip you with some skills to help support your child in their understanding of Maths.

How do we teach for mastery?



How do we teach for mastery?

Representation and structure

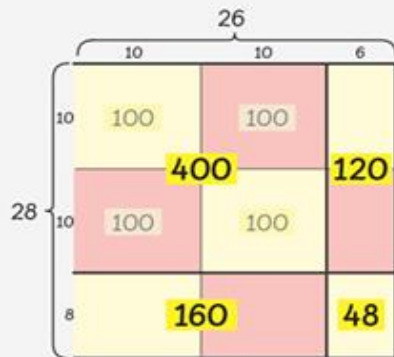
Representation and structure is used to expose the mathematical structure being taught with the aim being that children will be able to move on to doing the maths without recourse to the representation.

This can be concrete or pictorial representation and should not be limited to KS1 only.

How can we help?

Use household objects and encourage children to draw representations.

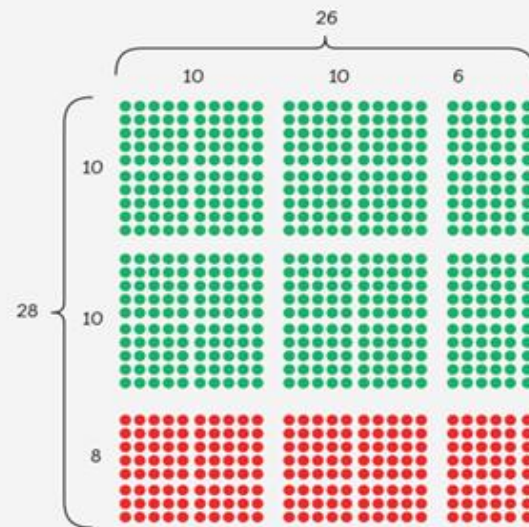
There are 28 rows.
Each row consists of 26 seats.



$$\begin{aligned} 28 \times 26 \\ = 400 + 160 + 120 + 48 \\ = 728 \end{aligned}$$



There are 728 seats.



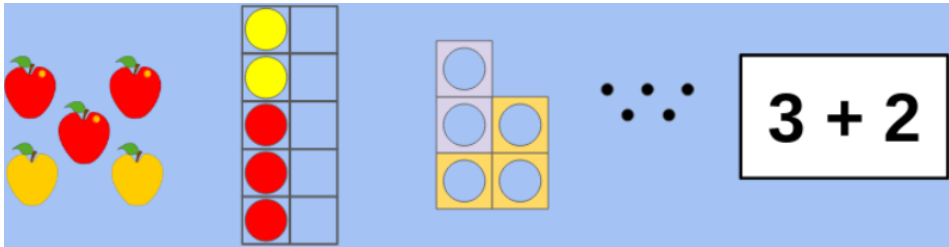
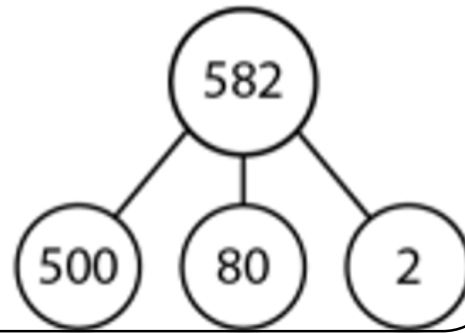
How do we teach for mastery?

Representation and structure

Numerical and linguistic representations- stem sentences and correct vocabulary

Using the correct resources

There are _____ hundreds.
There are _____ tens.
There are _____ ones.
Altogether, there are _____.



There are _____ hundreds, _____ tens and _____ ones. The number is _____

_____ = _____ + _____ + _____

The difference in value between the start and end point is 1,000,000

There are 10 intervals. $1,000,000 \div 10 = 100,000$

The number line is counting up in 100,000s

How do we teach for mastery?

Fluency

Fluency is more than just rapid recall of number facts. It also encompasses efficiency, accuracy and flexibility.

Fluency demands the flexibility to move between different contexts and representations of mathematics, to recognise relationships and make connections and to make appropriate choices from a whole toolkit of methods, strategies and approaches.

How can we help?


Discuss different methods with children. Explore relationships between numbers.

Y3 Place Value 7

Place Value: Hundreds

Fluency

1) There are 100 fidget spinners in each box. How many fidget spinners are there altogether?



2) Complete the sequences:

200	300		500
-----	-----	--	-----

	900		700
--	-----	--	-----

3) Use $<$ or $>$ or $=$ to compare the place value charts:

Hundreds	Tens	Ones		Hundreds	Tens	Ones
●			○	●		
●				●		
				●		

How do we teach for mastery?

a) $400 + 300$

$430 + 300$

$439 + 300$

$300 + 477$

b) $700 - 200$

$780 - 200$

$783 - 200$

$701 - 200$

What do these mean?
Automaticity
Subitising

Write down what patterns you notice.

The image shows two handwritten methods for calculating 999×8 on lined paper. The first method is a standard column multiplication:

$$\begin{array}{r} 999 \\ \times 8 \\ \hline 7992 \\ \\ \\ \hline 7992 \end{array}$$

The second method is a compensation strategy:

$$\begin{array}{r} 1000 \times 8 - 8 \\ 8000 - 8 \\ \hline 7992 \end{array}$$

A yellow speech bubble on the right asks: "Which method demonstrates fluency?"

How do we teach for mastery?

Variation

Variation highlights the essential features of a concept or idea by varying the non-essential features.

To emphasise variation, it is important to show children - What the mathematical concept is
- What the mathematical concept is not

When constructing a set of activities/questions, it is important to consider what connects the examples; what mathematical structures are being highlighted?

Procedural variation

Progression through a variety of problems/calculations to form an understanding of a concept, stage by stage

$$\begin{array}{l} 18 - \square = 8 \\ 18 - \square = 10 \\ 18 - \square = 12 \\ 18 - \square = 14 \\ 18 - \square = 16 \end{array}$$

$$\begin{array}{l} 2 + 3 = \square \\ \square - 3 = \square \\ 3 + 5 = \square \\ \square - 5 = \square \end{array}$$

$$\begin{array}{l} 180 \div 2 = \\ 180 \div 20 = \\ 270 \div 30 = \\ 270 \div 90 = \end{array}$$

Conceptual variation

Experiencing a concept in lots of different contexts

Commutative Property
 $5 \times 3 = 15$

Repeated Addition
 $3 + 3 + 3 + 3 + 3 = 15$

Groups of: $3 \times 5 = 15$ An Array

3 groups of 5

How do we teach for mastery?

procedural variation

7×4
 70×4
 70×8
 14×4
 140×40

If I know this.....

Then I know this.....

How do we teach for mastery?

Mathematical Reasoning

For children to understand a taught concept deeply, they must be able to *work on* that taught concept. This will look like a child thinking about, reasoning with and discussing that concept with others.

How can we help?

- Ask questions that require children to reason, “What is the same? What is different? What patterns can you see?”
- Ask children to explain, convince/prove, draw diagrams or use manipulatives to illustrate an idea or strategy.

Explore

A and B are whole numbers.

Rounded to the nearest 100, A is 500

Rounded to the nearest 10, B is 350

What is the smallest possible difference between A and B?

How do we teach for mastery?

Is this sometimes, always or never true?

How is this the same? How is it different?

Can you prove this?

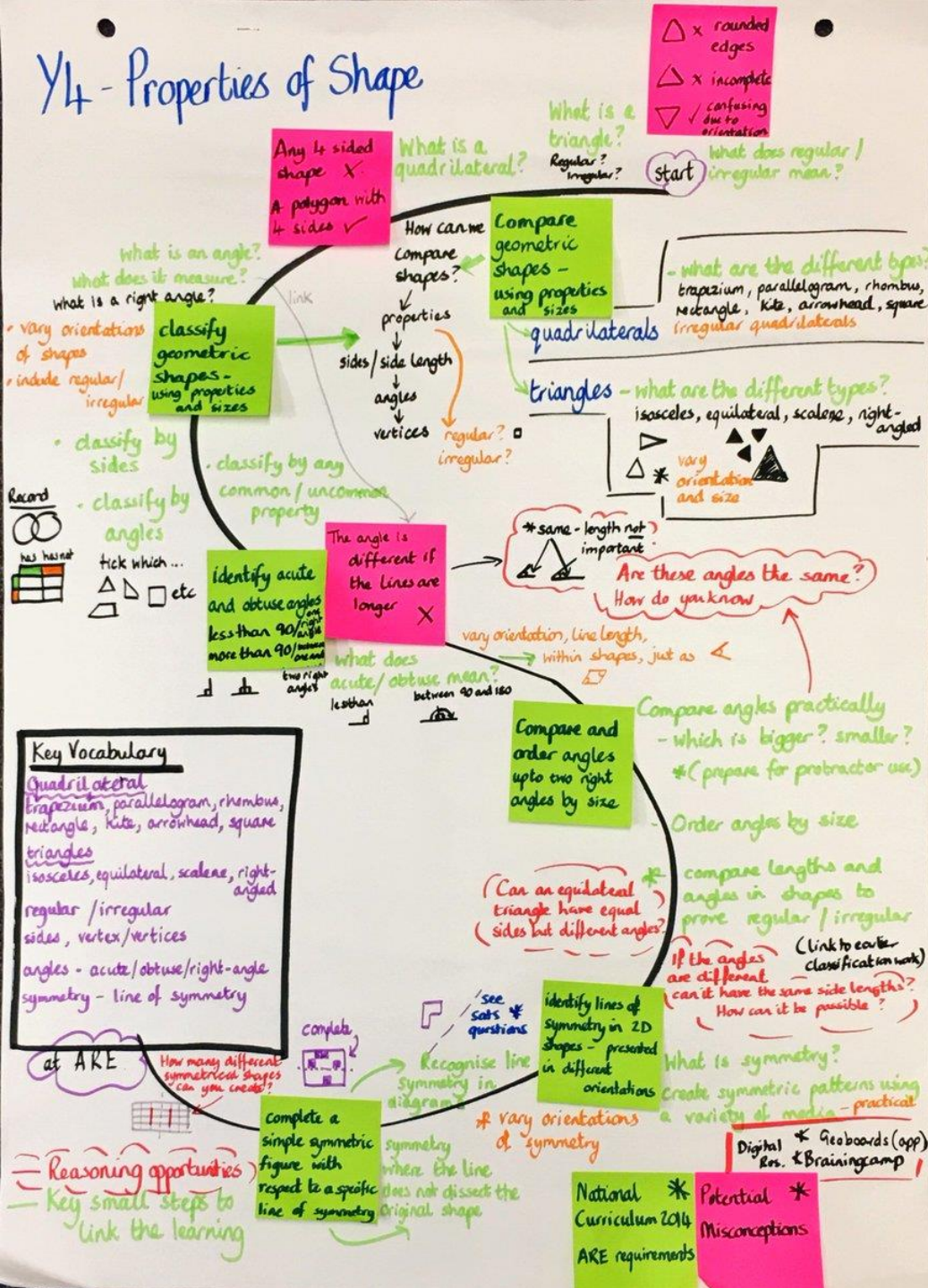
- A Answer
- B Because
- C Convince

	H	T	O
	100 100	10 10	1 1
	100	10 10	1 1
			1 1
			1 1
+			1 1
			1 1

Draw this place value grid in your book and explain what you need to do to complete the calculation.

What column will definitely change, maybe change and never change?

Y4 - Properties of Shape



Coherence

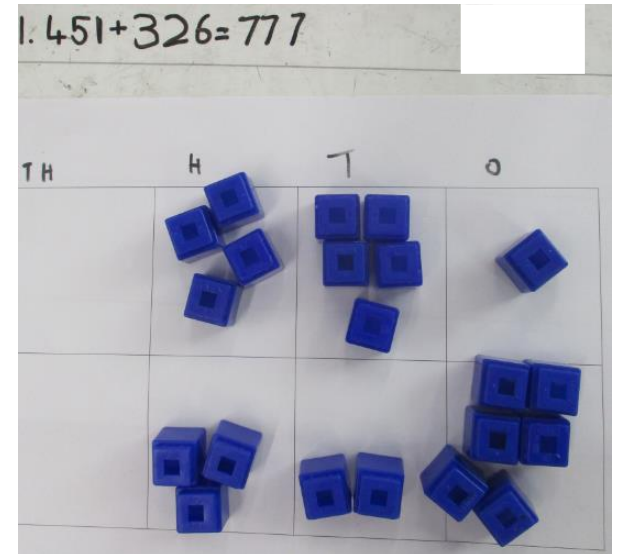
1. Small steps are easier to take.
2. Focusing on one key point, each lesson allows for deep and sustainable learning.
3. Certain images, techniques and concepts are important pre-cursors to late ideas. Getting the sequencing of these right is an important skill in planning and teaching for mastery.
4. When something has been deeply understood and mastered, it can and should be used in the next steps of learning.

Addition - Vocabulary

$$43 + 7 = 50$$

Diagram illustrating the components of an addition equation:

- An orange arrow points from the number 43 to the word "Addend" (written in orange).
- A black arrow points from the number 7 to the word "Addend" (written in black).
- A purple arrow points from the number 50 to the word "Sum" (written in purple).



Why do we need to use these words?

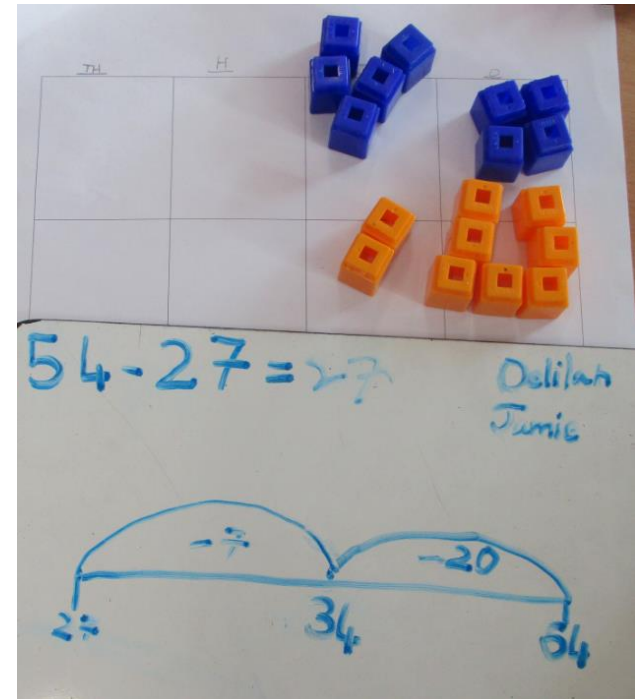
Subtraction - Vocabulary

$$43 - 7 = 36$$

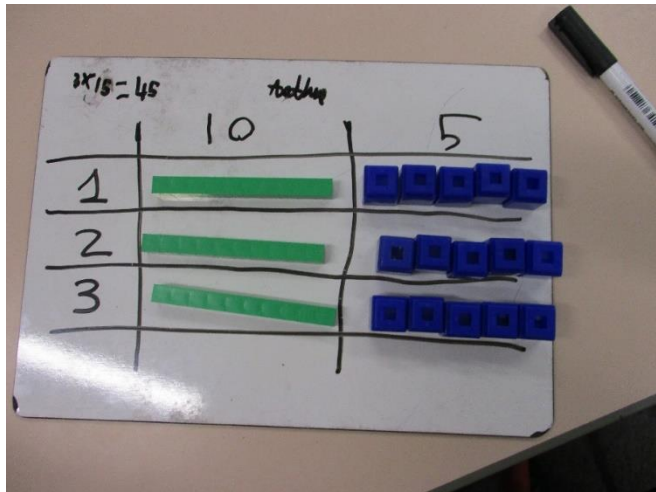
Minuend

Subtrahend

Difference



Multiplication - Vocabulary



$$43 \times 7 = 301$$

Multiplicand
(Factor)

Multiplier
(Factor)

Product

3 Laws

Commutative Law

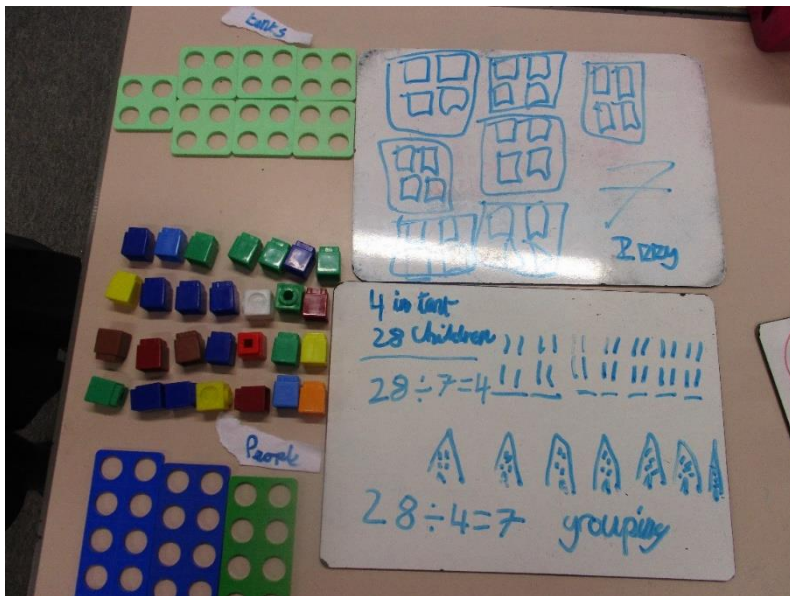
Distributive Law

Associative law

Division - Vocabulary

$$42 \div 7 = 6$$

↙ Dividend
↓ Divisor
↘ Quotient



DIVISION

to separate into equal groups

SHARING division

UNKNOWN: How many in each group?

There are 28 kittens napping in 7 cat beds at the Animal Rescue Center. There are the same number of kittens in each bed. How many kittens are in each bed?

$$\frac{28}{\text{total}} \div \frac{7}{\# \text{ groups}} = \frac{?}{\# \text{ in each group}}$$

There are 4 kittens in each bed.

GROUPING division

UNKNOWN: How many groups?

There are 18 bunnies at the Animal Rescue Center. Three bunnies can fit in a cage. How many cages do they need to fit all the bunnies?

$$\frac{18}{\text{total}} \div \frac{3}{\# \text{ in each group}} = \frac{?}{\# \text{ groups}}$$

They all need 6 cages to fit the bunnies.

Bridge 10

Talk Task



Which questions are easy, which are hard?

$453 + 10 =$

$930 - 100 =$

$493 + 10 =$

$910 - 120 =$



Why are some easy and some hard? Explain your reasons.

Greater depth

- Archie and Sophie are both working out the answer to the following question:

$$350 + 278 + 250$$

They have both used different strategies.

Archie's method

$$350 + 278 + 250$$

$$350 + 278 = 628$$

$$628 + 250 = 878$$

Answer = 878

Sophie's method

$$350 + 278 + 250$$

$$350 + 250 = 600$$

$$600 + 278 = 878$$

Answer = 878

Which do you prefer? Explain why.
Use the method you preferred to solve
 $320 + 458 + 180$

The sea level is usually taken as zero.

Look at the picture of the lighthouse.

If the red fish is at -5 m (5 metres below sea level):

Where is the yellow fish?

Where is the green fish?



Can you draw a fish at -35 m?

Can you draw a seagull at 20 m above sea level?

What would the position of your fish and the seagull be if each of the intervals on the lighthouse represented 7 m?

Non-negotiables by end of LKS2

Multiplication

By the end of Year 4, children should be fluent in their multiplication up to 12×12 .

This will provide a strong foundation for them as they move on to UKS2.

More complex multiplication

$$25 \times 19 = ?$$

If $25 \times 19 = 475$, how can we use that to work out $27 \times 19 = ?$

If $25 \times 19 = 475$, how can we use that to work out $525 = 25 \times ?$

Reason your answer carefully.

Reasoning

I know... so...

$$25 \times 48 = \underline{\quad}$$

$$100 \times 48 = 4800$$

$$\underline{\quad} \times 48 = 4848$$

True or false?

$$17 \times 13 = 15 \times 15$$

What do you notice?

Try other examples. Do you see a pattern?

Is it the same?

$$800 + 160$$

$$240 \times 2 \times 2$$


Is **24×40** the same as...

$$6 \times 160$$

$$20 \times 40 \times 4$$

Vocabulary





- Exchange/regroup
- calculation
- number sentence
- oblong 

hundreds tens ones
H T **1's**

digit →
→ **62**

number
62



- borrow or steal
- sum = total
- rectangle
(family name)
 
- units

Useful Links

NCETM National Centre for Excellence in the Teaching of Mathematics

<https://www.ncetm.org.uk/>

Nrich

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

I See Reasoning

<https://www.iseemaths.com/i-see-reasoning-ks1/>