Mathematics Mastery

What is Maths Mastery?

Aims of session

To gain an understanding of Maths Mastery

- Where it has come from
- How it is implemented in schools
- Impact on the children's learning
- Cross curricular links (Throughout)
- Use of outdoors (Throughout)
- Helping parents

Mathematics Mastery

Where has Maths Mastery come from?

Read or hear the word “maths” in England right now, and you’re likely to see or hear the word “mastery”, too.

Given this, a new teacher could be forgiven for thinking that talk of mastery has been around for a long time. However, a quick search in the Schools Week archive reveals that in 2015 there were only passing references, and generally they were not linked to maths.
Teachers who have been around for a little longer probably have some inkling that this talk of mastery has something to do with maths teaching in East Asia, and particularly Singapore and Shanghai.

Mathematics Mastery

Where has Maths Mastery come from?

The idea of mastery learning goes back to the 1960s, when Benjamin Bloom had a novel idea: if learners don't get something the first time, then teach them again and in different ways until they do. More recently, the Ark academy chain began to develop a maths curriculum influenced by Singapore.

They got funding from the Education Endowment Foundation for further development and for trials of the new approaches. In 2011 the term "mathematics mastery" was adopted.

Over the next few years, Mathematics Mastery developed as a curriculum and professional development programme that eventually separated from Ark to become an independent not-for-profit organisation.

Mathematics Mastery

Where has Maths Mastery come from?

Meanwhile, a number of trips were made by school leaders, civil servants and politicians – not to Singapore, but to Shanghai. This led to the National Centre for Excellence in the Teaching of Mathematics (NCETM) starting to talk about "mastery approaches" and then to the formulation of "teaching for mastery", alongside the mathematics teacher exchange programme with Shanghai.

It is also now the word that is becoming used to sum up good maths teaching – teaching for mastery is where it's at. But regardless of the words used or where the ideas come from, what is important is whether the ideas and teaching approaches work for teachers and children. If everything is a remix, then teachers need to know how to make professional judgements about adopting or adapting ideas so that they will work for them, their schools and their children.

Mathematics Mastery

What is Maths Mastery?

Maths for mastery involves employing approaches that help pupils to develop a deep and secure knowledge and understanding of mathematics at each stage of their learning, so that by the end of every school year or Key Stage, pupils will have acquired mastery of the mathematical facts and concepts they've been exposed to, equipping them to move on confidently and securely to more advanced material

Two fundamental points: (1) Acquiring mastery of mathematics is something for *all* pupils. (2) Teaching for mastery approaches *can* enable all pupils (with only a tiny proportion of exceptions) to succeed in maths.

Mathematics Mastery

The Three aims of the National Curriculum

Children should become **fluent** in the fundamentals of mathematics, including through varied and frequent practice, so that pupils develop conceptual understanding and recall and apply knowledge;

Children should **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and using mathematical language;

Children should **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

Mathematics Mastery

The Problem!

At present, **England is significantly underachieving in terms of developing able mathematicians**, and this situation is now critical. It is necessary to increase systematically the number of young mathematicians with a robust and deep grasp of the range of mathematical ways of thinking and working. Students should have an engaging and challenging experience of school mathematics that will encourage many more to pursue mathematically-intensive courses at university.

Potential heavy users of mathematics should **experience a deep, rich, rigorous and challenging mathematics education, rather than being accelerated through the school curriculum.**

Mathematics Mastery

Mindset: fixed vs growth

Mathematics Mastery

Mindset: fixed vs growth

Fixed Mindset

In a **fixed mindset**, people believe their basic qualities, like their intelligence or talent, are simply **fixed** traits. They spend their time documenting their intelligence or talent instead of developing them. They also believe that talent alone creates success—without effort. Are they wrong?

Growth Mindset

Alternatively, in a **growth mindset**, people have an underlying belief that their learning and intelligence can **grow** with time and experience. When people believe they can get smarter, they realize that their effort has an effect on their success, so they put in extra time, leading to higher achievement.

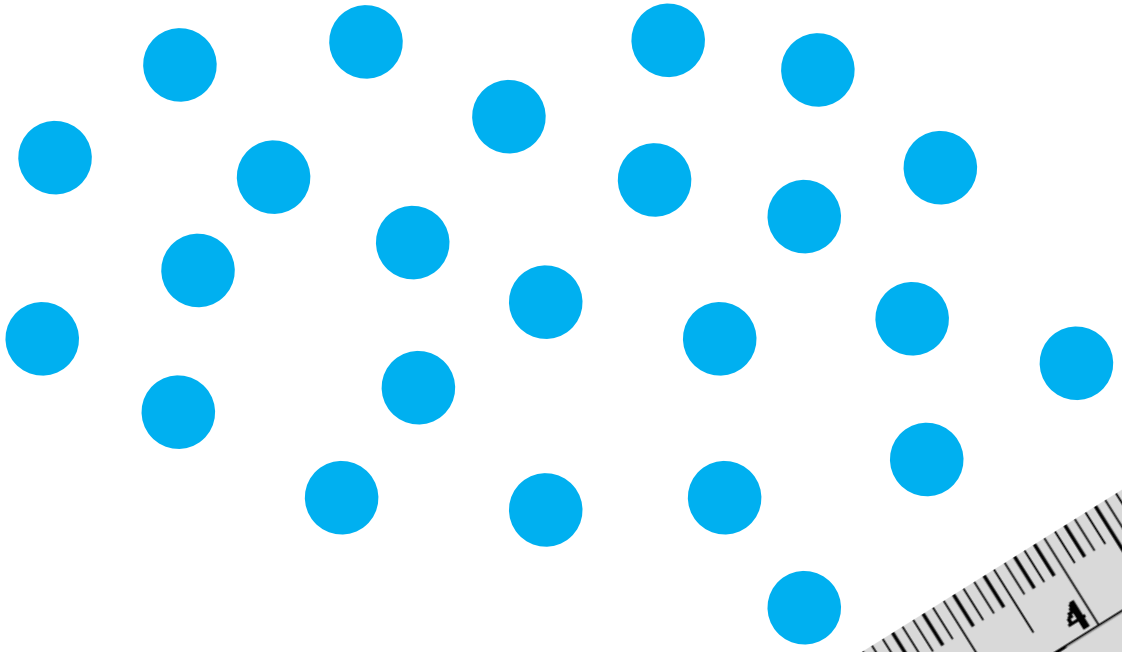
Mathematics Mastery

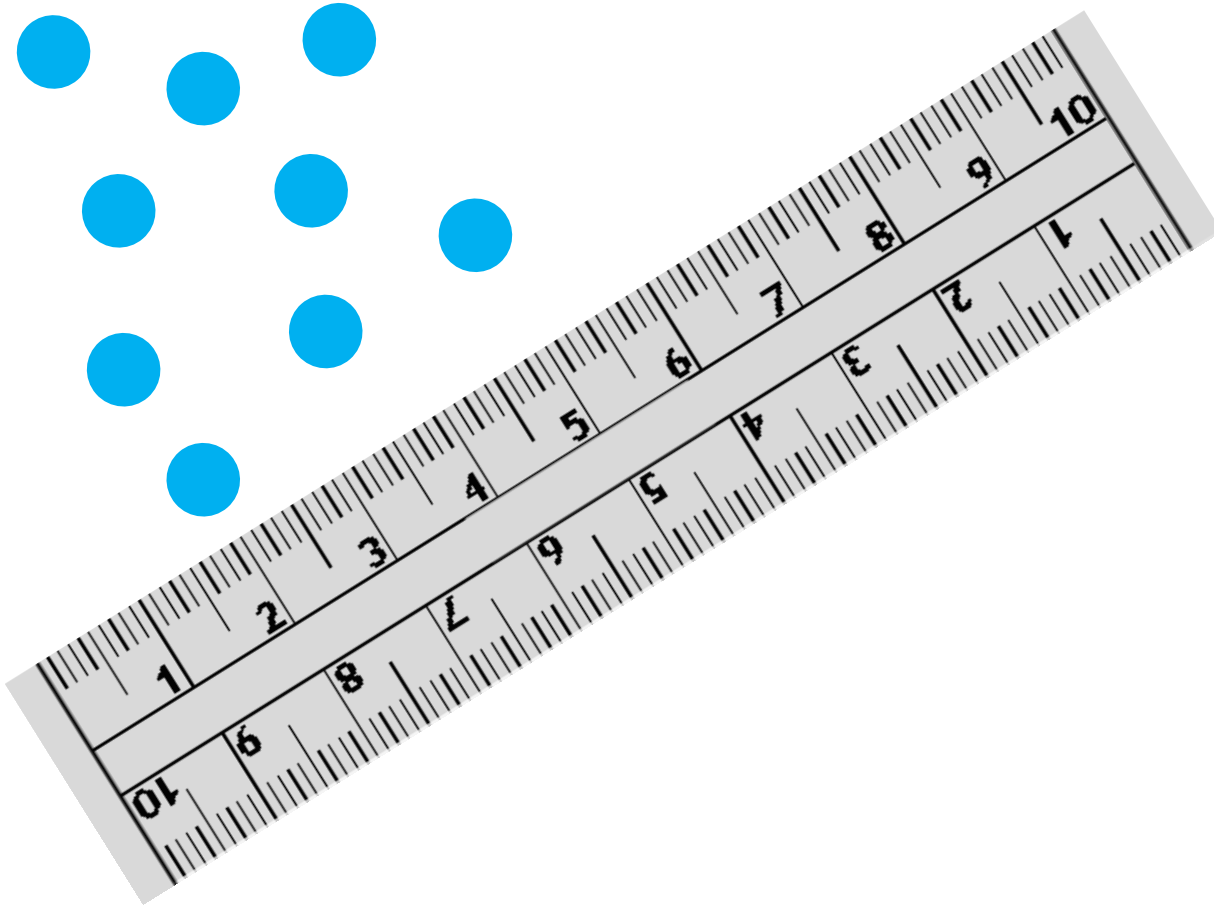
Mindset: fixed vs growth – Quiz!!!

Mathematics Mastery

Do Now/Talk Task (P)

What is a number?





Mathematics Mastery

‘What is a number?’ feedback

Continuous

Numeral

Number

Finite

Set

Discrete

Count

Infinite

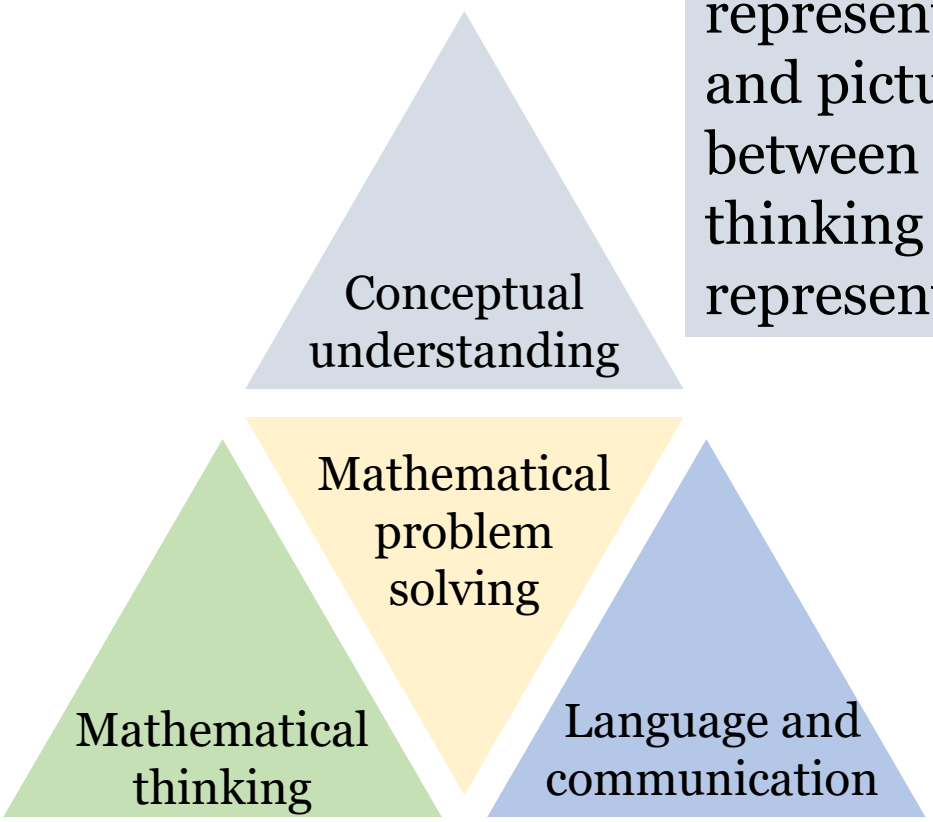
Quantity

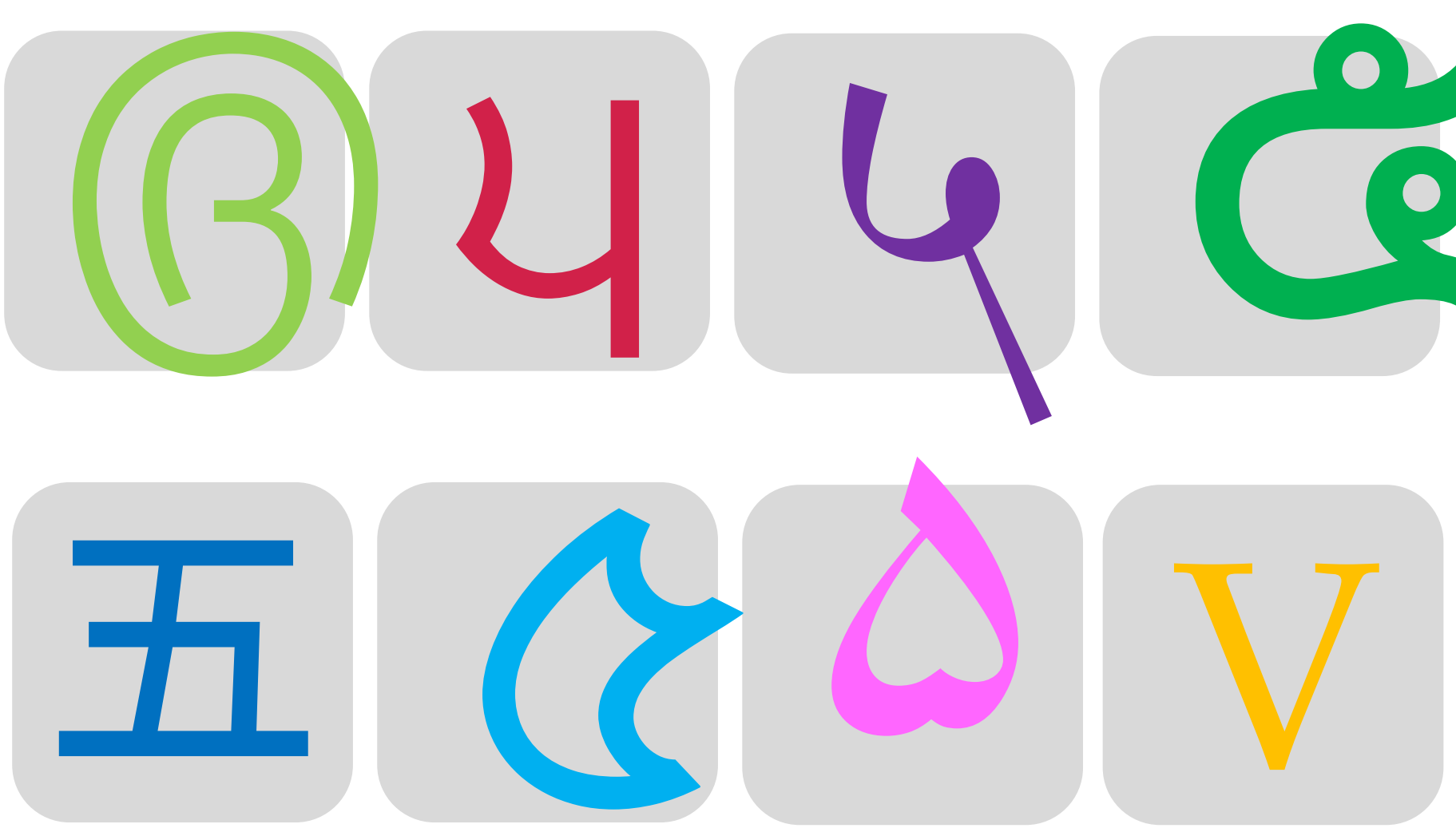
Compare

Magnitude

Key Principles of Mastery

Conceptual understanding
Pupils deepen their understanding by representing concepts using objects and pictures, making connections between different representations and thinking about what different representations stress and ignore.

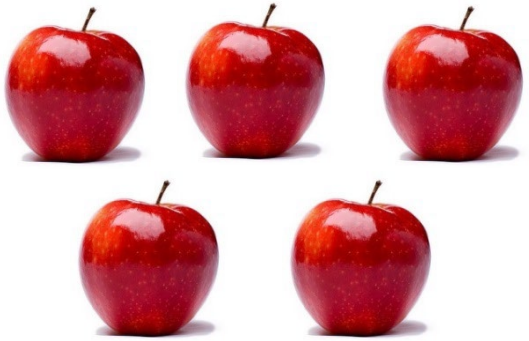




Multiple representations

Concrete

The DOING



Demonstrating depth

Pictorial

The SEEING

Abstract

The SYMBOLIC

5

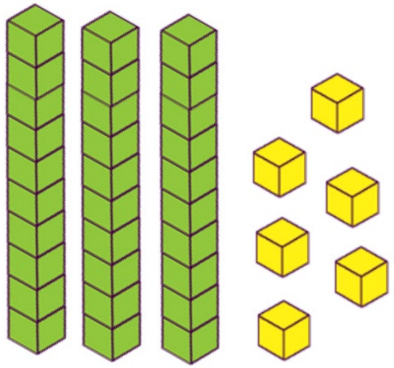
five

/ˈfaɪv/

Talk Task (P)

What does each representation of 36 reveal about the number?

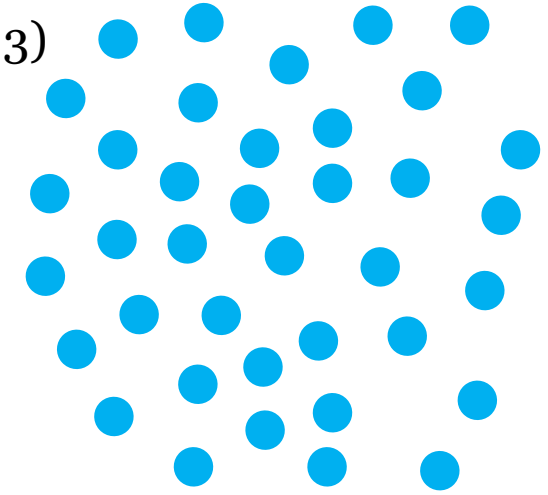
1)



2)

Tens	Ones
3	6

3)



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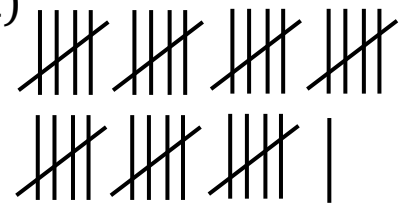

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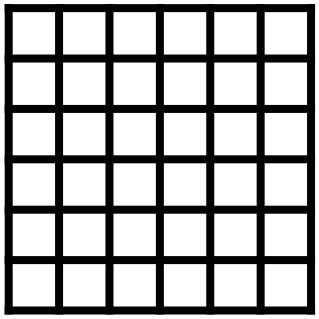

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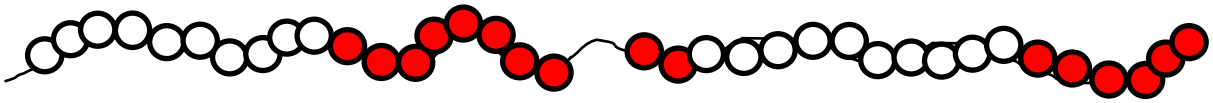


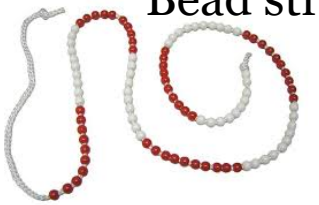
Conceptual understanding

Pupils deepen their understanding by representing concepts using objects and pictures, making connections between different representations and thinking about what different representations stress and ignore.

Can you think of other representations?

Tools for representations

Bead strings

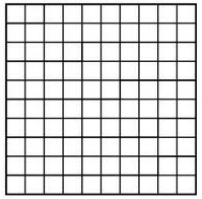


Dienes blocks

Multilink cubes

Geoboards

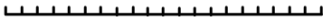
100 grids



Fraction blocks

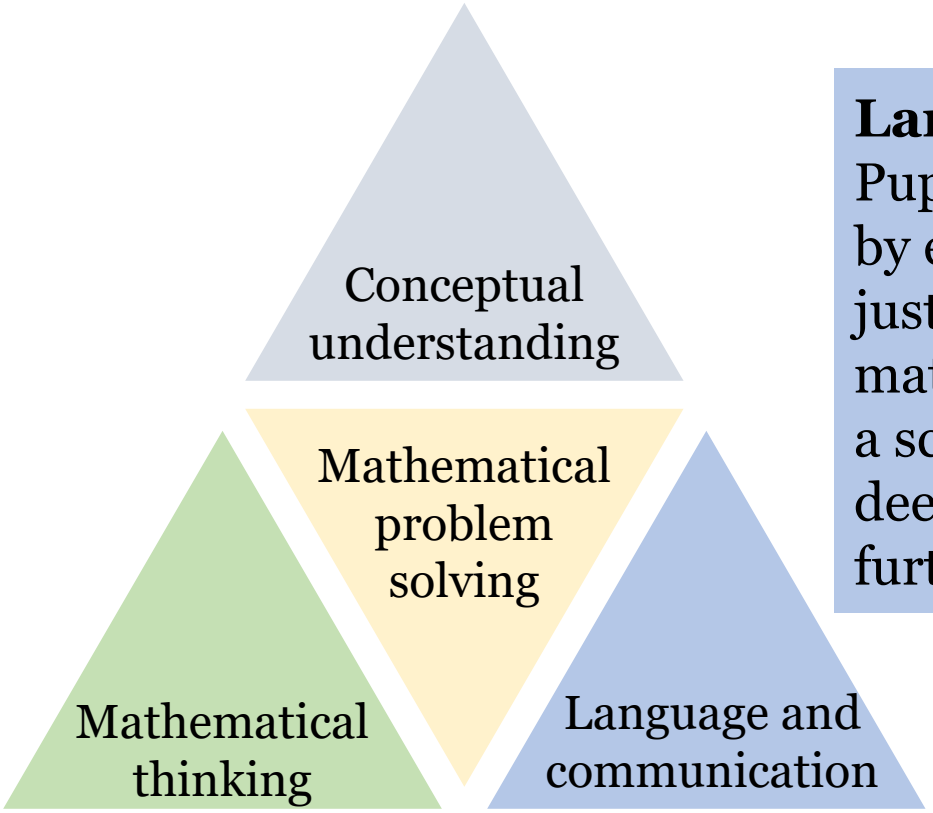
Cuisenaire rods

Number lines



- What have we got?
- What do we/don't we use?
- What might the barriers be?

Key Principles



Language and communication
Pupils deepen their understanding by explaining, creating problems, justifying and proving using mathematical language. This acts as a scaffold for their thinking deepening their understanding further.

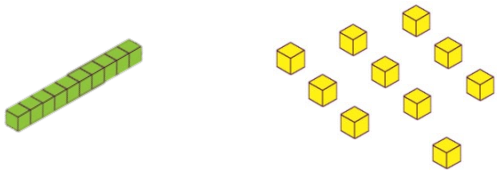
What comes next…? (P)

Thousands
Hundreds
Tens

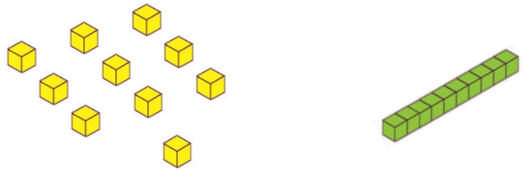
What comes next…?

Thousands
Hundreds
Tens
Ones!!

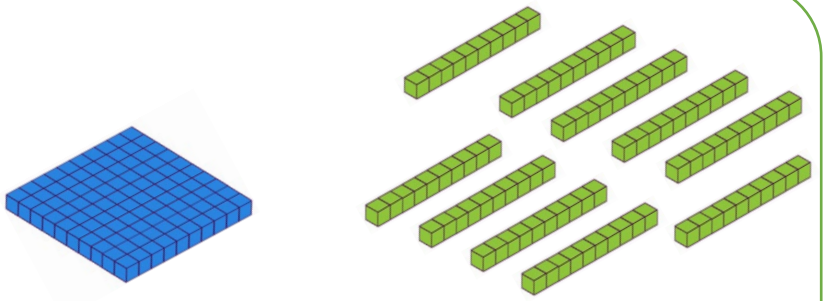
Why ‘ones’?



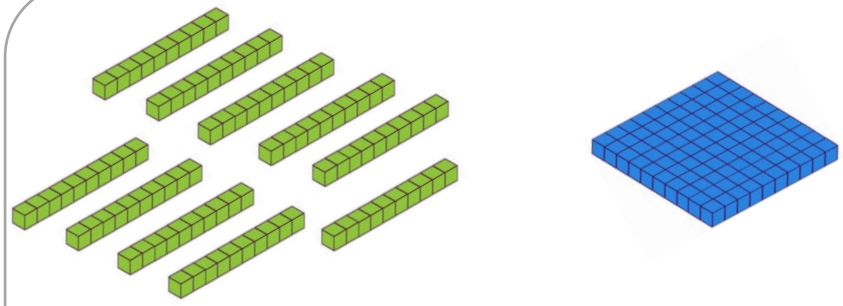
one ten = ten ones



ten ones = one ten

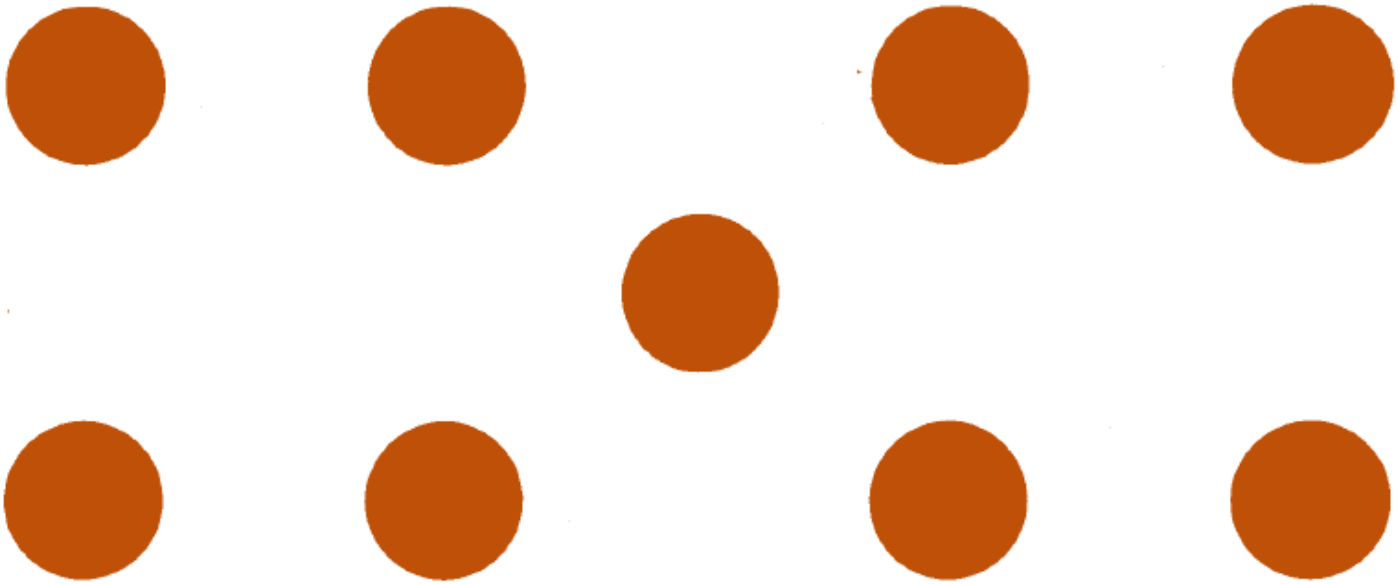


one hundred = ten tens

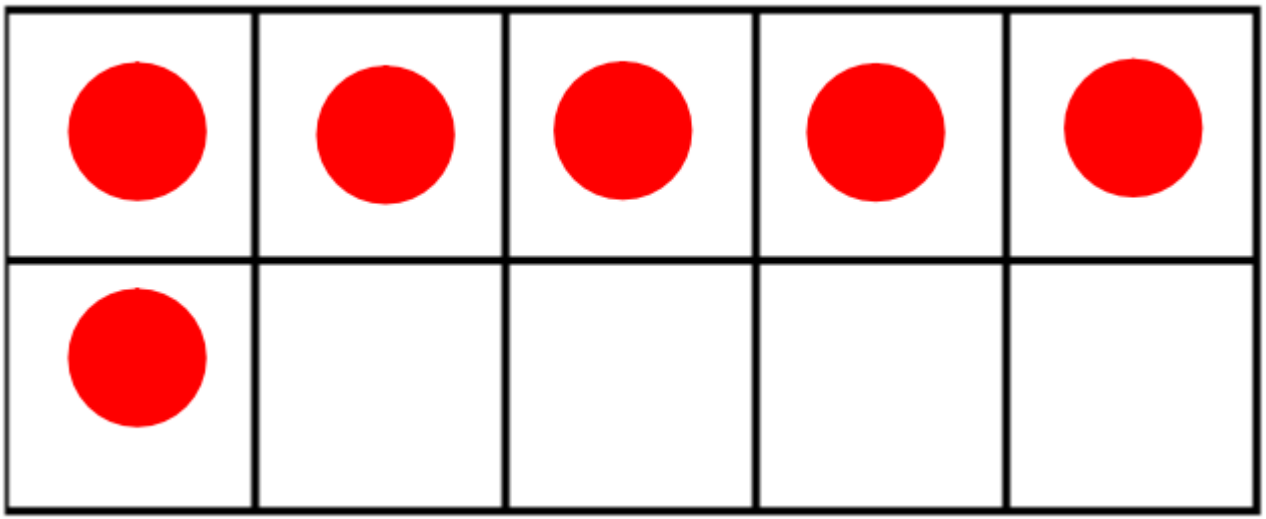


ten tens = one hundred

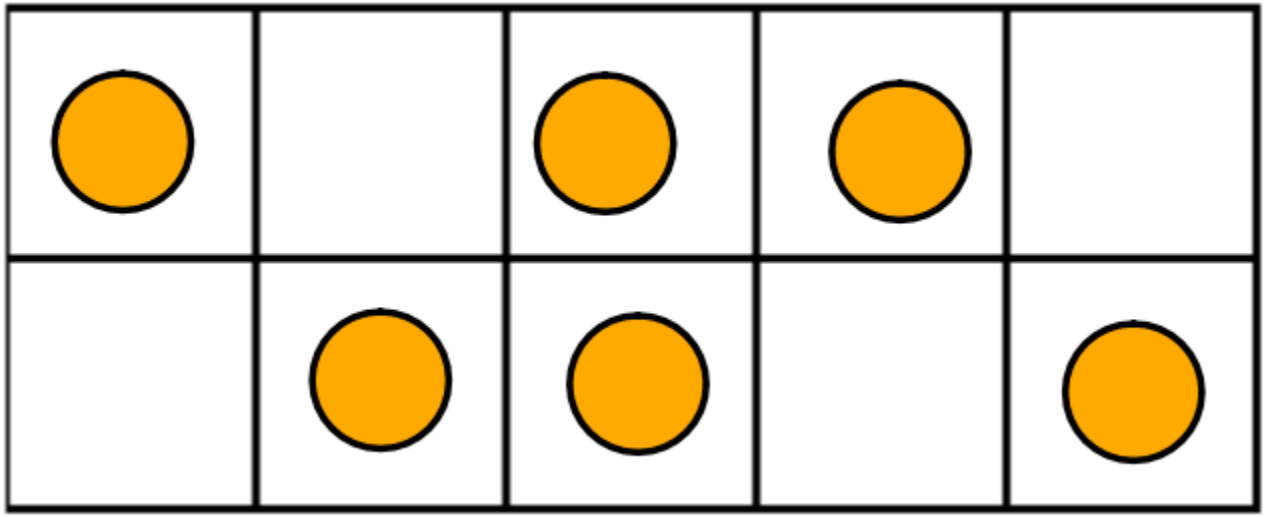
Count the Dots (P)



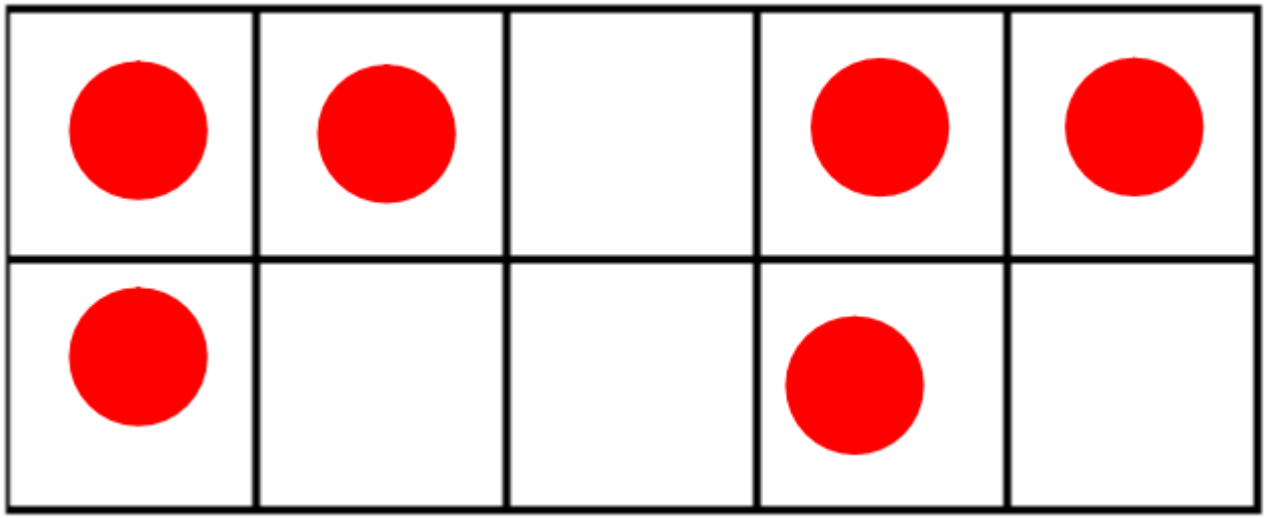
Create numbers and talk about what they see on a tens frame.



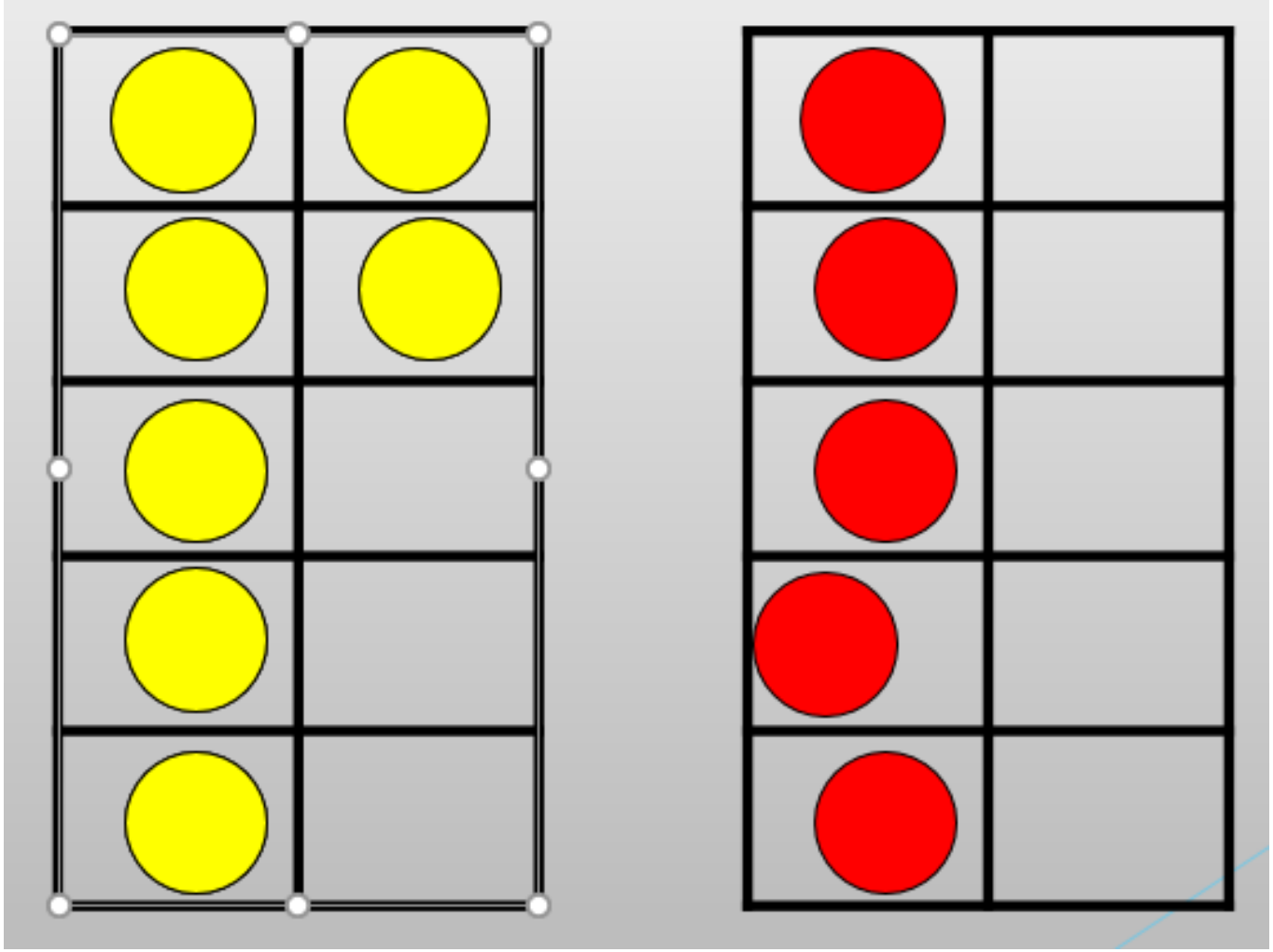
Subitise numbers, discuss what they see



Can the children subitise the number? write it in all the different ways they can see! What is one more? One less? How many more make ten?

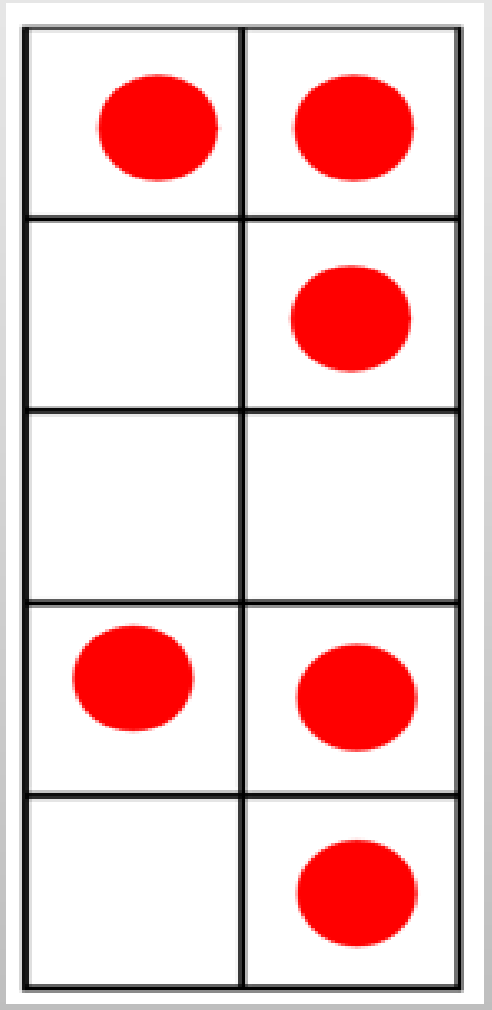


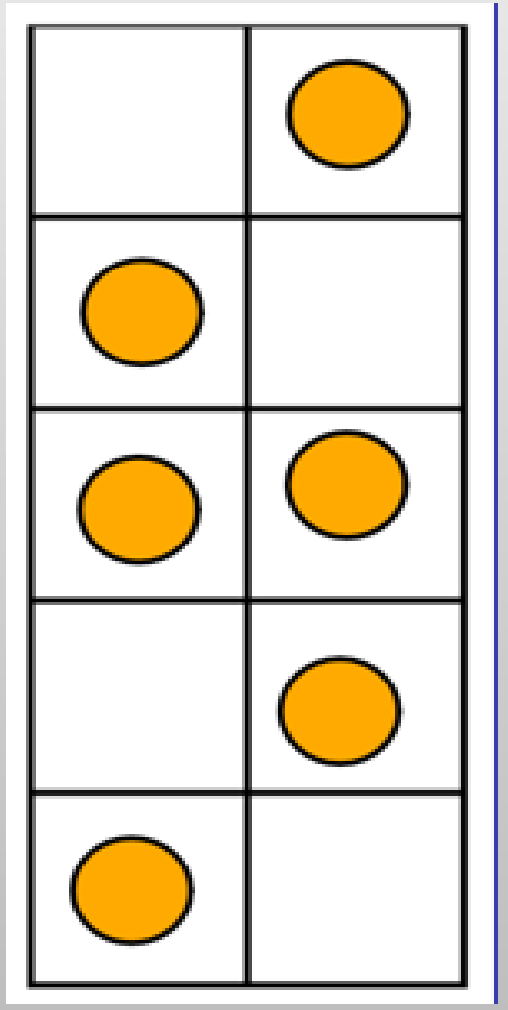
Bridging 10
What is the Calculation?



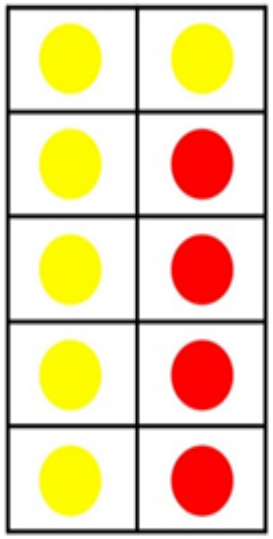
How can we use 10 to solve the addition problem?

What's the same and what is different? How many make ten? Double the number?



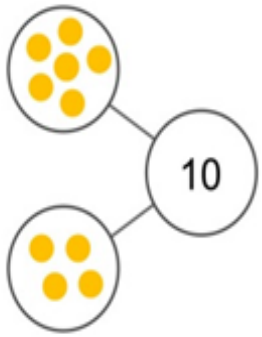


Linking their knowledge using other models and images



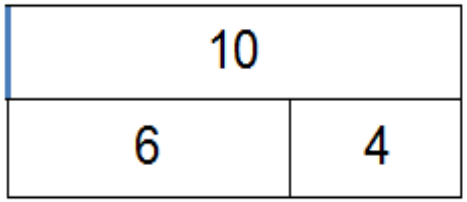
6 + 4 = 10
4 + 6 = 10
10 – 4 = 6
10 – 6 = 4

Tens Frame



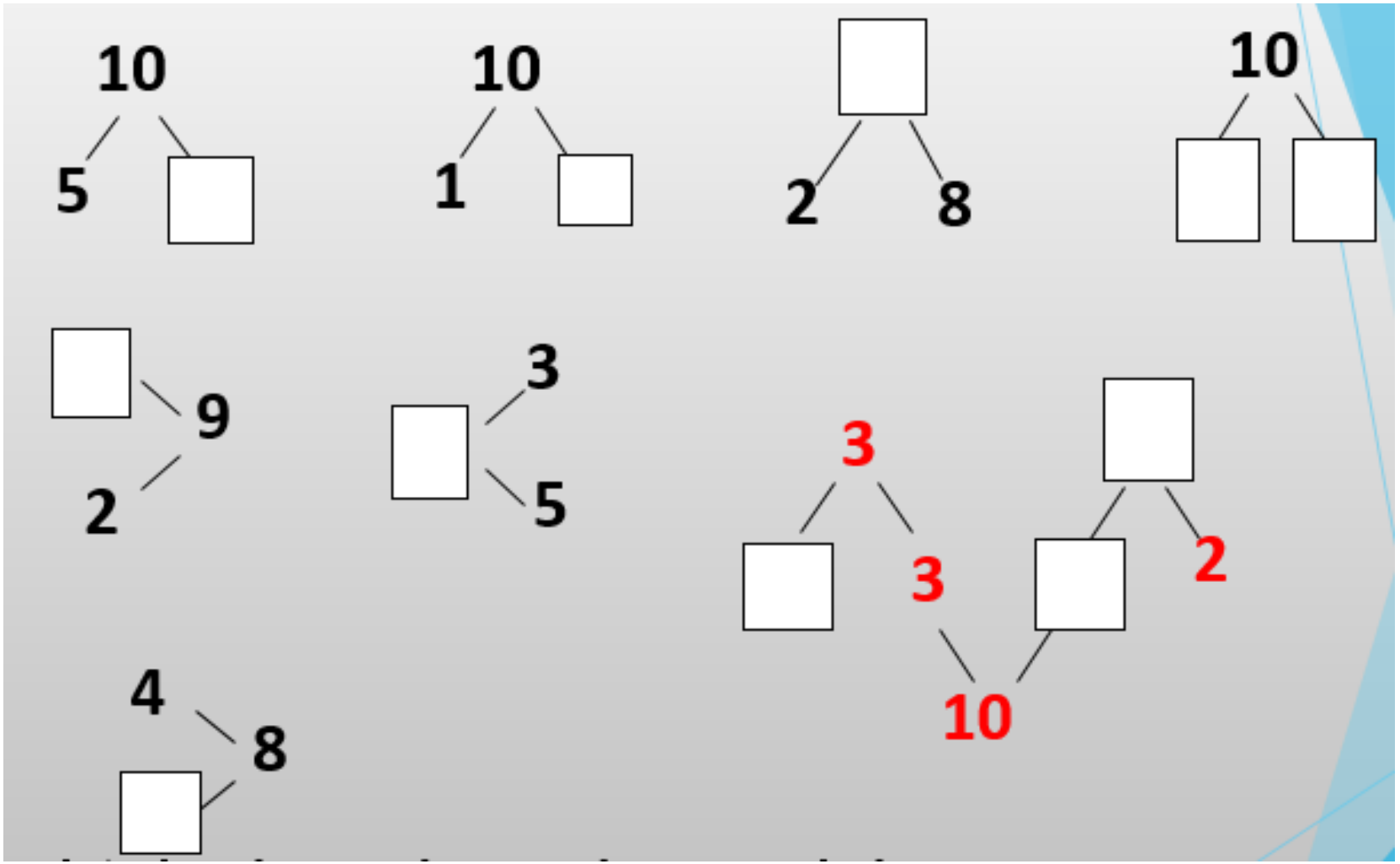
6 + 4 = 10
4 + 6 = 10
10 – 4 = 6
10 – 6 = 4

Part Whole Model



6 + 4 = 10
4 + 6 = 10
10 – 4 = 6
10 – 6 = 4

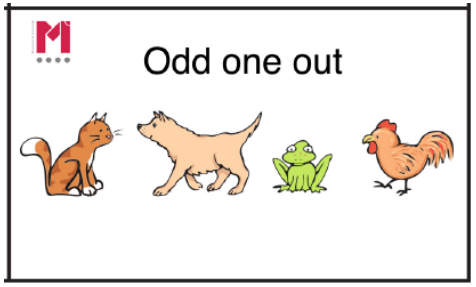
Bar Model



Think about how the model can support efficient strategies

Which one doesn't belong? (P)

Find reasons why EACH one could be the odd one out!



17	26
44	65

Number talk (P)

Mentally evaluate 18×5

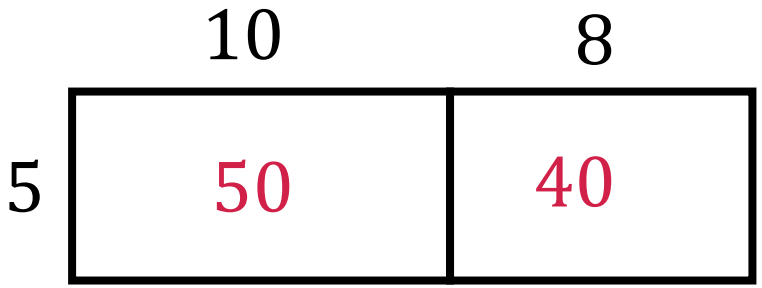
Explain your method

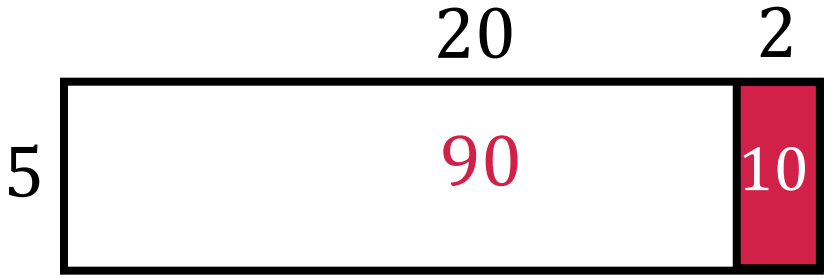
Did anybody do it in a different way?

18×5 – some possibilities

$$10 \times 5 + 8 \times 5$$

This can also be written as: $5(10 + 8)$



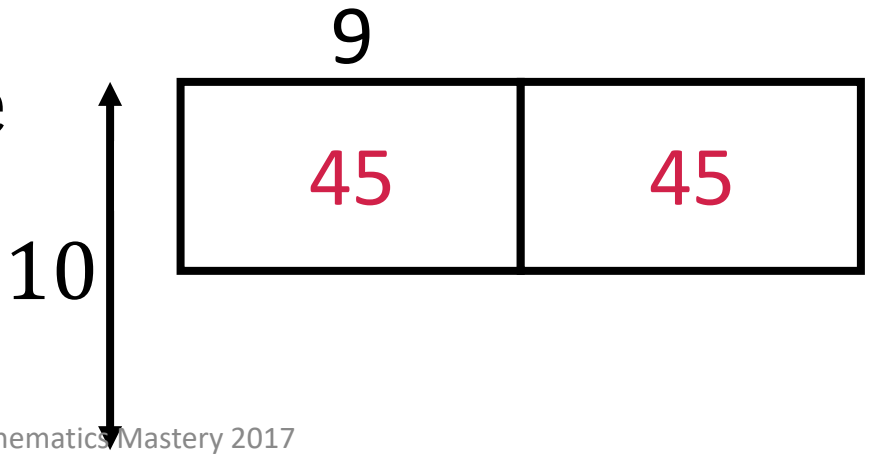


$$20 \times 5 - 2 \times 5$$

This can also be written as: $5(20 - 2)$

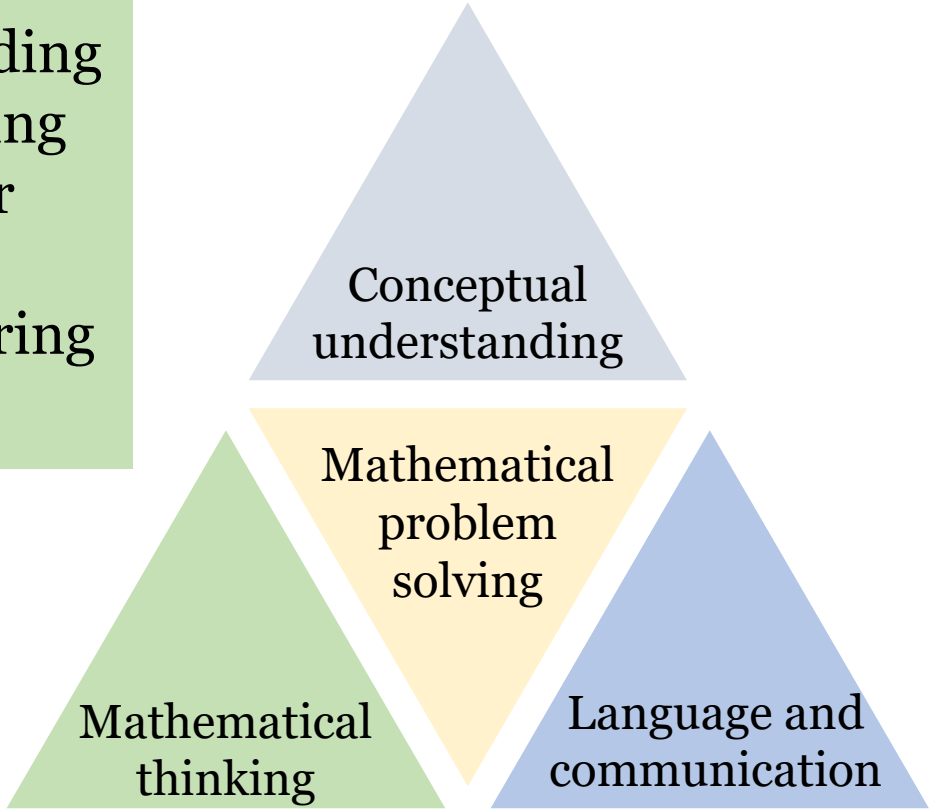
9×5 , then double the answer

$$18 \times 5 = 9 \times 10$$



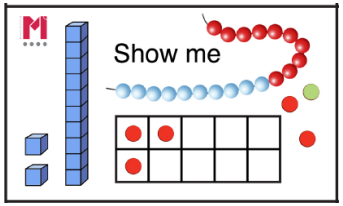
Key Principles

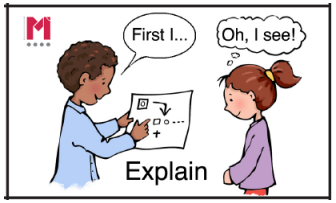
Mathematical thinking
Pupils deepen their understanding by giving an examples, by sorting or comparing, or by looking for patterns and rules in the representations they are exploring problems with.

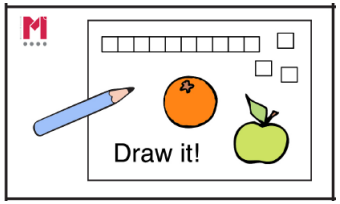


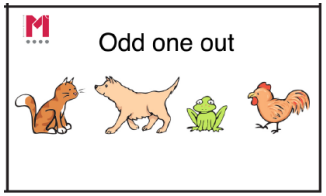
Promoting mathematical thinking

- If we know this, what else do we know?
- Why is that a good mistake?
- Give me . . .tell me . . .show me . . .

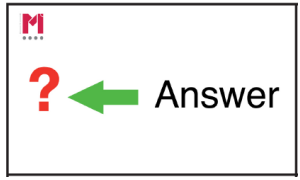




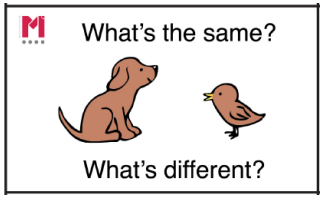




- Why is this the odd one out?
- The answer is . . .what is the question?



- Give me a silly answer for . . .?
- What's the same? What's different?



- Is it always, sometimes or never true?

Reflection

What did I learn today?

Which activities from today could I incorporate into my mathematics teaching?

Mathematics Mastery

Expectations

- Model
- Pupils use correct mathematical vocabulary at all times
- Pupils speak in full sentences
- Pupils engage in mathematical talk
- Pupils look for patterns, make conjectures

Mathematics Mastery

Reasoning and Problem Solving

I am going to show you a problem

I am a two digit number. The product of my digits is eighteen. I am a prime number.

Who am I?

Now think – how did you solve the problem? How did you start? If you meet a problem like this again, what do you think is important to remember?

Find a partner – decide who is A and who is B

- The next slide will show two problems labelled A and B. Solve your problem, this time focussing on how you know you are right. When both of you are done, ***prove*** that you are right to each other – explain your reasoning.

A: I am a multiple of 17 and I am less than 100. I have 5 as a factor. Who am I?

B: I am a multiple of 13 and I am more than 100. I have 10 and 5 as a factor.
Who am I and can you guess two more of my factors?

Are you convinced?

- Convince yourself
- Convince a friend
- Convince an enemy

Reasoning

Mathematical vocabulary

Mathematical language

Mathematical symbols

Drawings or concrete apparatus – if it's tricky, draw a piccie!

The thing I noticed was...

When I saw this it made me think about...

I know this is true because...

I realised it couldn't be right because...

When I got stuck I decided to try...

The connection I think is important is...

The thing that helped me see the connection was...

I though the answer looked right because...

The way I would describe the pattern is...

I wondered what would happen if...

I already know...so this helped me to work out...

The strategy I used was...

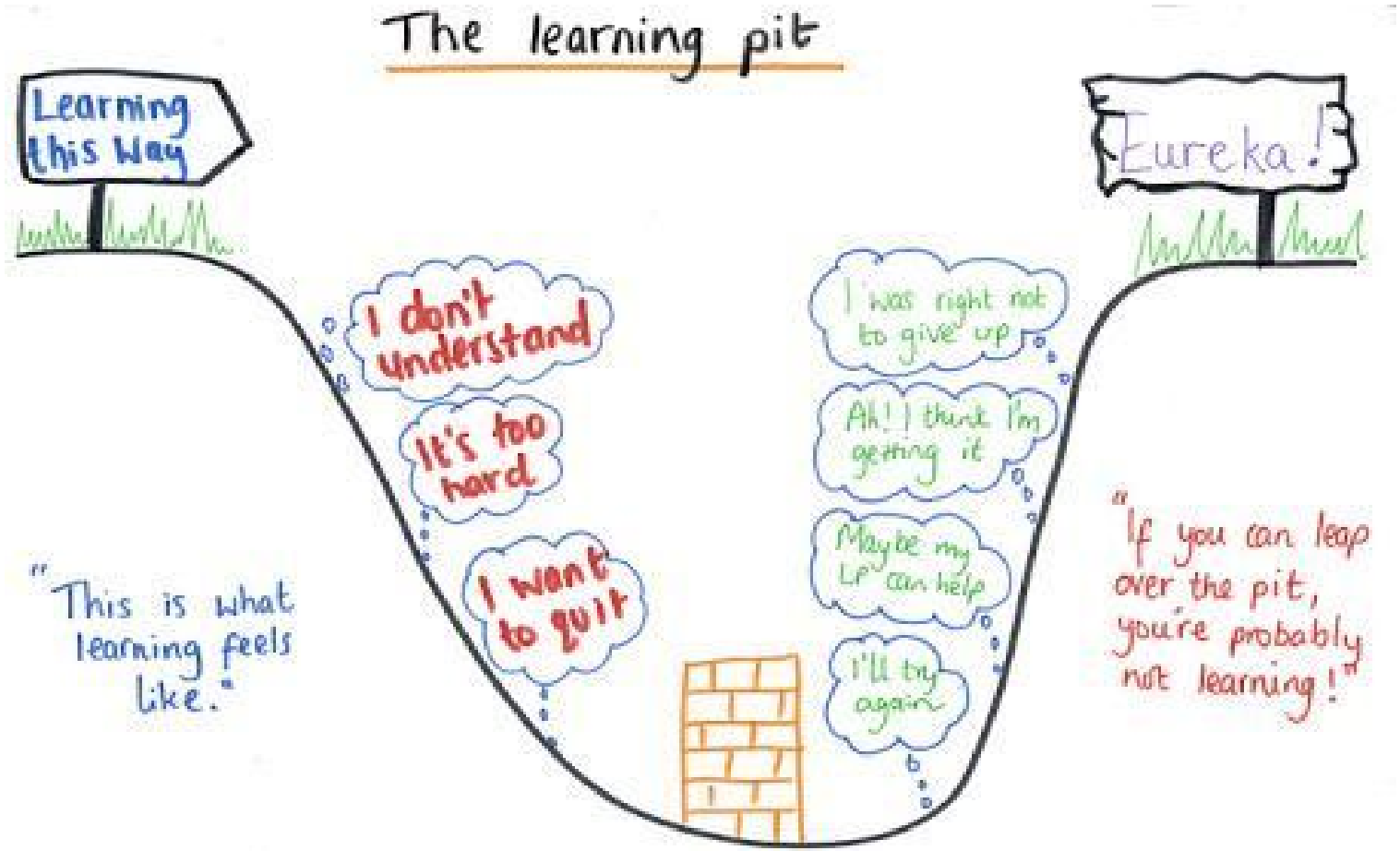
When do we use reasoning? Can we plan opportunities?

1. When first encountering a new challenge.
2. When logical thinking is required.
3. When a range of starting points is possible.
4. When there are different strategies to solve a problem or calculation.
5. When there is missing information.
6. When selecting a problem solving skill.
7. When evaluating a solution in context.

Here are some possible sentence starters:

I think this because …
If this is true then …
I know that the next one is … because …
This can't work because …
When I tried ……. I noticed that …
The pattern looks like …
All the numbers begin with …
Because ….. then I think ….
This won't work because ..

The learning pit



Helping Parents

Session 1
Counting and early number & place value
Session 2
Addition
Session 3
Subtraction
Session 4
Multiplication
Session 5
Division
Session 6
Fractions
Session 7
A mastery lesson

Celebration event

- Presentation of certificates

- Volunteer intervention lead at school?
- Continue learning with Derby University?