MAWA Annual Primary Mathematics Conference
Igniting the Flames
19 November 2018 | Crown Convention Centre, Perth
Workshop 12:05 – 1:00 pm

What's in Your Problem Solving Toolbox?

Anita Chin

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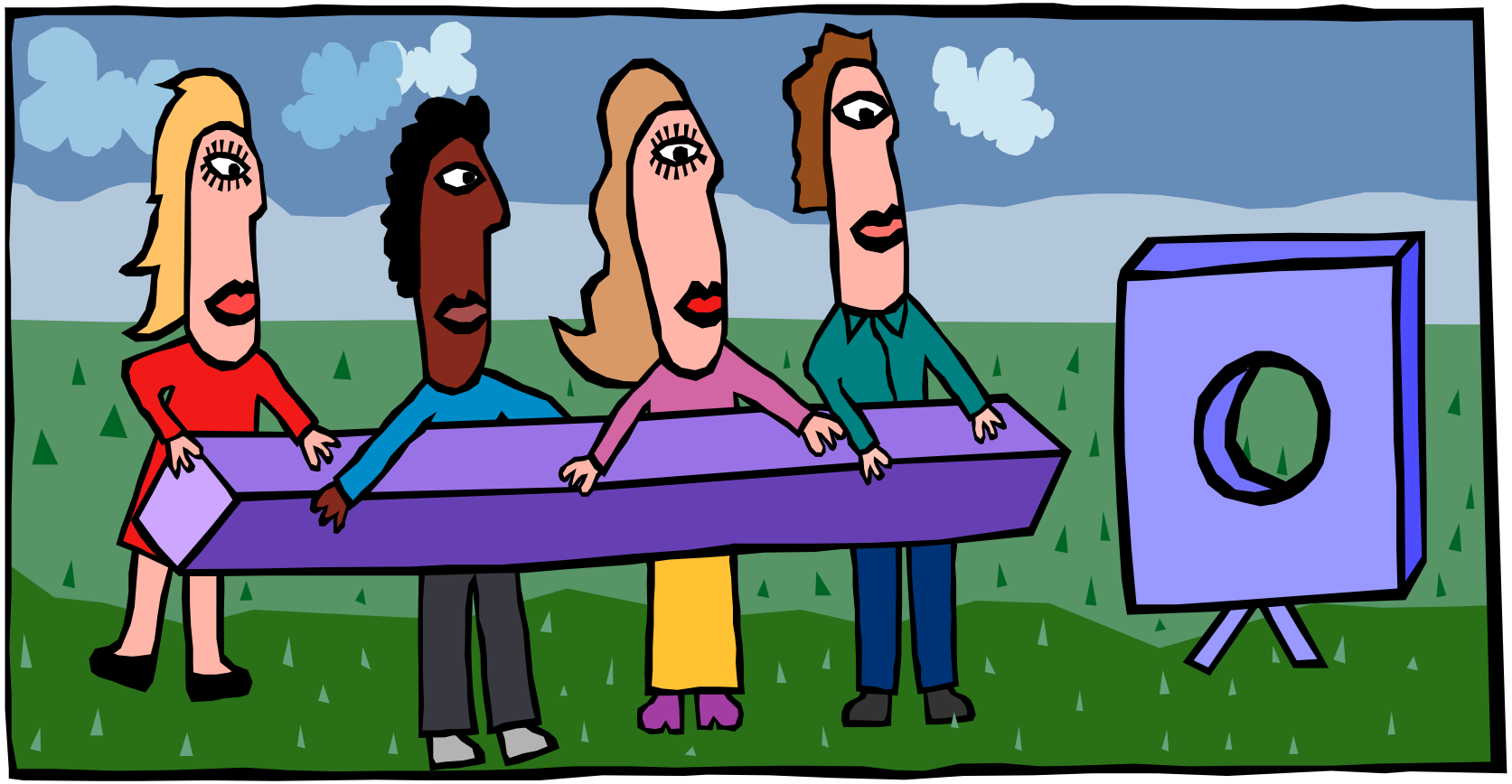
Anita Chin
inspired mathematics teaching

What is problem solving?



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What is problem solving?

Problem solving is about solving problems that you don't know how to do. It's not problem solving if you already know how to do it.

Peter Sullivan

Mathematics proficiencies introduction video by Peter Sullivan
https://www.australiancurriculum.edu.au/resources/mathematics-proficiencies/

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Overview

1. Making maths visible: The Bar Model Method
2. Using open-ended questions to differentiate
3. Using concrete materials
4. Mental computation problems

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The Bar Model: Problem #1

Toy Cars – Problem 1

Marcus has 15 toy cars. John has 3 times as many toy cars as Marcus. How many toy cars does John have?

Mathematical problem solving: The Bar Model Method (2014, p.18, Yueh Mei Liu & Vei Li Soo). More details.

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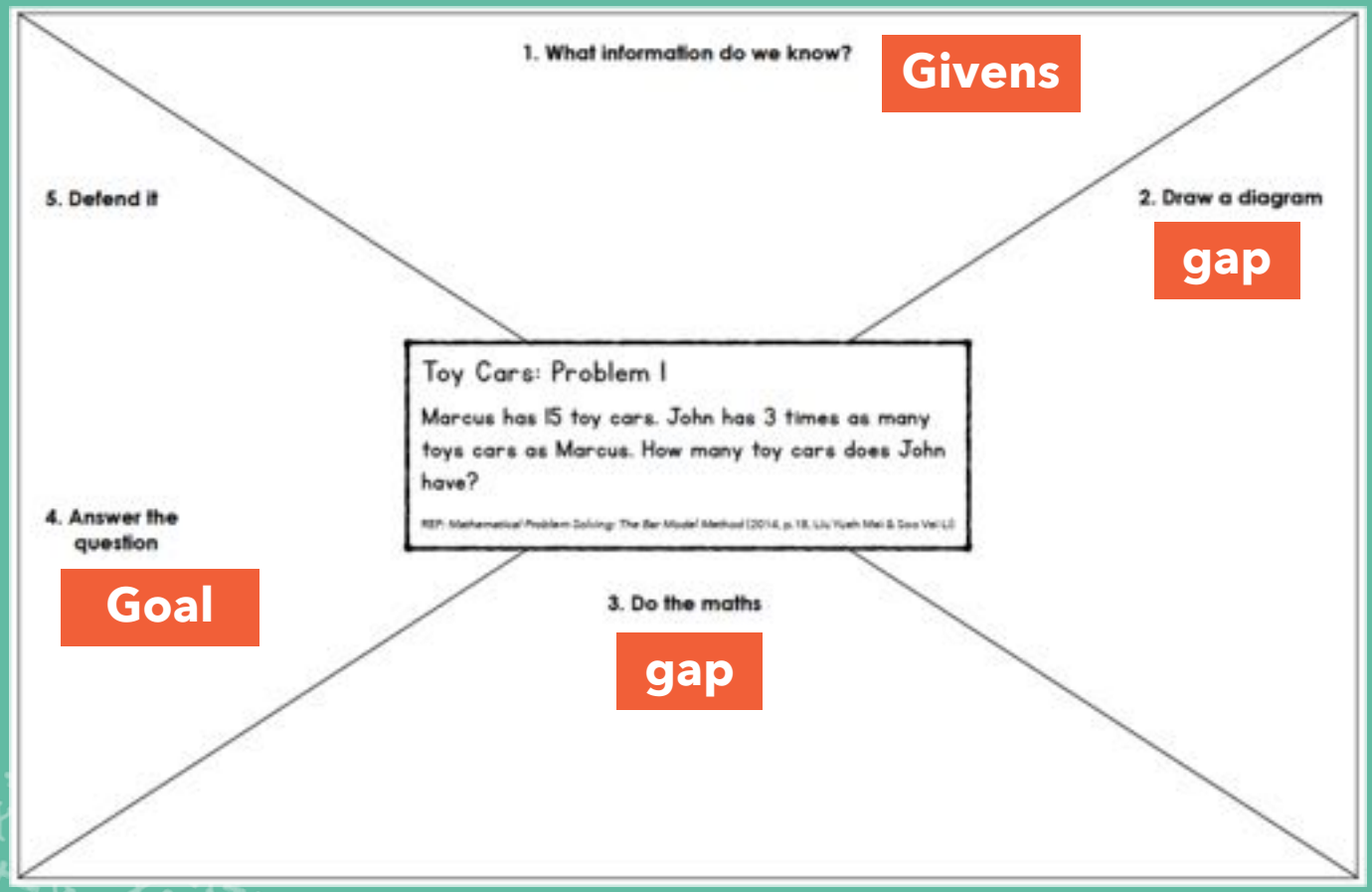
Introducing my 'Think Map'



BLM *'Graphic Organiser: Think Map (solving word problems using the Bar Model Method)'* available to download from Anita's website www.anitachinmaths.com.au/resources

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Toy Cars: Problem 1

Marcus has 15 toy cars. John has 3 times as many toys cars as Marcus. How many toy cars does John have?

REF: Mathematical Problem Solving: The Bar Model Method (2014, p 18, Liu Yueh Mei & Soo Kei Li)

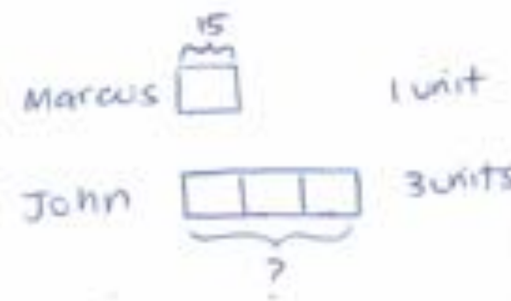
1. What information do we know? GIVENS

Marcus = 15 toy cars

John = 3 times as many as Marcus

John = ? toy cars

2. Draw a diagram GAP



3. Do the maths GAP

Marcus = 1 unit = 15 cars

John = 3 units = 15 × 3 = 45 cars

mental strategy of repeated addition → 15 × 3 = 15 + 15 + 15 = 30 + 15 = 45

3 × 15 : 3 tens + 3 fives = 30 + 15 = 45 ← mental strategy of multiplying the tens and then the ones.

4. Answer the question GOAL

John has 45 toy cars.

5. Defend it

Marcus = 15

John = 45

45 ÷ 15 = 3

Sample solutions by Anita Chin

The Bar Model: Problem #2

Toy Cars – Problem 2

John has 3 times as many toy cars as Marcus. They have 92 cars altogether. How many toy cars does Marcus have?

Mathematical problem solving: The Bar Model Method (2014, p.19, Yueh Mei Liu & Vei Li Soo)

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Toy Cars: Problem 2

John has 3 times as many toys cars as Marcus. They have 92 cars altogether. How many toy cars does Marcus have?

REF: Mathematical Problem Solving: The Bar Model Method (2014, p. [illegible]) Liu Yueh Mei & Soo Wei Li

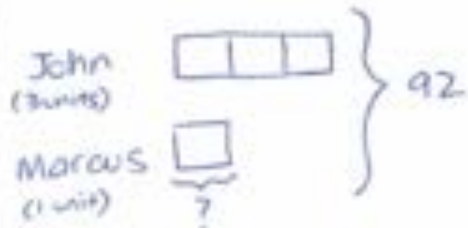
1. What information do we know? GIVENS

John = 3 times as many toy cars as Marcus

Marcus = ? toy cars

Altogether = 92 cars

2. Draw a diagram GAP



3. Do the maths GAP

units Altogether = John + Marcus = 3 + 1 = 4 units

Altogether = 4 units = 92 cars

Marcus = 1 unit = 92 ÷ 4 = 23 cars

4. Answer the question GOAL

Marcus has 23 toy cars.

5. Defend it

Marcus = 23 cars

John = 3 × 23 = 69 cars

Altogether = 23 + 69

= (22 + 1) + 69

= 22 + 70

= 92 cars

sample solutions by Anita Chin

The Bar Model: Problem #3

Toy Cars – Problem 3

John has 3 times as many toy cars as Marcus. Marcus has 42 toy cars fewer than John. How many toy cars do they have altogether?

Mathematical problem solving: The Bar Model Method (2014, p.19, Yueh Mei Liu & Vei Li Soo)

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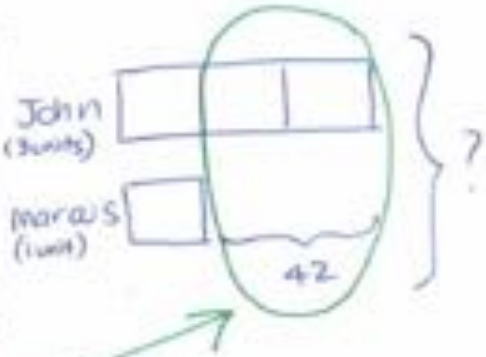
1. What information do we know? GIVENS

John = 3 times as many as Marcus

Marcus = 42 fewer than John

Altogether = ? cars

2. Draw a diagram GAP



3. Do the maths GAP

2 units = 42 cars

So, 1 unit = 42 ÷ 2 = 21 cars = Marcus

Therefore, 3 units = 21 × 3 = 63 cars = John

Altogether = 21 + 63 = 84 cars

21 × 3 = 60 + 3 = 63

20 × 3 = 60

1 × 3 = 3

mental strategy of multiplying the tens and then the ones

4. Answer the question GOAL

They have 84 toy cars altogether.

5. Defend it

John = 3 × Marcus
= 3 × 21
= 63

Marcus = 42 fewer than John
= 63 − 42
= 21

Altogether = 63 + 21 = 84

Toy Cars: Problem 3

John has 3 times as many toys cars as Marcus.

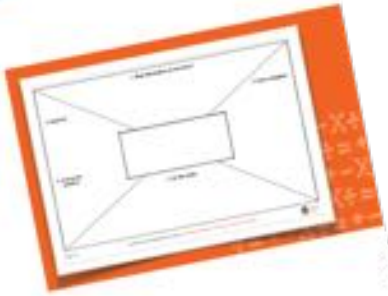
Marcus has 42 toy cars fewer than John. How many toy cars do they have altogether?

901 Mathematical Problem Solving: The Bar Model Method (2014, p.77, Lu Yueh Mei & Soo etc.)

Graphic Organiser: Think Map

(solving word problems using the Bar Model Method)

Version 1.0



Contents

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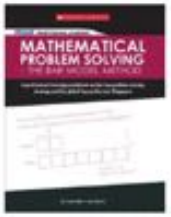
Teacher resources: The Bar Model Method

Teacher reference book



Yeah, M.L & Soo, V.L (2014). *Mathematical problem solving: The Bar Model Method*. Singapore: Scholastic Education International.

The Bar Model Method is a key problem solving strategy consistently taught to primary school students in Singapore. It enables students to understand, visualise and represent conceptually complex problems and their solutions elegantly, and in doing so, further reinforces and builds students conceptual and procedural knowledge, making them more effective problem solvers.

I've had the privilege of seeing Vei Li present at the 2015 AAMT conference in Adelaide and from that moment on, I fell in love with the elegance of the Bar Model Method!

Classroom equipment

Connecting Cubes, 2 cm
Small group set Yr 3-6

It contains 10 'loose blocks' of the one colour, connected to make 'towers of 10'. 10 different coloured towers are then placed into a snap lock bag (22 x 25) cm to make a 'bag of 100' blocks.

Connecting Cubes, 2 cm
Class Kit K-6

It contains 10 'bags of 100' blocks to make a 'tub of 1000' blocks. Stored in a 12 L clear tub with a clip-on lid.

For further details visit the Resources page of my website at www.anitachinmaths.com.au/resources

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Loved using my Think Map?

Download the full PDF at www.anitachinmaths.com.au/resources

2. Open-ended questions

The answer is 12, what is the question?

or

What do you know about the number 12?

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3. Using concrete materials: counters

Task #1

Four students have 15 counters between them. All students have a different number of counters. How many counters might each student have?

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Things to consider

- What knowledge and skills is required?
- **Make the maths visible:** use a hundreds chart to check the numbers add to 15
- **Focus:** the importance of being systematic.

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More things to consider

- **Enabling prompt:** Two students have 15 counters between them…
- **Extending prompt:** Convince me you have all possible answers.

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Being systematic

1, 2, 3, 9

1, 2, 4, 8

1, 2, 5, 7

1, 3, 4, 7

1, 3, 5, 6

There are only five possible solutions.

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Packaging counters: A whole-school approach

Class Kit
16 clear jars, each with 20 counters.

Pair Set
20 counters in a clear jar.

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3. Using concrete materials: pattern blocks

Task: Compare/contrast strategy

- using pattern blocks
- scaffold sheet for language

Word Wall: Two-dimensional (2D) shapes

orange
square
all four sides equal
quadrilateral
all 4 angles are right angles
opposite sides equal
two pairs of parallel sides

green
equilateral triangle
all three sides equal
3 acute angles
Angle sum = 60° + 60° + 60°
= 3 x 60°
= 180°

blue
rhombus
all four sides equal
quadrilateral
2 acute and 2 obtuse angles
opposite sides equal
two pairs of parallel sides

yellow
regular hexagon
all six sides equal
convex six-sided polygon
all 6 interior angles are equal
Angle sum = (2n - 4) x 90°
= (2 x 6 - 4) x 90°
= 720°

red
trapezium
four sides
quadrilateral
two sides equal
one pair of opposite sides parallel

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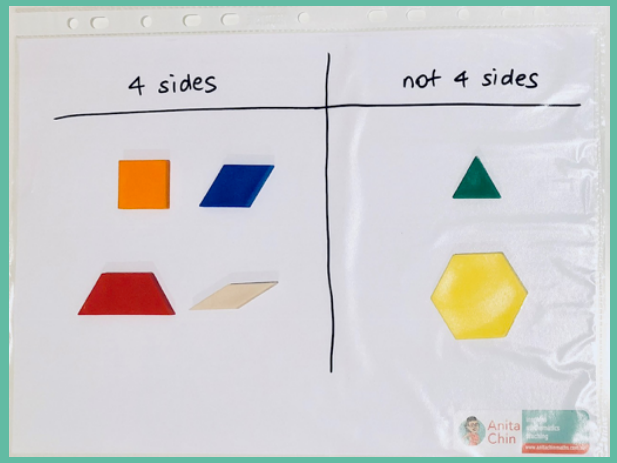
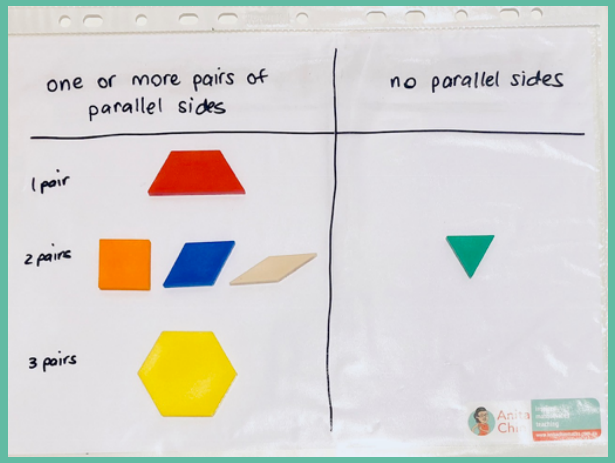
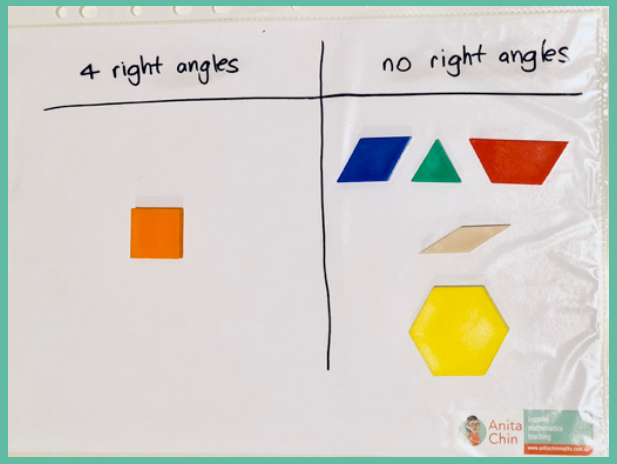
Same / different







BLM *'Graphic Organiser: Venn Diagrams (comparing and contrasting2D shapes using pattern blocks)'* available to download from www.anitachinmaths.com.au/resources

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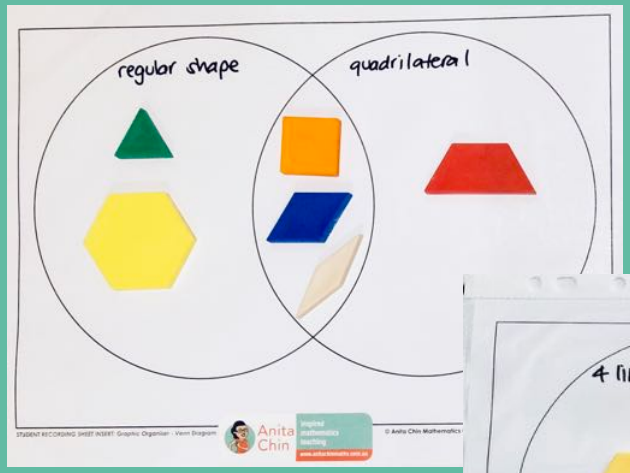
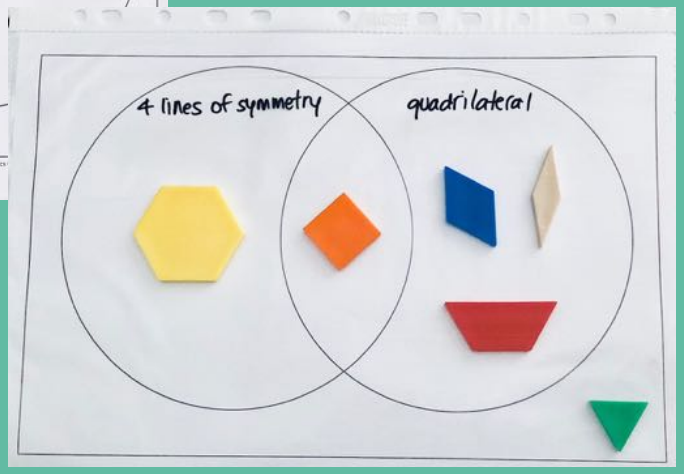
Compare / contrast



side lengths

Y2 (ACMMG042);

Y3 (MA2-15MG)

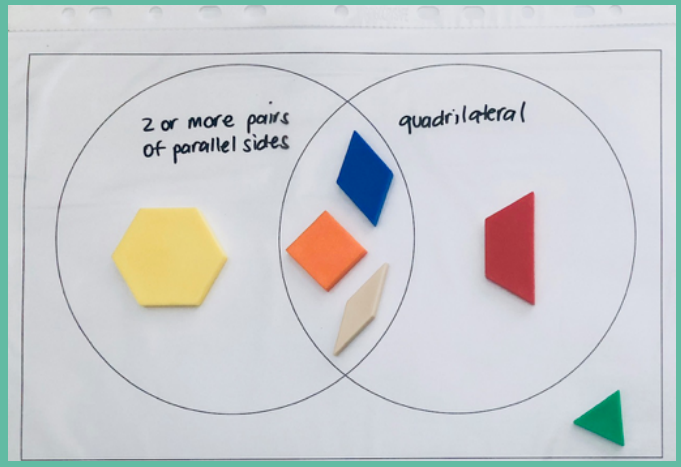


line symmetry

Y3 (ACMMG066); Y2 (MA2-15MG)

parallel sides

Y3 (MA2-15MG); Y7 (ACMMG164)



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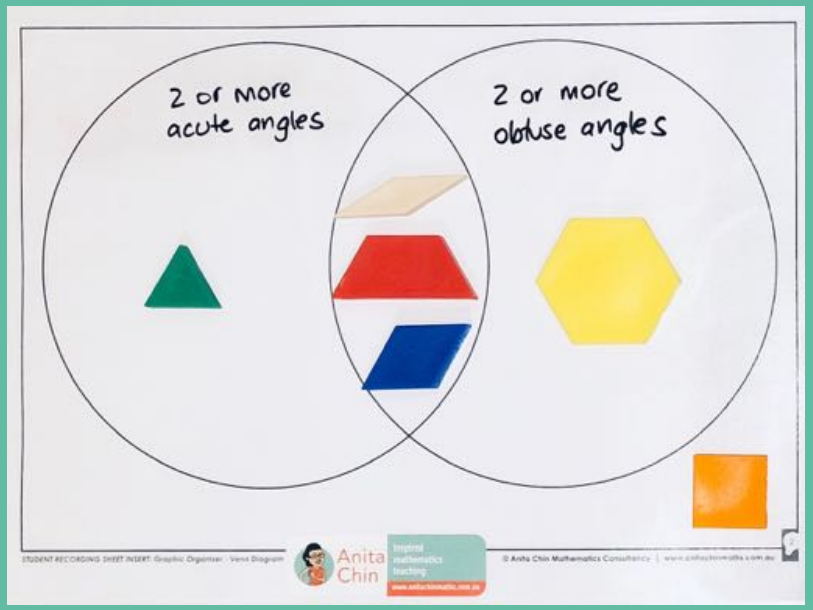
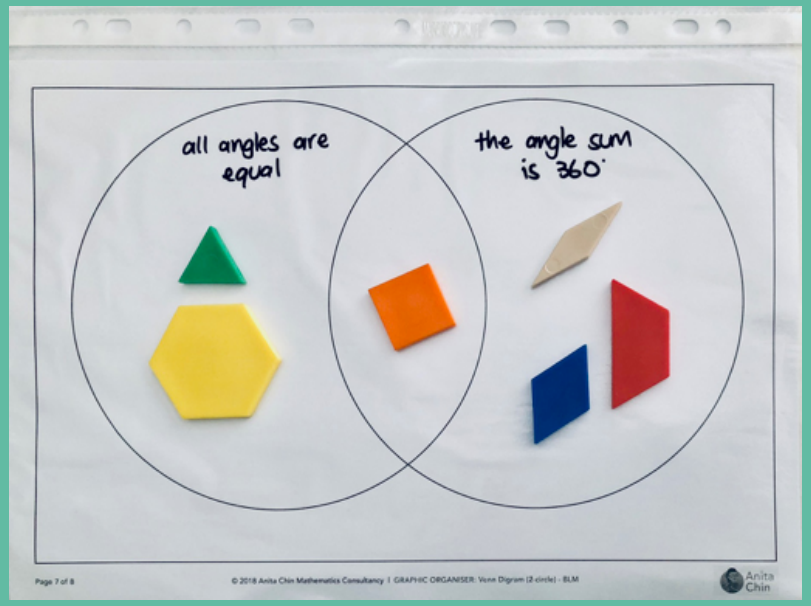
Compare / contrast



angle sizes

Y4 (ACMMG089, MA2-16MG)



angle sum

Y7 (ACMMG166, MA4-17MG)

BLM *'Graphic Organiser: Venn Diagrams (comparing and contrasting2D shapes using pattern blocks)'* available to download from www.anitachinmaths.com.au/resources

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Graphic Organiser: Venn Diagram

(comparing and contrasting 2D shapes using patterns blocks)

Version 1.0

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Packaging pattern blocks: A whole-school approach

*K-2 one set per 4 students: 120 pattern blocks

K-2 Class Kit: 8 sets of 120 pattern blocks

Pair Set Yr 3-4: 30 pattern blocks
*Individual Set Yr 5-8: 30 pattern blocks

Teacher dem K-8: Jumbo magnetic set of 52 pattern blocks

Class Kit Yr 5-8: 32 individual sets

*For further details visit the Resources page of my website at www.anitachinmaths.com.au/resources

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Loved this task using a Venn Diagram?

Download the full PDF at www.anitachinmaths.com.au/resources

Make it,

Say it,

Draw it,

Write it

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Anita's classroom mantra. Eg. Students roll a double die to make two numbers, then say "I rolled a 4 and a 3. Three groups of 4 is 12". They draw over the dots to make an array on a student insert sleeve whiteboard. They write a number sentence to describe the picture 4+4+4=4 x 3 = 12

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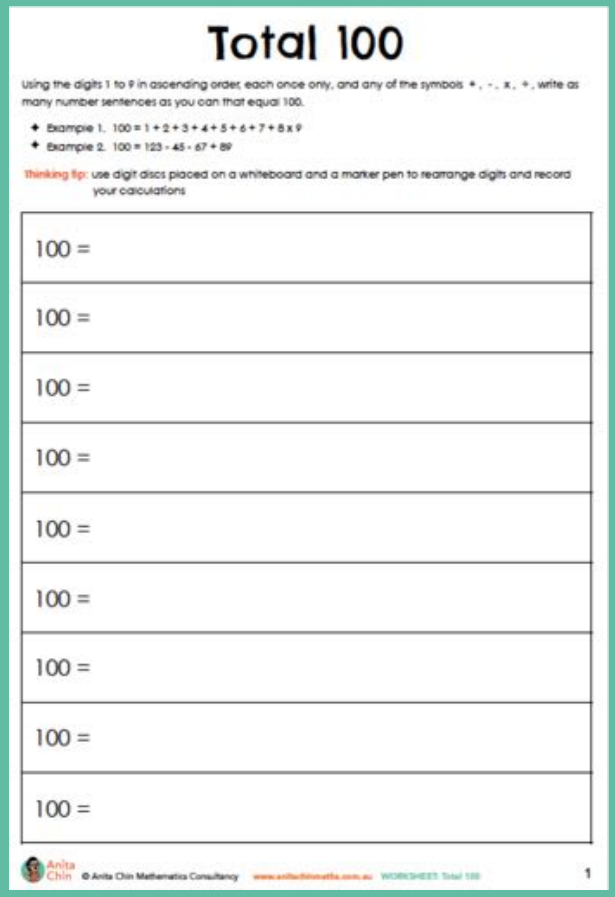
4. Number problem #1

Total 100

Using the digits 1 to 9 in ascending order, each once only, and any of the symbols +, - , x, ÷ , write as many number sentences as you can that equal 100.



Total 100

Using the digits 1 to 9 in ascending order, each once only, and any of the symbols +, -, x, ÷, write as many number sentences as you can that equal 100.

- Example 1. 100 = 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 x 9
- Example 2. 100 = 123 - 45 - 67 + 89

Thinking tip: use digit discs placed on a whiteboard and a marker pen to rearrange digits and record your calculations

100 =
100 =
100 =
100 =
100 =
100 =
100 =
100 =
100 =

Anita Chin © Anita Chin Mathematics Consultancy www.anitachinmaths.com.au WORKSHEET: Total 100 1

'Total 100' worksheet available for download from Anita's website
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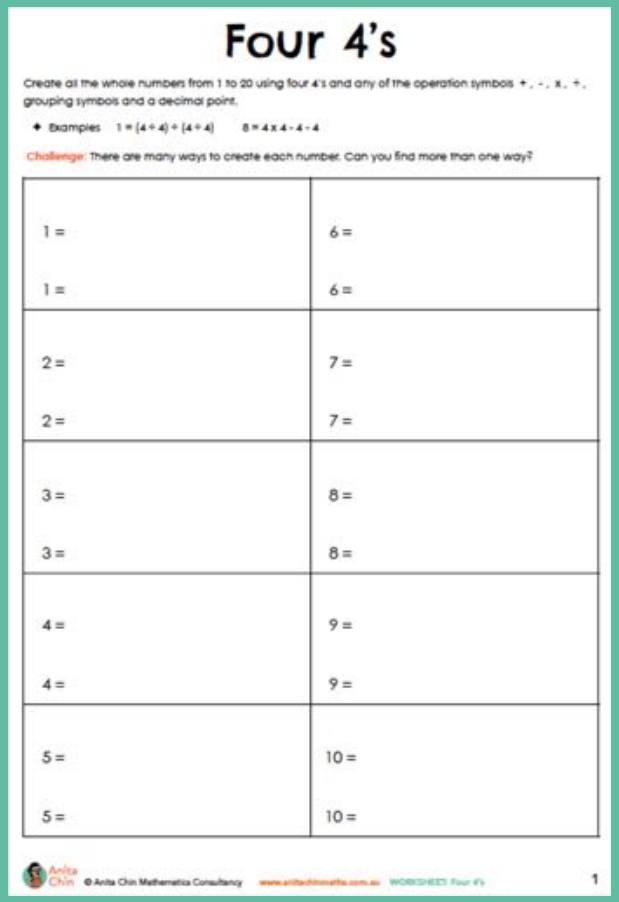
4. Number problem #2

Four 4's

Create all the whole numbers from 1 to 20 using four 4's and any of the operation symbols +, - , x, ÷ , grouping symbols and a decimal point.

Eg. 8 = 4 x 4 – 4 - 4



Four 4's

Create all the whole numbers from 1 to 20 using four 4's and any of the operation symbols +, -, x, ÷, grouping symbols and a decimal point.

✦ Examples 1 = (4 ÷ 4) ÷ (4 ÷ 4) 8 = 4 x 4 - 4 - 4

Challenge: There are many ways to create each number. Can you find more than one way?

1 = 1 =	6 = 6 =
2 = 2 =	7 = 7 =
3 = 3 =	8 = 8 =
4 = 4 =	9 = 9 =
5 = 5 =	10 = 10 =

Anita Chin © Anita Chin Mathematics Consultancy www.anitachinmaths.com.au WORKSHEETS Four 4's 1

'Four 4's' worksheet available for download from Anita's website
www.anitachinmaths.com.au/resources

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4. Number problem #2

Challenge

There are many ways to create each number.

Can you find more than one way?

Super Challenge

Create all the whole numbers from 1 to 100 using four 4's and any of the operation symbols +, - , x, ÷ , grouping symbols and a decimal point.

Anita Chin

From the desk of Anita Chin

Anita Chin

Thank you

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inspired mathematics teaching