Name of Strategy:	Depth and Complexity Icons and Maths Icons
Organising Element: Higher order thinking	Conceptual Representations

Purpose of Strategy:

Dr. Sandra Kaplan from USC created icons to represent elements that generate a deeper, more complex thought process. The Depth and Complexity icons are used as a visual aid to strengthen thinking skills and cognitive operations.

Students involved in the learning process, can apply elements of depth and complexity as they begin to assimilate new information, make connections, and dig deeper into content.

In recent years Dr Kaplan created mathematical icons that can be used on their own or with the depth and complexity icons in order to challenge and extend highly able learners. Both sets of icons may be downloaded free from www.jtayloreducation.com

Depth and Complexity Icons

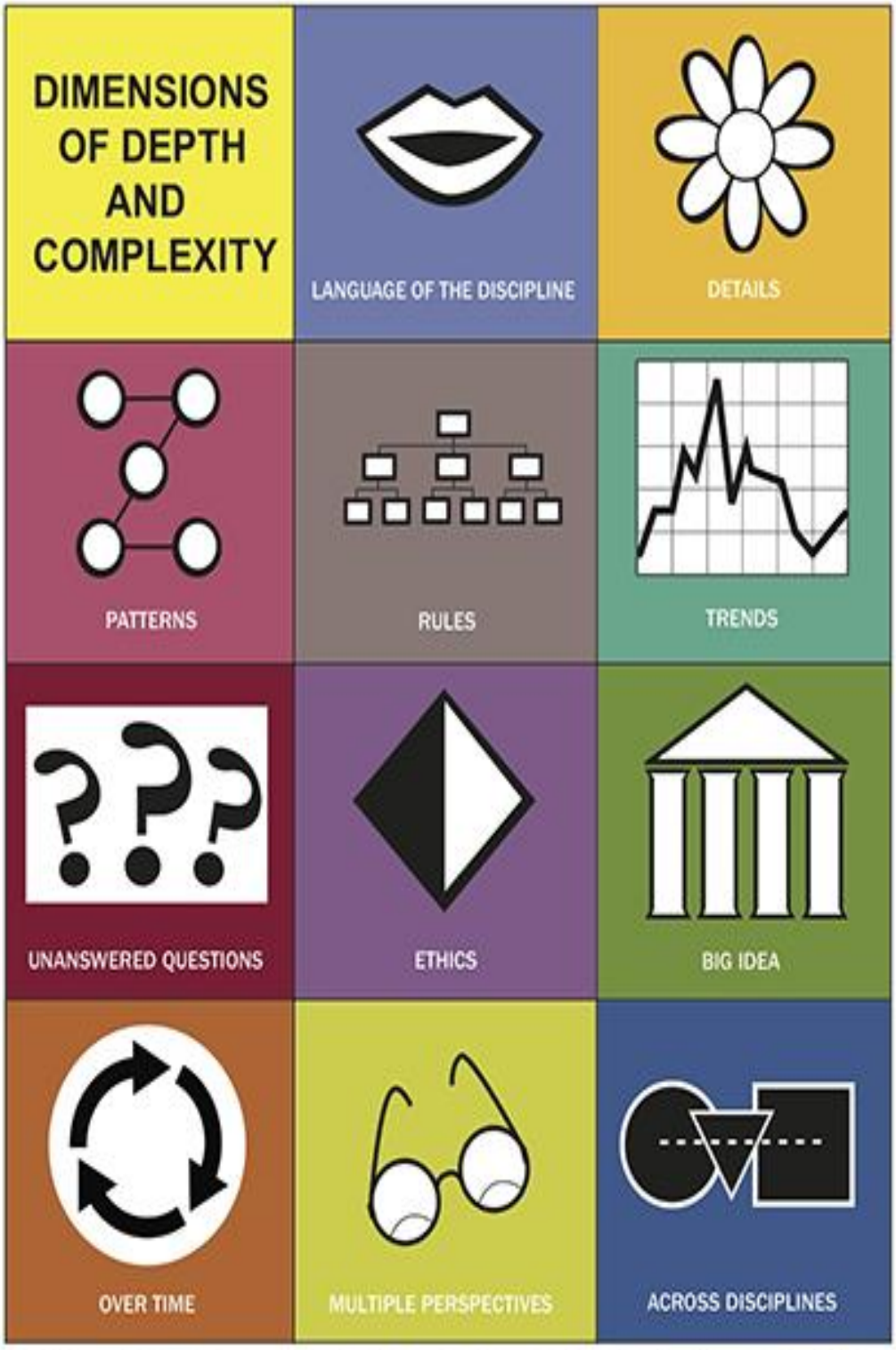
Maths Icons

Description of Strategy

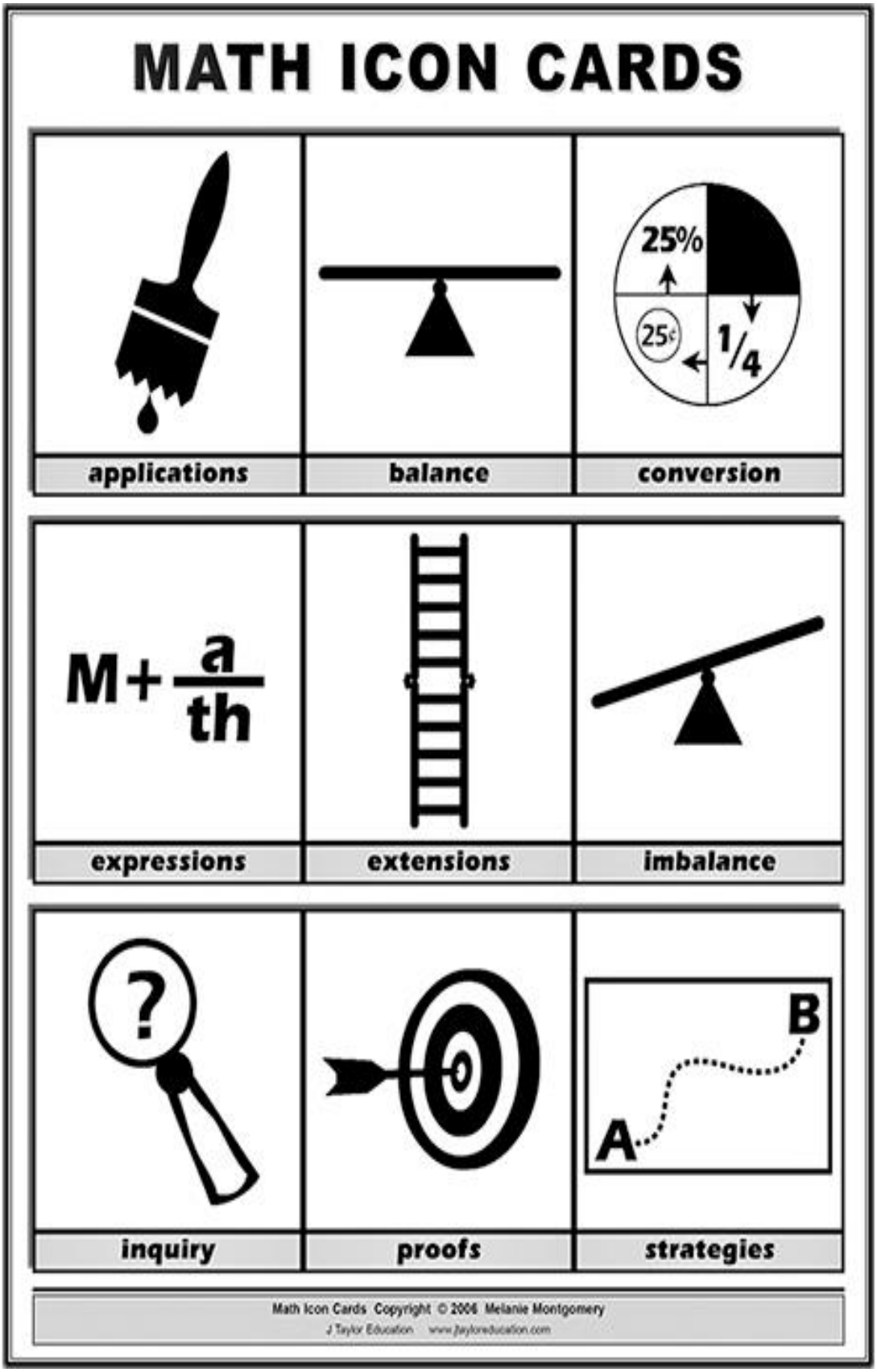
When students think using the icons, they learn to approach subjects from the point of view of an expert. In doing so, they will understand concepts in a deeper and more complex way.
On the back of each Depth and Complexity card is a definition of the concept, task starters for the concept, related thinking skills, and each concept is explored through the disciplines of Language Arts, Mathematics, Social Studies and Science.

Maths icons are intended to promote a deeper, broader understanding of maths concepts.
On the back of each icon card is a definition of the concept, key questions related to the concept, concept related terms, related thinking skills and symbols.

Dimensions of Depth & Complexity



Acknowledgments: Definitions of dimensions of depth and complexity are from "Differentiating the Core Curriculum and Instruction to Provide Advanced Learning Opportunities," California Department of Education and California Association for the Gifted, 1994. Symbols for dimensions of depth and complexity developed under the auspices of OERI, Javits Curriculum Project T.W.O., 1996.



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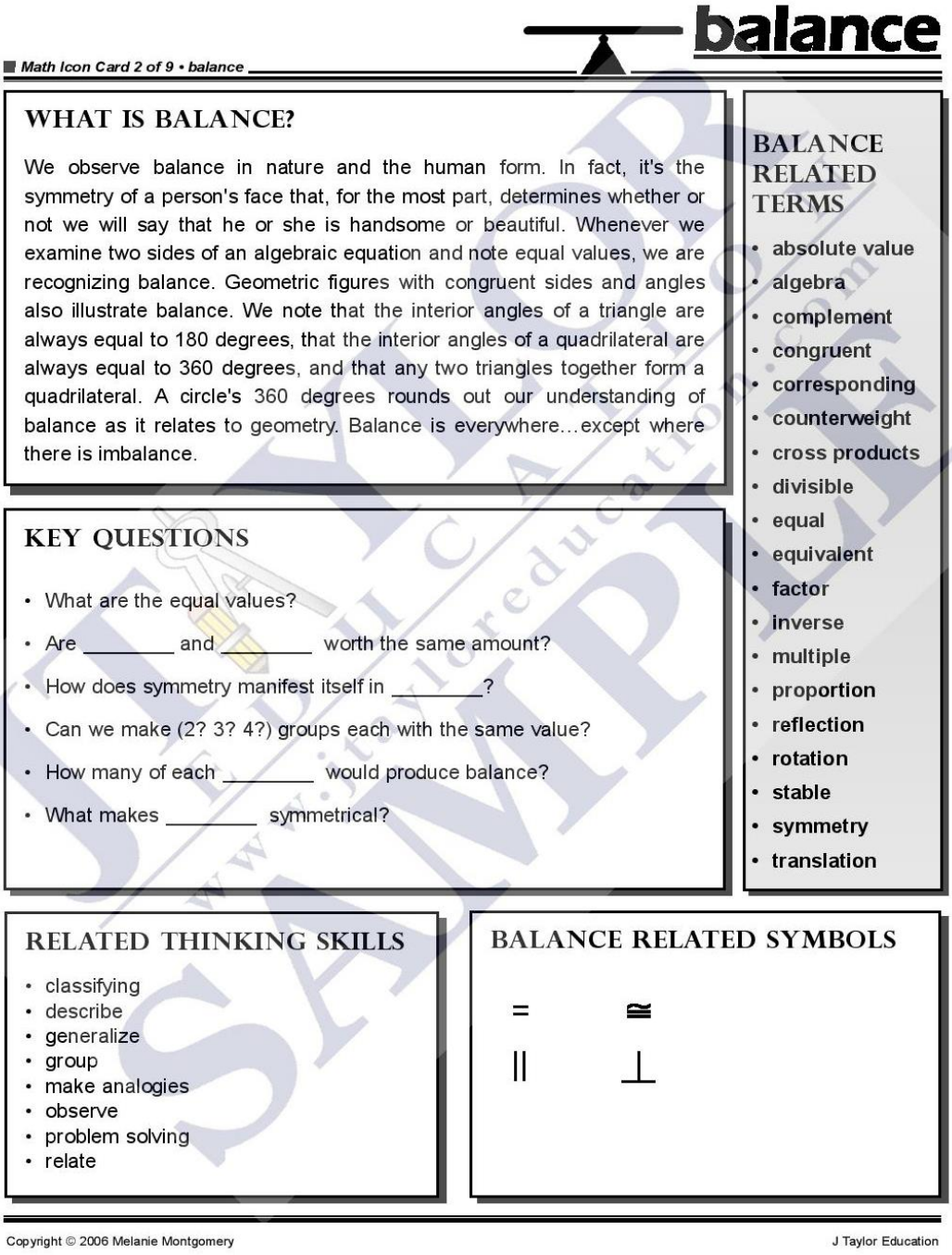

balance

Math Icon Card 2 of 9 • balance

WHAT IS BALANCE?

We observe balance in nature and the human form. In fact, it's the symmetry of a person's face that, for the most part, determines whether or not we will say that he or she is handsome or beautiful. Whenever we examine two sides of an algebraic equation and note equal values, we are recognizing balance. Geometric figures with congruent sides and angles also illustrate balance. We note that the interior angles of a triangle are always equal to 180 degrees, that the interior angles of a quadrilateral are always equal to 360 degrees, and that any two triangles together form a quadrilateral. A circle's 360 degrees rounds out our understanding of balance as it relates to geometry. Balance is everywhere...except where there is imbalance.

KEY QUESTIONS

- What are the equal values?
- Are _____ and _____ worth the same amount?
- How does symmetry manifest itself in _____?
- Can we make (2? 3? 4?) groups each with the same value?
- How many of each _____ would produce balance?
- What makes _____ symmetrical?

BALANCE RELATED TERMS

- absolute value
- algebra
- complement
- congruent
- corresponding
- counterweight
- cross products
- divisible
- equal
- equivalent
- factor
- inverse
- multiple
- proportion
- reflection
- rotation
- stable
- symmetry
- translation

RELATED THINKING SKILLS

- classifying
- describe
- generalize
- group
- make analogies
- observe
- problem solving
- relate

BALANCE RELATED SYMBOLS

= ≅

∥ ⊥

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J Taylor Education

Teaching Example	Year levels: Primary

Year 3 Number and Algebra Example below using both sets of icons.

References:

Brydseed, I., http://www.byrdseed.com/introducing-depth-and-complexity

Envision Gifted, http://envisiongifted.com/depth-and-complexity-math/

JTaylor Education, http://www.jtayloreducation.com/

Note: The Depth and Complexity Icons can be seen in Mathematics Enrichment Frames.

Year 3 Mathematics Example:

Outcome:

By the end of Year 3 students will:

Recognise the connection between addition and subtraction and solve problems using efficient strategies for multiplication. (knowledge and understanding)

They recall addition and multiplication facts for single digit numbers. Students correctly count out change from financial transactions. They continue number patterns involving addition and subtraction. (Skills)

Learning intentions:

Prior learning: (ACMNA053)

- We are learning to partition, rearrange and regroup numbers to assist calculations and solve problems.
- We are using our knowledge of place value to help us partition, rearrange and regroup numbers to at least 10 000.

New learning 1: (ACMNA054 & ACMNA055)

- We are showing our understanding about addition and subtraction to create some role plays to demonstrate the actions involved!
- We are learning to recognise and explain the connection between addition and subtraction
- We are practicing our recall of addition facts and related subtraction facts.

New learning 2: (ACMNA056 & ACMNA057)

- We are experimenting with number patterns (using addition and subtraction) and sharing the pattern rules with our peers.
- We are learning about number patterns that helps us remember our multiplication facts of two, three, five and ten
- We are learning about the connection with division.
- We are practising our recall of multiplication and related division facts.
- We are representing and solving problems using our multiplication strategies.

In context: (ACMNA059)

- We are learning to use our understanding of addition, subtraction and multiplication to help us work out how much money we will need and how much change we will have - when we go shopping.

Success criteria:

Eg. New learning 2:

Co-constructed with students as a process success criterion:

I know I have learned this when I can:

- write a pattern rule for a number pattern.
- read a number pattern rule and make the pattern to match.
- tell if a number pattern is increasing, decreasing or repeating.

- make my own predictable number patterns with at least 6 terms.
- continue a number pattern by adding the next 3 terms.
- circle the core of a repeating pattern.
- use what I know about number patterns to solve word problems.

Co-constructed with students as a performance success criterion:

Continue number patterns involving + & -	***A***	***B***	***C***	***D***	***E***
Understanding, fluency, problem solving and reasoning	*I identified complex number patterns and used examples and mathematical words to explain and justify my thinking and understanding of the connections between + and -.*	*I showed my understanding of number patterns and used my mathematical language to explain the connections between + and -.*	*I showed my understanding of number patterns and used mathematical language to describe the rules.*	*I continued number patterns and solved some pattern problems. I could use some mathematical language.*	*I don't understand number patterns and still need some help please.*

Evidence:

For learning	**As learning**	**Of learning**
Pre- test: • **Place value, partitioning, regrouping** • **Addition** • **Subtraction** • **Knowledge and understanding of grouping and sorting / Multiplicative thinking**	**Problem solving tasks where collaboration and peer feedback is used. (eg sharing of strategies)**	**Pre-test before and at the end of the unit.**
Annotated observations / anecdotal	**End of 'lesson' reflection strategies**	**<u>Annotated</u> observations**
Co- constructed process or performance success criteria	**Students individualise class success criteria to add in a next step / smaller steps**	**Achievement rubrics**
Revisit pre-test items at end of unit		

Reflection and feedback

- Using the learning intention and success criteria:
- Verbally provide ongoing feedback – specific and intentional.
- Written feedback - Written / email / log / portal - Feedback that is specific to the learning intention skill or concept plus a question or suggestion for a next step.

Reflection

- **Private talk and public conversation**
  - exit cards
  - paint cards
  - Bouncing ball
  - Thumbs up
  - Traffic lights

- **Establish a goal setting process**.
    - number line
    - 100-point target setting

Language/ vocabulary

Place value, number busting, number splitting, partitioning, regrouping, addition, plus, add up, sum, subtraction, difference, minus, take away, less than, equal, same as, multiplication, times as much, groups of, lots of, product of, rows of, division, sharing, grouping, problem solving, reasoning, justifying, proving, explain, strategy, patterns, repeating, continuing, growing, extending, number

Create a word wall or a maths glossary

- Students create their own glossaries defining words and putting in their own examples
- This could be done in paper or as an iBook
- This could also be done as a mind-map (Popplet, Inspiration or Visuwords (http://www.visuwords.com/))- to show the connection between words, symbols and functions.

Language of discipline

Learning experiences

Prior learning: (ACMNA053)

- We are learning to partition, rearrange and regroup numbers to assist calculations and solve problems.
- We are using our knowledge of place value to help us partition, rearrange and regroup numbers to at least 10 000.

LI: We are learning to partition, rearrange and regroup numbers to assist calculations and solve problems.

Maths proficiencies:

Understanding	Problem solving	Fluency	Reasoning
Enabling prompts • Use 20 frames to	**Whole class** Have students glance at a scatter of between five and 20 sticky dots on a flashcard and say how many dots are on the card. Rotate the card so that students see different groupings from different directions. Ask: What groups of dots did you see from where you are sitting? Repeat the activity with different cards showing a range of different arrangements.  **BALANCE** **Working together and independently** Students take 20 counters in their hand (check the quantity count). Drop the collection from a small height onto a piece of		**Extending prompts** • Record related number families. • Number bust larger numbers using knowledge of place value.

show number busting collections to help students see the part whole relationship.	paper. Record the different number busting combinations that total 20. Record with numbers and symbols. **Details** **BALANCE** **EXPRESSION** Ways to make a number (Depth and complexity worksheet) http://envisiongifted.com/math.html **STRATEGIES**	• Show reasoning and justify thinking. • Play make 50 • Play make 100 **PROOFS**

Materials: sticky dots on flashcards / paper plates, counters, 20 frames

LI: We are using our knowledge of place value to help us partition, rearrange and regroup numbers to at least 10 000.

Maths proficiencies

Understanding	Problem solving	Fluency	Reasoning

Warm up

Have pairs of students decide who has the most matches. Each pair takes two handfuls of matches and groups them to make counting easier.
Then, they count the matches before regrouping them in a different way and re-counting.
Ask: Which grouping made it easier to count? Did you get the same number? Why? Why not? Is it easier to see 'how many' in the groups of three or groups of ten? Why?

IMBALANCE

INQUIRY

Learning together

Have students work out the different ways they could buy 95 sweets if they come in boxes of 5, 10, 15, 20, and 50.

Enabling prompt

Extending prompt

• Provide student with boxes representing the different quantities, grid paper representations showing the quantity. **PROOFS** • Choose a different number of sweets eg. 100 • Play Make 10	Ask students to record their ideas and select the arrangement of 95 sweets that they would prefer for their family. Have students represent and justify their choices. **EXPRESSIONS** **Multiple perspectives** Use maths word problem solving flow map to represent the problem. http://envisiongifted.com/uploads/3/1/6/5/3165797/math_word_problem_solving_flow_map.pdf • Play Make 50 • Play make 100 **Patterns**	• What if all the boxes of 5 were sold, how could you solve the problem now? • What if you wanted double the number / half the number of sweets? **Unanswered questions** **STRATEGIES** **EXTENSIONS** • Create new Make 50 and Make 100 game –boards **Big Idea** **EXTENSIONS**
Materials: boxes of sweets in appropriate groupings, make 10, 50 and 100 game-boards, 100 grids, blank game-boards, matchsticks, grid paper		

J Farrall & D Gilbert 13/12/2017