Sequenced Teaching of Problem Solving

HOME LEARNING MATERIAL

Year 2

Introduction

The modern maths curriculum in schools places a great focus on children's ability to solve problems and reason mathematically. When learning maths, children must be able to apply the core skills they have learned to a variety of problems and challenges.

At STOPS, we have devised 8 key problem-solving strategies that will help children approach problems with confidence. For each strategy, we have a range of problems that increase in difficulty so that children learn to tackle any tough maths problems with confidence.

Your child uses the STOPS problems in school and this book is designed to support and supplement the work that they are doing in school.

The problems and guidance in this book are designed to run in parallel to the work that your child is doing in school, enabling you to support them to become great mathematicians and successful problem-solvers - ensuring them success all the way to the end of primary school.

The STOPS Problem Solving Strategies:

A. Act it out / make a model

A great way to start solving problems. Act out, make or draw what the problem shows and you will be well on the way to solving it.

B. Trial and Error

A strategy every child must have - simply make some guesses and see how they go. Much better than not knowing how to start.

C. Trial By Improvement

The next step. Make an estimate, get a solution. Is it correct? Why not? How can we change our estimate to improve it? Children become more systematic.

D. Make a list or table

Many problems can be tackled by making a list of potential solutions. This can go hand-in-hand with strategies B and C to give children serious mental tools with which to solve tricky problems. Later, turn your list into organised tables and you can solve anything.

E. Find the pattern

Many problems can be solved by identifying a repeating pattern in shapes or numbers and using it to predict what may happen in other situations.

F. Simplify the problem

Some problems can be intimidating for children, but by making it more simple, it becomes more accessible.

G. Work Backwards

Start at the end and work back. Children will refine their skills of reasoning and 'inverse operations' to work their way through maths problems with ease.

H. Solve algebraically

It sounds more difficult than is, especially to children. When broken down into manageable steps of learning using shapes, symbols and eventually letters, children will become confident and experts in using algebra to solve problems

Using this booklet and how to best help your child

Each strategy has a one main problem to work through with your child and one other supporting problem. There are different steps within each strategy that make sure the problems are age-appropriate for your child. Remember that problem solving skills are very different to maths skills and children can develop at very different rates.

Each problem has notes afterwards that will give you guidance and examples of questions or modifications to support them if they are not sure or questions that could extend them if they are finding it easy.

Each problem is based on the STOPS problem-solving grid, where each strategy has 7 steps of difficulty for each of the 8 strategies. At the top of each problem in this book is the 'step' that the problem comes from, so that you can pick up on the next step of the strategy in every school year.

Some general tips:

- Encourage your child to make mistakes and feel positive about them, this is the only way to learn.

- Encourage children to record their thoughts in writing, on paper or in a special 'problem solving' notebook.

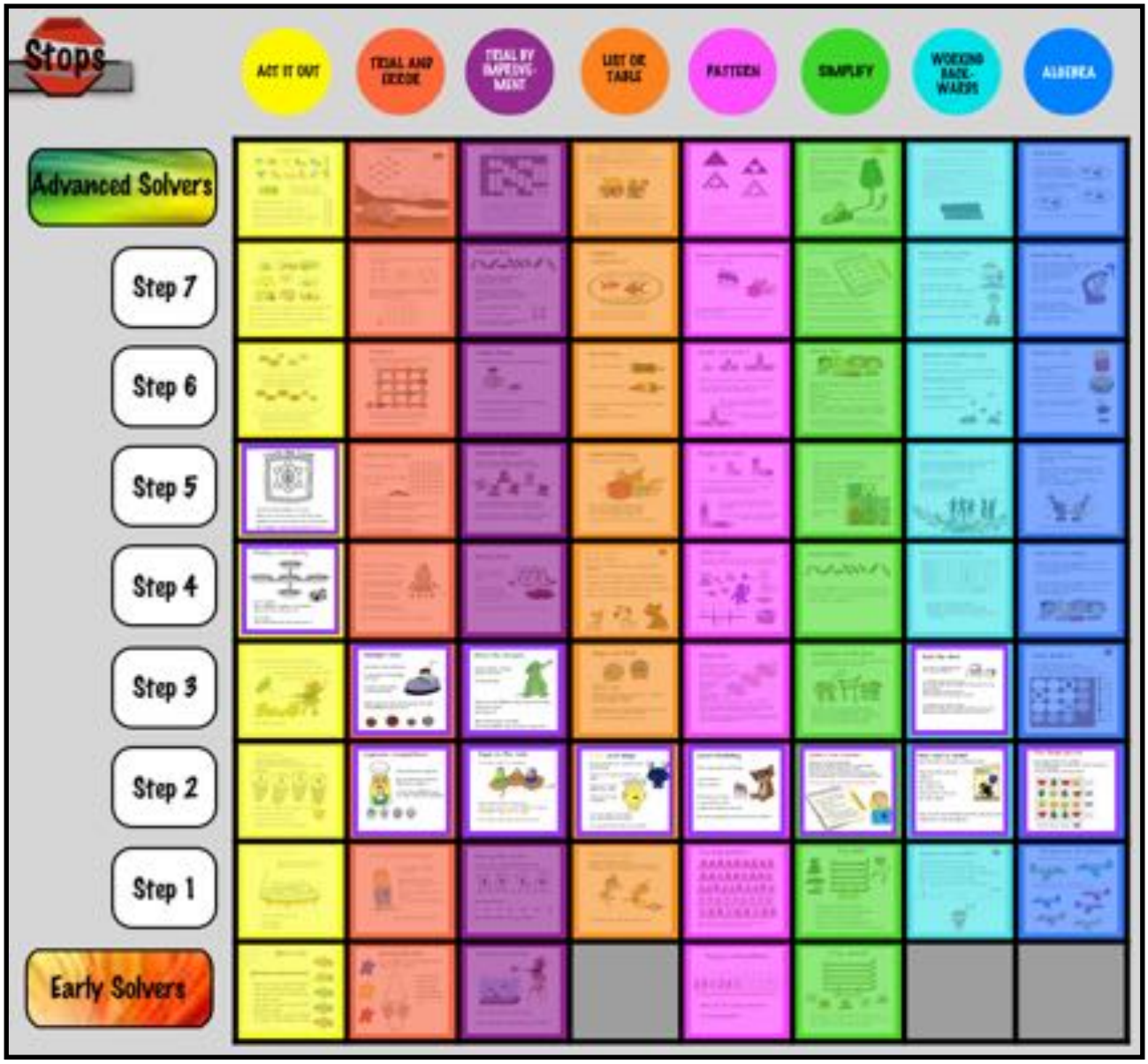
- Allow children time to think through for themselves, do not be tempted to do too much for them.

How do ‘steps’ and year groups work?

The STOPS problem solving skills are based on our famous grid, where each of the strategies has 7 steps within it that must be completed to be an expert problem-solver.

Each strategy is different, so ‘step 1’ does not always mean ‘year 1’.

Below is our grid, with the recommended year 2 problems highlighted. This book will provide support and companion problems to the year 2 set of problems that your child is studying at school.

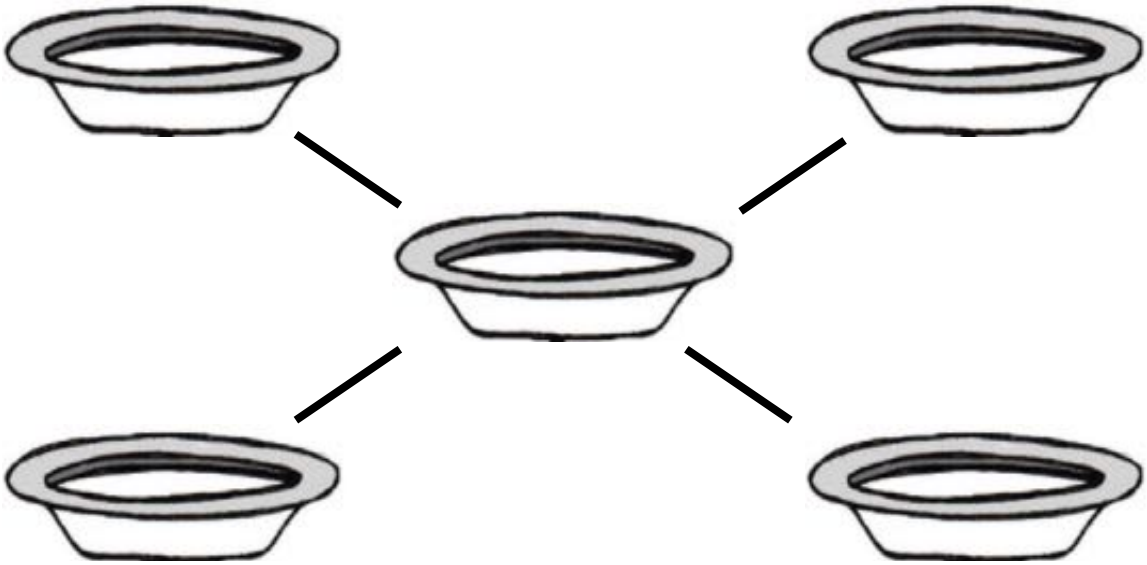


STRATEGY A - ACT IT OUT/MAKE A MODEL

STEP 4 – Party Plates

We have 15 sweets to share out at a party.

Can you put a different number of sweets in each plate and make each line add up to 9?



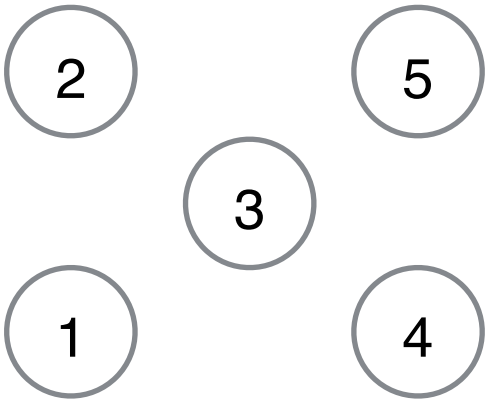
Challenge:
Can you share out 20 sweets so that each line adds up to 12?
Clue: no dish has only one sweet.

How to help:

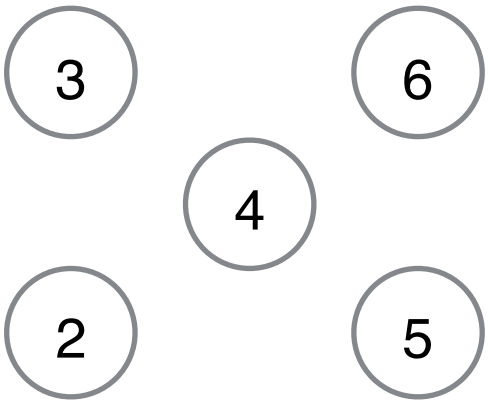
- *It would be fun to set this problem up with paper plates and counters/ buttons to represent sweets. Alternatively, use the diagram on the problem and place objects onto it. It is important that children learn to model real-life situations mathematically.*
- *As children become more confident with an actual, physical model, they can move to a diagram where numbers are written instead of actual counters.*
- *Encourage children to begin to use a trial-and-error strategy, using the model they have made.*
- *Encourage children to look at the total for each line and identify if one has a larger total than the other. We could start again from scratch or swap two numbers to give a lower total.*
- *Hint: the plates contain the numbers 1-5, as each plate must have a different number of sweets. In the challenge, it is the numbers 2-6.*

Solutions:

- *For the first part, one solution is:*

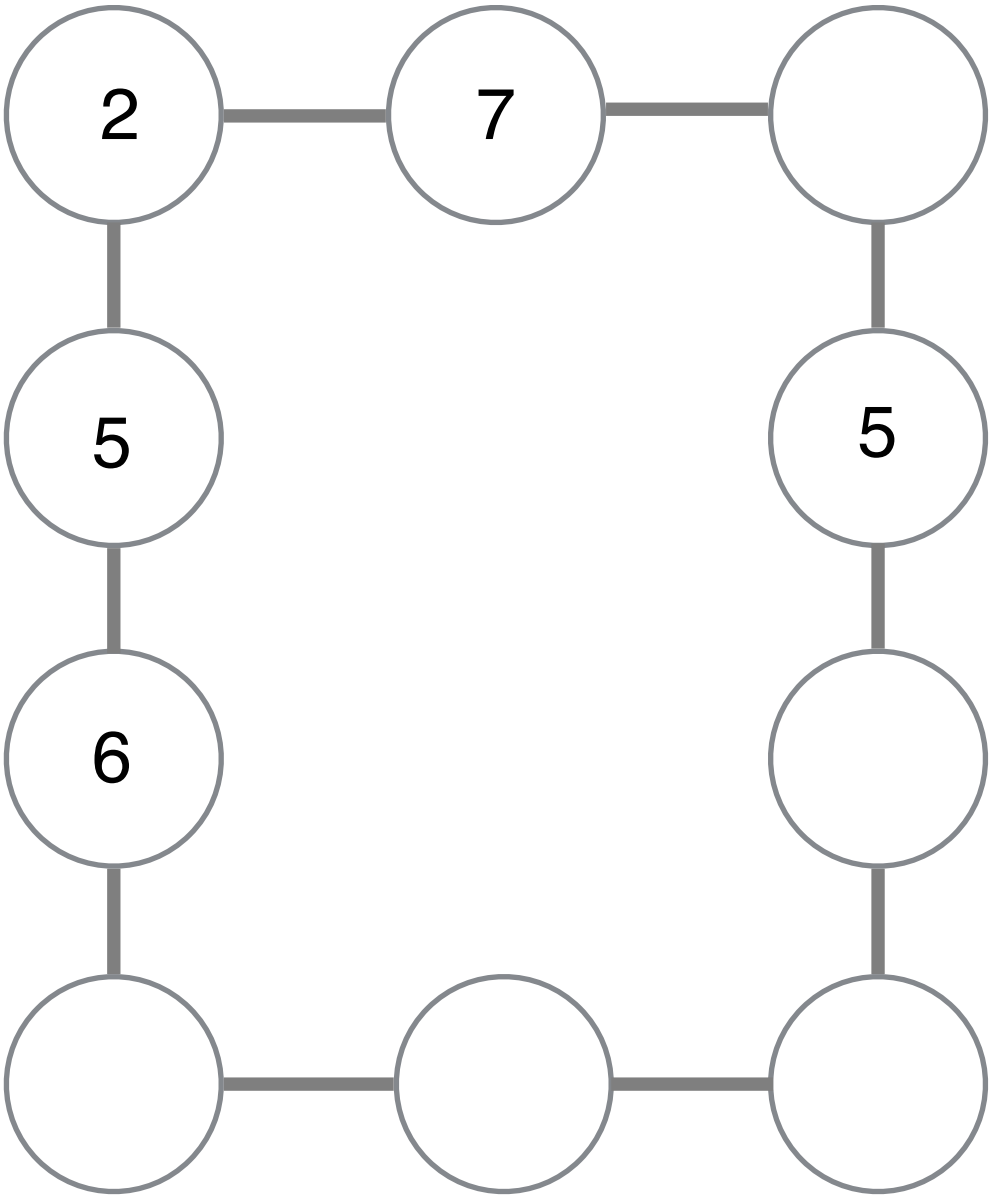


For the challenge, one solution is:



STEP 4 - Line Totals

Put numbers in the circles to make each line total 20. There is more than one answer!

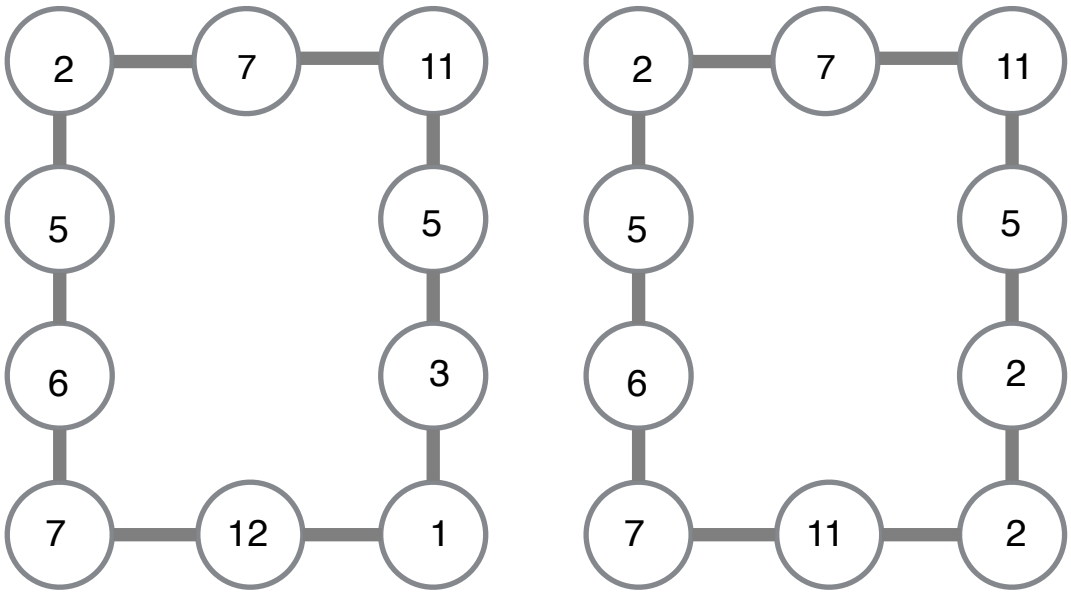


How to help:

- *Post-it notes could be useful here, or simply a pencil and rubber.*
- *Encourage children to add mentally but they can use jottings if needed*
- *There are several possible solutions to this problem. There is no requirement to use numbers only once or to have a foxed total of numbers.*
- *Children should identify that the 2 and the 7 total 9, leaving 11 to go in the top right corner. Children may find counters or a number line useful in establishing this. Help them to see that 20 - 9 = 11 and that 9 + 11 =*
- *The bottom left corner also only has one solution, it must be 7. Again, reinforce with children how subtraction of the total from 20 gets us the solution.*
- *Now, several solutions are possible. Looking at the right-hand vertical side, we have 11 and 5 making 16. To make 20, the final two circles could be 3 and 1, 2 and 2, or 1 and 3. Allow children to establish a solution that works before finding additional solutions.*
- *Complete the final side, the lower horizontal line.*
- *Encourage children to go back and check their addition.*

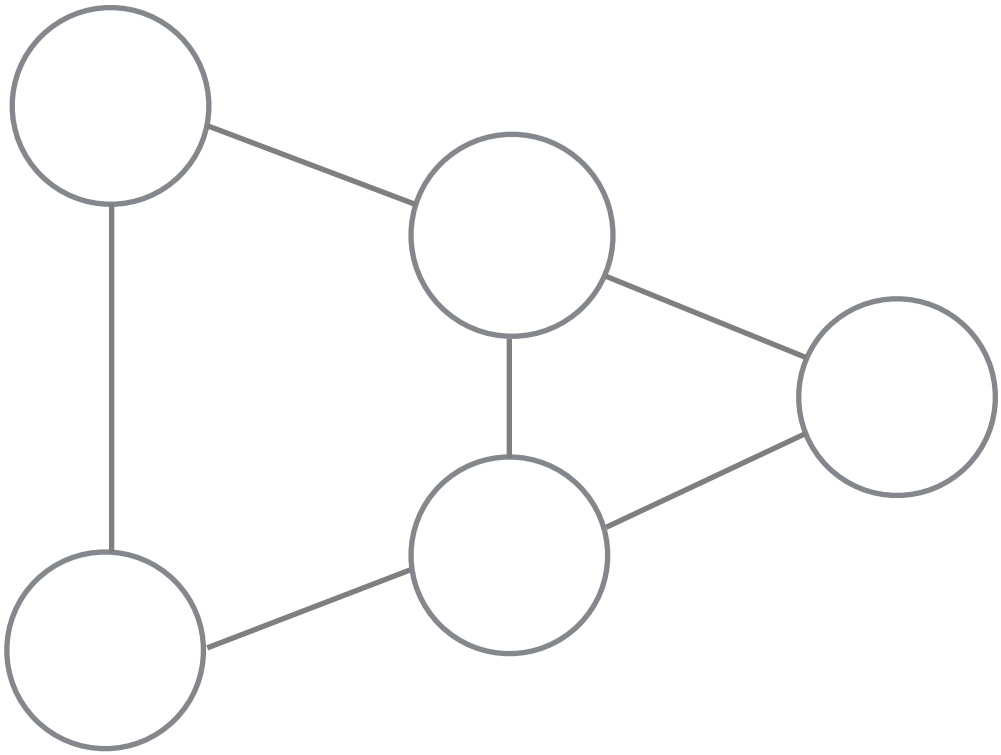
Solutions:

- *Many solutions are possible. Two examples are given below.*



STEP 5 - Codebreaker

To solve this code, you must put the numbers 1-5 into the 5 circles. But, you must make sure that no numbers that are next to each other are joined by a line. For example, 4 cannot be joined to 3 or 5.

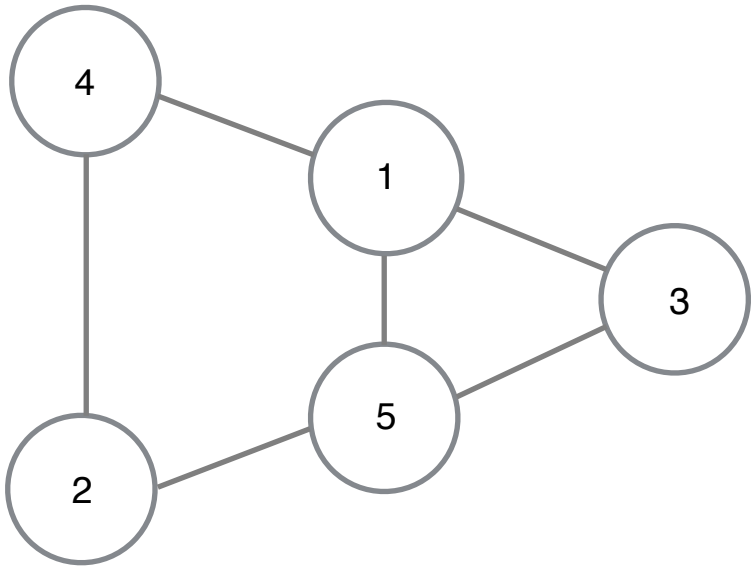


How to help:

- *Encourage children to make some random trials and see where mistakes are. They can either start again from scratch or try swapping certain numbers around, depending on their confidence.*
- *As with all problems, establish a 'culture of error' where making mistakes and corrections is an essential part of learning.*
- *Children may realise that the middle numbers have more numbers joined to them, so placing the 1 and 5 there is a point to reach in their thinking.*
- *Next, separate the odd and even numbers so they cannot be together in the puzzle.*

Solutions:

- *There are several versions of the solution, all must involve 1 and 5 as the central two numbers. An example solution is below, some numbers could be swapped around.*



STEP 5 - Card Tricks

Valto the magician has 6 cards with numbers 1-6 on them.

He picks 4 cards, they add up to 14.

Which cards could he have picked?

Could he have picked different cards to get the same total?

1	2	3	4	5	6

How to help:

- *With the "Act it Out / Make a Model' strategy, it is still appropriate and useful for children to replicate this model with cards and make random picks. Encourage children to add mentally.*
- *However, you may find children begin to make more sensible trials and/ or 'work backwards'. For example, you could pick a 2, 3 and 5 to make 10. Children could then subtract 10 from 14 to establish that they must pick a 4 next. Allow the child to dictate the pace and work through the puzzle on their own, developing strategies as they go, rather than being pushed into one strategy or another.*
- *If they find it difficult, suggest cards 1-5 and picking two to make 7.*
- *To extend, suggest cards 1-8 and picking 4 to make 18.*

Solutions:

- *Two solutions are possible:*

2 + 3 + 4 + 5

1 + 3 + 4 + 6

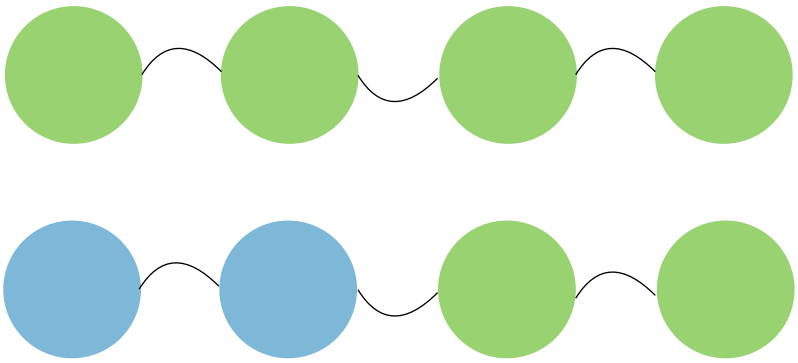
STRATEGY B - TRIAL AND ERROR

Step 2 – Aisha's Bead String

Aisha has two colours of beads: green and blue.

She wants to make a string of 4 beads.

How many different ways can you find to arrange green and blue beads to make a string of 4 beads? Two different ways are done for you.



How to help:

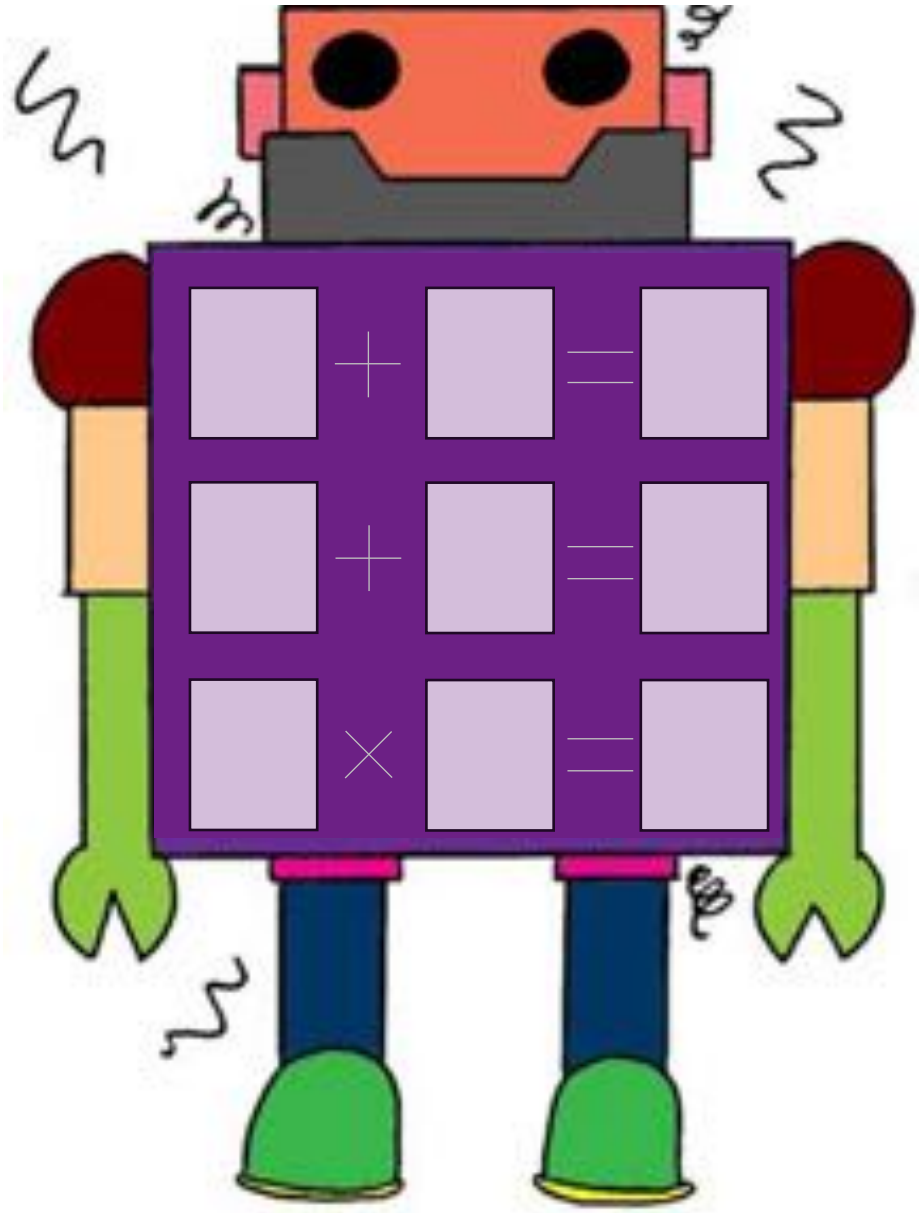
- *This strategy focuses on 'Trial and Error, so allowing children to make mistakes is critical.*
- *If you have beads or coloured counters, it would be a fun way to make the activity more practical.*
- *A template of four blanks beads could be used if the child is struggling to draw them. Its better if they can do it on their own, it doesn't have to be a perfect drawing!*
- *Point out how 'repeats' work. For example, green-green-green-blue is a different pattern to green-blue-green-green, even though they have the same numbers of each colour.*
- *Encourage children to realise for themselves that their trials need to be recorded, or we won't know if we already made that combination.*
- *You could encourage children to use their 'Make a Model' skills by just using G and B for the colour beads when recording their trials.*
- *Children do not need to find every possible solution at this age. The key learning is that we can make trials to solve a problem and we should find a way of recording our trials so that we know what we have done.*
- *Reduce to three beads if children are finding it tricky.*

Solutions:

There are 16 possible solutions:
G G G G
G G G B
G G B B
G B B B
B B B B
B B B G
B B G G
B G G G
B G B G
G B G B
G G B G
G B G G
B G G G
B B G B
B G B B
G B B B

Step 2 - Number Robot

Can you make these statements true by using the digits 1-9 once only?



How to help:

- *Once again, children should approach this with a 'Trial and Error' strategy. Pick some numbers, see if they work, if not - pick again!*
- *Children should be reminded of the importance of perseverance, to build their resilience for harder problems later on.*
- *Some confident children may use reasoning or "Work Backwards", for example realising that 9, as the highest number, is likely to be an addition total.*
- *If children are finding it hard, refer to the solution and give some starting numbers.*

Solution:

1 + 7 = 8

5 + 4 = 9

2 x 3 = 6

There could be some variation, e.g. 7 + 1 = 8 or 3 x 2 = 6.

Step 3 – Ice Lolly

On a hot summer day, Josh bought an ice lolly with exactly 3 coins.

It cost less than 12p.

Which amounts less than 12p can you make with exactly three coins?

How to help:

- *The illustration tells you that only 1p, 2p, 5p and 10p coins will be needed. Make sure that the child is familiar with basic denominations of coins.*
- *Begin with a trial and error strategy: pick an amount and see if you can make it from 3 coins.*
- *Alternatively, pick 3 coins at random from a set (if you have them) and record the total.*
- *Ask children how we will record our trials.*
- *Finding all solutions to 12p should be appropriate for a child in year 2*
- *If they are finding it easy, extend the amount to 15p or even 20p*

Solution:

1p - not possible
2p - not possible
3p - 1p + 1p + 1p
4p - 1p + 1p + 2p
5p - 2p + 2p + 1p
6p - 2p + 2p + 2p
7p - 5p + 1p + 1p
8p - 5p + 2p + 1p
9p - 5p + 2p + 2p
10p - not possible
11p - 5p + 5p + 1p
12p - 10p + 1p + 1p or 5p +5p + 2p

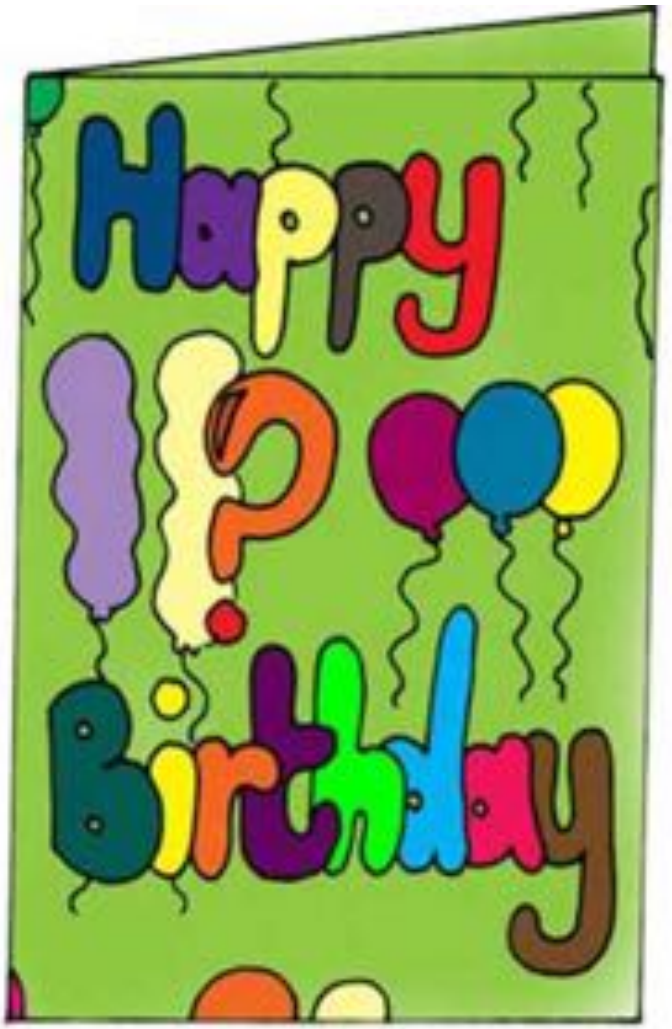
Step 3 - Happy Birthday To You

1) Mike is 5 years older than James. Their ages add up to 13. How old are Mike and James?

2) Sarah is 3 years younger than Luca. Their ages add up to 13. How old are James and Luca?

3) Aisha is 1 year older than Lisa. Their ages also add up to 13. How old are Aisha and Lisa?

4) Roman's age is double the age of his sister, Nadia. The total of their ages is 24. how old are Roman and Nadia?



How to help:

- *Encourage children to pick some ages at random, find the total and see if they are correct.*
- *Allow them to pick any other two ages after this. They may choose to use "Trial By Improvement" to adjust their answer logically, but do not force it at this stage.*
- *Again, explain the importance of recording trials.*
- *If children find it easy, try with some examples with higher ages.*
- *If children find it difficult, model to them how you would go through the thought process, e.g. "Well I will try for James being 6 years old. 5 years older than this is 11 years old. 6 + 11 = 17. That's not right, I need to try another number for James."*

Solution:

- *Mike is 4, James is 9*
- *Sarah is 5, Luca is 8*
- *Aisha is 7, Lisa is 6.*
- *Roman is 16, Nadia is 8*

STRATEGY C - TRIAL BY IMPROVEMENT

Step 2 - Dinosaur Eggs

Three dinosaurs laid a total of 14 eggs between them.

They each laid a even number of eggs.

How many different ways could they have laid the three eggs?

Dinosaur A	Dinosaur B	Dinosaur C	Total

How to help:

- *Make sure that children are familiar with odd and even numbers before starting. Ask them to define what odd and even means and give examples of each.*
- *This strategy calls for a more systematic approach, beyond trial and error.*
- *Discuss how to record their trials, to build on their work in the Trial and Error strategy. You can use the table in the problem or design your own. You could give the dinosaurs fun names in the table, like Terry Tyrannosaur or Danny Diplodocus!*
- *As a starting point, ask children to pick three even numbers and find their total. If it is more than 14, how can we modify it? What if it is less than 14? Encourage children to articulate how and why they would make changes to their next trial.*
- *It is not strictly necessary to find all solutions, just to know that there are many ways of solving the problem and that we should record our trials.*
- *If they are finding it hard, reduce the total number of eggs to 10. If they find it easy, increase the total number of eggs to 20.*

Solutions:

- *There are many possible solutions:*

2 + 2 + 10
2 + 4 + 8
2 + 6 + 6
2 + 8 + 4
2 + 10 + 2

4 + 4 + 6
4 + 6 + 4
4 + 8 + 2

6 + 2 + 6
6 + 4 + 4
6 + 6 + 2

8 + 2 + 4
8 + 4 + 2
10 + 2 + 2

Step 2 – Aliens From Outer Space!

On a far-away planet, there are two types of aliens. Some have 2 eyes and some even have 3 eyes!

In a group of aliens, there are 15 eyes altogether.

How many of each type could there be?

2 eyes	3 eyes	Total

How to help:

- *Begin by making a trial, e.g. "Lets say there are 5 with two eyes and 4 with three eyes. 5 x 2 = 10 and 4 x 3 = 12. 10 + 12 = 22. That is too many, what shall we do next?"*
- *Encourage children to wrote down their trials, even if they are unsuccessful.*
- *Children should make jottings to support their multiplication.*
- *If it is too hard, reduce the number of eyes to 9. If they are confident, increase to 20.*

Solutions:

- *There are two possible solutions:*

3 two-eyed aliens and 3 three-eyed aliens.
6 two-eyed aliens and 1 three-eyed alien.

Step 3 – Giving to Charity

Josh's class have collected money to give to charity.

They have collected £50.

The money is only in £5, £10 and £20 notes.

How many ways can you find of making £50 using only these notes?

How to help:

- *This problem again requires making a trial, i.e. picking some notes, and seeing if they total £45.*
- *Children may begin to 'work backwards', e.g. by adding £20 and £20 and knowing that there is £10 left to make a total of £50.*
- *Encourage children to find a system to record their trials, successful or unsuccessful*
- *Reduce the total to £30 if children find it difficult or extend to £75 if they are finding it easy.*
- *It is not necessary to find every solution but it is an interesting challenge for confident children.*
- *Remind children of the importance of perseverance and not giving up when mistakes are made.*

Solutions:

- *There are 12 ways of making £50 from £5, £10 and £20*

20 + 20 + 10
20 + 20 + 5 + 5
20 + 10 + 10 + 10
20 + 10 + 10 + 5 + 5
20 + 10 + 5 + 5 + 5 + 5
20 + 5 + 5 + 5 + 5 + 5 + 5
10 + 10 + 5 + 5 + 5 + 5 + 5 + 5
10 + 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5
5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5

10 + 10 + 10 + 10 + 10
10 + 10 + 10 + 10 + 5 + 5
10 + 10 + 10 + 5 + 5 + 5 + 5

Step 3 – Laying Eggs

Three birds laid 10 eggs between them.

They can put the eggs in any of their three nests.

Find 5 different ways of arranging 10 eggs in 3 nests.

Can you find even more?

How to help:

- *Hopefully, children are now becoming confident and making a trial and refining their answer. Encourage children to describe to you how they intend to solve the problem before they get started.*
- *If children are confident, increase the total to 15 or even 20.*
- *If children are not sure, reduce the total to 6 or even 5.*
- *We do not include 'repeats' in this problem. For example, 1 + 1 + 8 is the same solution as 1 + 8 + 1.*
- *Reinforce the importance of recording the trials.*
- *Finding all possible solutions is not necessary.*

Solutions:

- *There are 8 ways of splitting 10 eggs into 3 nests:*

1 + 1 + 8
1 + 2 + 7
1 + 3 + 6
1 + 4 + 5

2 + 2 + 6
2 + 3 + 5
2 + 4 + 4

3 + 3 + 4

STRATEGY D - MAKE A LIST OR TABLE

Step 2 - Fashion Designer

At the clothes shop they make two colours of coats.

Purple coats have 3 buttons.

Orange coats have 5 buttons.

They only have 20 buttons at the store.

How many of each type of coat can they make with exactly 20 buttons?

How to help:

- *This strategy requires children to find a systematic way of recording their work in a list or table. Help them to create a table that has red coats and yellow coats as headings.*
- *Work through systematically: "If we have 1 red coat, that makes 3 buttons. That leaves 17 buttons to use. Can we use 18 buttons exactly in groups of 5?"*
- *Work through different combinations until you arrive at the two solutions.*
- *If children find it easy, increase the total buttons to 30. If they are finding it difficult, reduce the total buttons to 16.*

Solutions:

- *There are two solutions:*

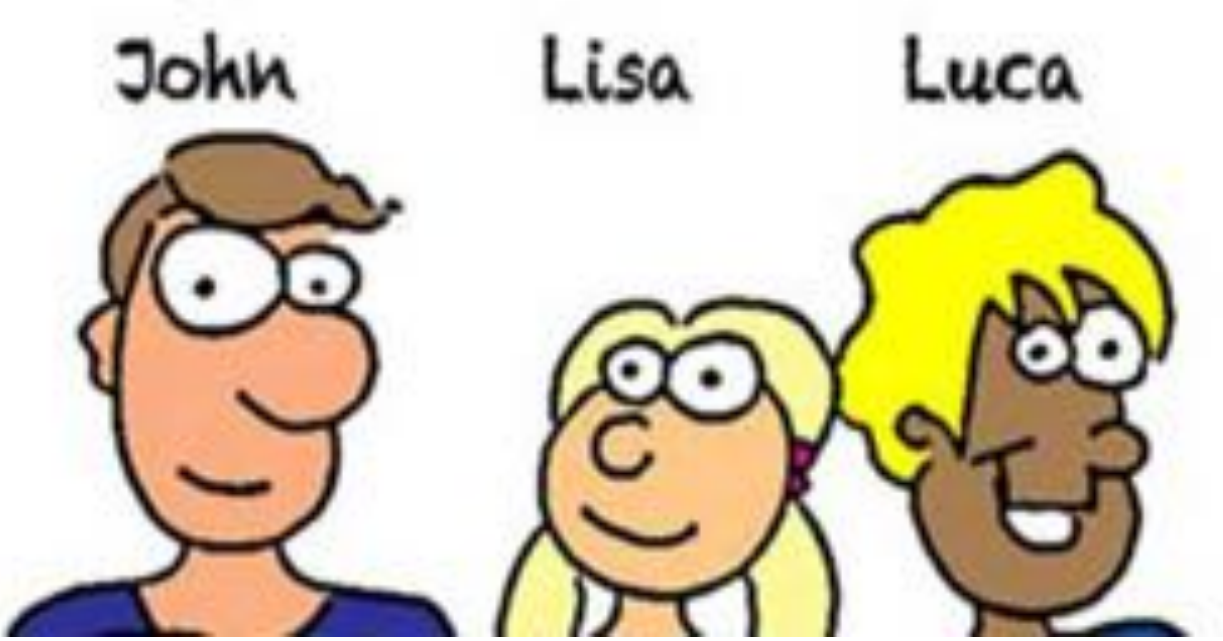
5 purple coats (15 buttons) and 1 orange coat (5 buttons)
4 orange coats (20 buttons)

Step 2 – Counting competition

John, Lisa and Luca are going to count to 50 in different ways.

John counts up in 4's, starting at 0.
Lisa counts up in 3's, starting at 1.
Luca counts up in 5's, starting at 3.

What is the first number that all three of them say?



How to help:

- *Discuss strategies with the child before you begin, asking them how they would start this. You could try counting out loud first before realising that this it is very difficult to remember all of the numbers.*
- *Create a list or table with the lists of numbers.*
- *Encourage children to cross-check the tables when they have written the lists.*
- *If it is too difficult, change the starting points or reduce the number of people counting. For example, John counts in 3's starting at 0, Lisa starts at 4 counting at 0.*
- *If it is easy, ask children what the second number they will both say will be (solution: 68)*

Solutions:

- *They will all say the number 28*

STRATEGY E - FIND THE PATTERN

Step 2 - Birthday party

Josh has a birthday cake every year.

There are the same number of candles as his age.

How many candles has Josh had in total on his 3rd birthday?

How many candles has Josh had in total on his 5th birthday?

How many candles has Josh had in total in his 8th birthday?

How to help:

- *This strategy teaches children to find a pattern and use this to solve the problem. Help children to identify that we can solve the first part by adding 3 + 2 + 1.*
- *When this pattern is found, children should be able to identify how to solve the higher ages.*
- *Ask children to describe the number patterns that they have found.*
- *If they find this easy, you can go to higher and higher ages.*
- *If is is difficult, model the first part of the problem by drawing 3 cakes with 3, 2 and 1 candle on each and counting the total amount of candles on all 3 cakes.*

Solutions:

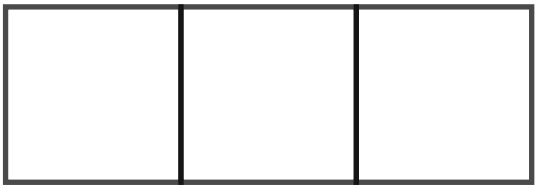
On his 3rd birthday, Josh has had a total of 6 candles.

On his 5th birthday, Josh has had a total of 5 + 4 + 3 + 2 + 1 = 15 candles.

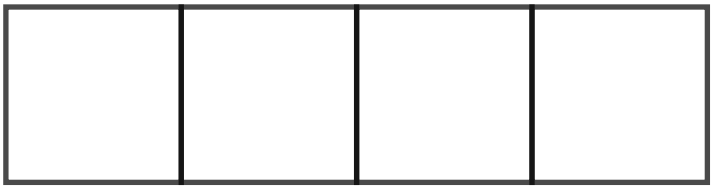
On his 8th birthday, Josh has had a total of 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 36 candles.

Step 2 - Counting Rectangles

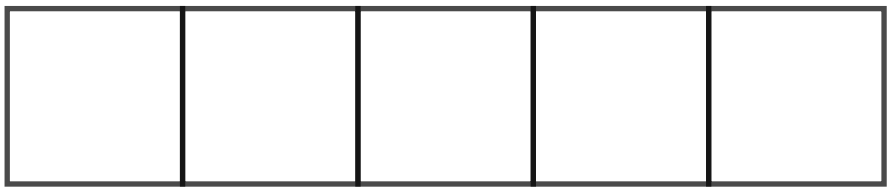
This pattern is made with 3 squares.
How many rectangles can you count?



This pattern is made with 4 squares. How many rectangles can you count?



This pattern is made with 5 squares. How many rectangles can you count?



How to help:

- *Hint: the squares are counted as rectangles. Children should learn that a square is a type of rectangle.*
- *Guide children to realising that there can be rectangles made of 2 squares, 3 squares etc*
- *Draw on their learning from other strategies and ask how we can record our work. We could make a list of 'how many squares?', 'how many 2-square rectangles?' etc*
- *Help children to gradually become more systematic, e.g. counting the squares first, then the smaller rectangles, then the bigger rectangles etc.*
- *use a highlighter or different colour pens to mark the different size rectangles.*
- *If it is easy, children can predict and draw the number of rectangles in different types of patterns made by squares, or draw their own to challenge you!*
- *If it is difficult, draw a rectangle made by two squares and model how to find the different rectangles.*

Solutions:

The 3-square pattern:

3 squares
2 rectangles made of two squares
1 rectangle made of three squares
6 rectangles in total

The 4-square pattern:

4 squares
3 rectangles made of two squares
2 rectangles made of three squares
1 rectangle made of four squares
10 rectangles in total

The 5-square pattern:

5 squares
4 rectangles made of two squares
3 rectangles made of three squares
2 rectangles made of four squares
1 rectangle made of 5 squares
15 rectangles in total

STRATEGY F - SIMPLIFY THE PROBLEM

Step 2 – The Icing on the Cake

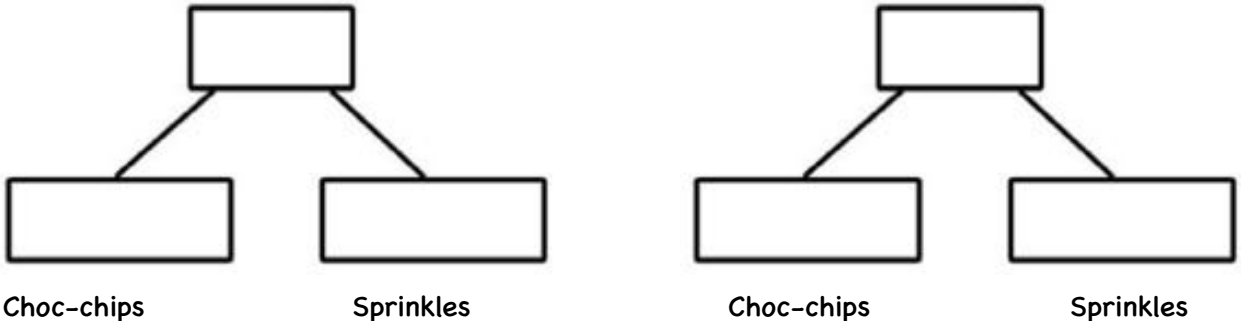
Aisha has been making some cup-cakes.

She can either use a green or a blue wrapper.

She can either use sprinkles or choc-chips to decorate.

- She makes 10 with a green wrapper.
- She makes 4 less with a blue wrapper than a green wrapper.
- In the green wrappers, she puts half with choc-chips and half with sprinkles.
- In the blue wrapper, she puts two more with choc-chips than with sprinkles.

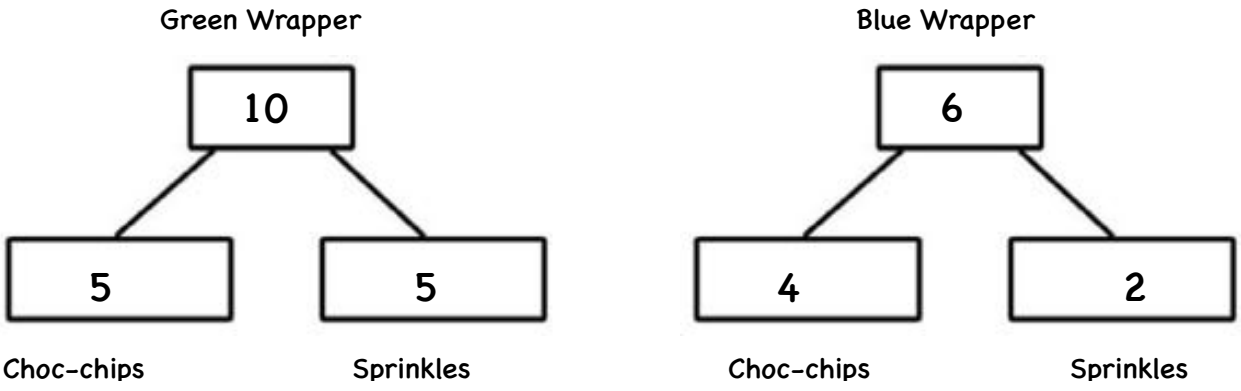
How many of each does she make? Use the diagrams to help you.



How to help:

- *The problem is initially very confusing - that is the point! Part of the strategy is not being overwhelmed by all of the information but to simplify it, step-by-step.*
- *Children should read each clue, one at a time, and see if information can be put into the diagram.*
- *Children should see that the 10 with a green wrapper can be put into the diagram straightaway.*
- *The clues can be followed in order in this example.*
- *If children find it easy, model the process for them and ask them to repeat it.*

Solutions:

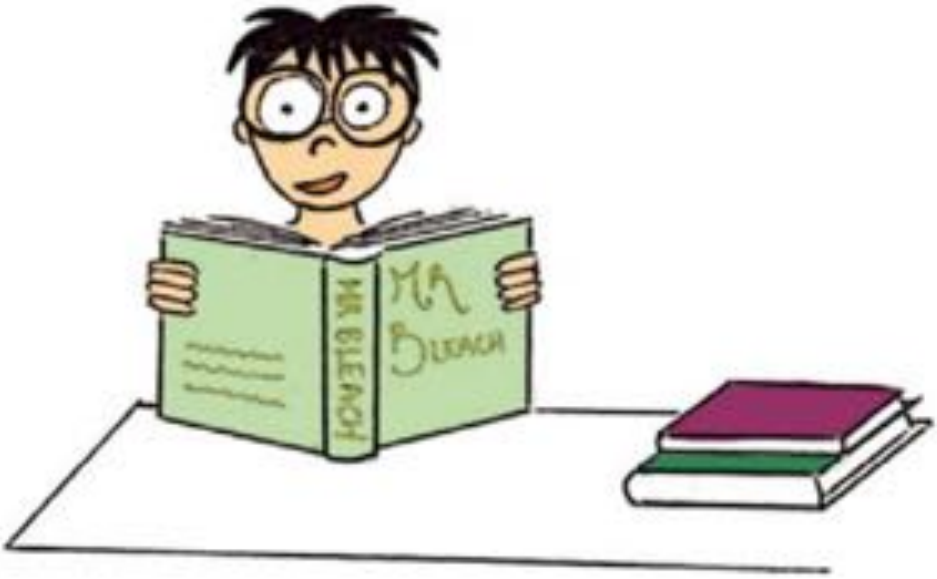


Step 2 – My Favourite Book

Eddie is reading a book.

The book has 103 pages.

How many of the pages have the number '3' in the page number?



How to help:

- *Begin by reminding children that we are trying to 'simplify the problem' with this strategy. Ask them how we can make this more simple. We could look at the first 10 pages, for example.*
- *We can draw on previous strategies, such as making a list of all the pages and counting the pages that have a 3.*
- *Alternatively, we can break down the number 3 in pages 0 - 10 - it only appears once.*
- *Next, it will appear in 13, 23, 33, 43 etc*
- *Finally, it will be in every page from 30 - 39*
- *Make sure that children can make jottings as they go to record their thoughts and encourage them to explain their thinking as they go.*
- *You can make the problem easier or harder by reducing or increasing the number of pages in the book.*

Solutions:

3, 13, 23, 33, 43, 53, 63, 73, 83, 93, 103
30, 31, 32, 34, 35, 36, 37, 38, 39

20 pages have the digit '3' in the page number.

STRATEGY G - WORK BACKWARDS

Step 2 – Can You Guess Their Age?

Aisha and her mum are playing a guessing game.

Mum says, "If you take my age and subtract 20, you get your age."

Aisha is 10 years old.

How old is her mum?

Next, Aisha plays the game with her Dad.

He says, "If you take my age, half it and take-away 7, you get your age."

How old is her Dad?

How to help:

- *Model the first part of the problem using an equation with a missing number, for example:*

___ - 20 = 10

Work with children to establish how to work backwards from 10 by adding 20 to get 30. Then, check that this works.

- *If children are finding this difficult, repeat with some similar examples. See if they can make up their own and challenge you!*

- *For the second part, it comes in two parts but can still be modelled with equations:*

___ ÷ 2 - 7 = 10

Work with children to start with 10 and work backwards, adding 7 and then multiplying by 2 to get the solution.

- *If children find this difficult, repeat with some similar examples and see if they can challenge you with some of their own.*

Solutions:

Aisha's mum is 30

Aisha's dad is 34

Step 2 - Going Shopping

Roman went shopping for toys.

He takes £50.

He buys a ball for £12.

He buys a book for £13.

He buys a toy robot.

He has £5 left.

How much was the robot?

How to help:

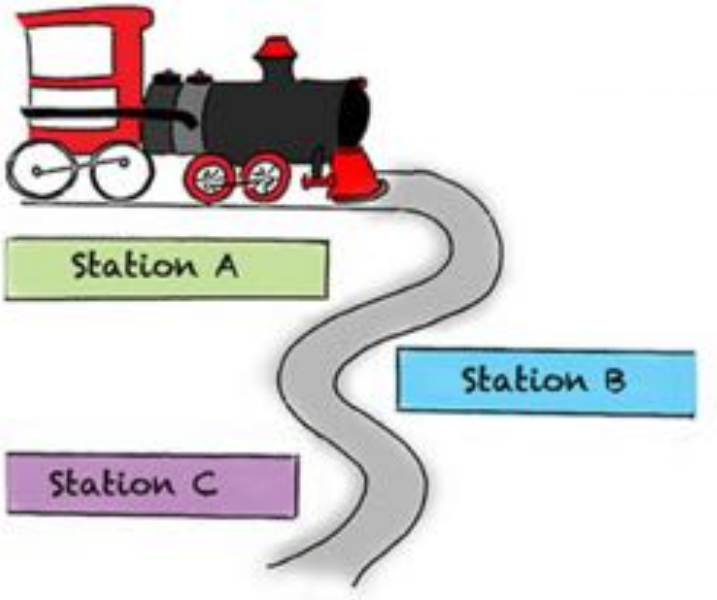
- *Tell children that the strategy is "work backwards" and ask them what things do we know that we can work from.*
- *Establish that he took out £50 but has £5 left, so he must have spent £45*
- *Encourage children to describe their thought process as they go and allow them to make - and hopefully self-correct - any mistakes.*
- *Establish that he must have spent £45 and we know that the book was £13 and the ball was £12.*
- *You could add 12 + 13 to give a total spend of £25 and deduct this from £45. See how the children approach it, it is a sensible strategy to first subtract 12, then subtract 13.*
- *If children find it difficult, only use one toy, then move to two toys. Replace the numbers with multiples of 5 and 10.*
- *If they are confident, increase the costs of the toys, avoiding multiples of 5 and 10.*

Solutions:

The robot cost £20

Step 3 - Take The Train

A train set off from Station A with some passengers on board.



At Station B, 12 passengers got on and 5 got off.

At Station C, 12 passengers got on and none got off.

After Station C, there were 23 passengers on board.

How many passengers were on the train when it set off from Station A?

How to help:

- *Remind children that we must work backwards to find the answer. Ask children to tell you what we know from the problem: that there were 23 passengers at the end.*
- *Work back through the clues. We know that 23 passengers were on the bus but 12 of them got on before that. We must subtract 12 from 23 to get 11.*
- *Check as you go: you can add 12 to 11 to get 23, so we must be correct so far.*
- *Model using equations as you go, for example: ____ + 12 = 23*
- *Move to the next step. 12 got on and 5 got off. We take our answer of 11, add 5 and subtract 12 to get 4.*
- *Check using addition: start with 4 then work forwards through the problem: 4 + 12 - 5 + 12 = 23, so we must be correct.*
- *If children are finding this complicated, reduce to just one station, then move to just one station where passengers get on and off the train.*

Solutions:

There were 4 passengers on the train when it set off.

Step 3 - Rolling Dice

The dots on opposite faces of a dice add up to 7.

If you have rolled a dice and 3 is facing up, what number is facing down?

Imagine you have rolled a dice. If you add up the dots that are not face down, you get 18. Which number is face down? How did you work it out?

Imagine you have rolled two dice. You add up all the dots that are not face down and get 40. Which two numbers are face down?

How to help:

- *Get some real dice to model the problem and make sure that children are familiar with dice.*
- *Repeat some examples from part 1 if children are not sure, for example if 6 is facing up, what number is facing down?*
- *For part 2, children must realise that the total of all the dots on a normal dice is 21. Support them to find this out and then ask them how we can find out what the missing number is. Do this without using the actual dice or they will easily spot what the face-down number is by checking what numbers they can see.*
- *Model using equations, for example: 18 + ____ = 21*
- *Repeat for the final part, helping children to realise that there are 42 total dots on 2 dice.*
- *Model using equations: 40 + ____ = 42*
- *If children find this difficult, repeat similar examples from part 1 and 2.*
- *If children find it easy, try an example with three dice.*

Solutions:

If 3 is facing up, 4 must be face-down.

If you can see 18, the number 3 must be face-down.

If you can see 40 on two dice, 2 dots are missing so they must both have the number 1 face-down.

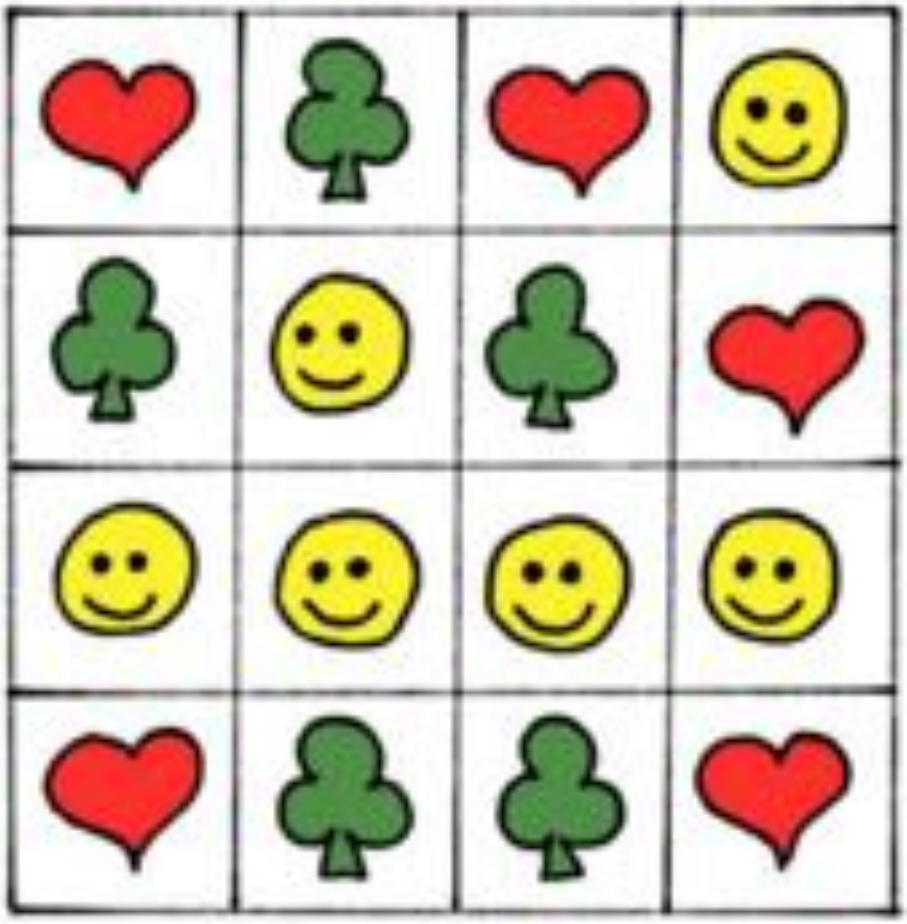
STRATEGY H - SOLVE WITH ALGEBRA

Step 2 - Shape Puzzle

Each shape stands for a number.

The numbers shown are the totals of each row and column.

Can you find the remaining totals?



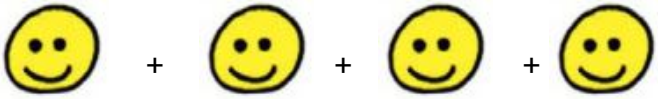
			21
			40
			30

How to help:

- *This strategy is about using algebra, but you don't need to call it algebra with children of this age unless you want to - there is nothing to be sacred of!*
- *The strategy is all about finding missing numbers. Ask children where we could start.*
- *Children should identify the row of smiley faces, as exactly 4 of them make 40. They may know intuitively that this is 10 but model using equations to support their learning of the concept:*

_____ x 4 = 40

and/or:

 *= 40*

- *From there, help children to see that we can look at the vertical column that totals 30. We know that the smiley face is 10 - ask children to describe to you how we could solve the next part. Model with equations to support their understanding:*

10 + ___ + 10 + _____ = 30

We know that 10 + 10 = 20, so that leaves 10, but it has been split into 2 equal parts.

- *Finally, ask children where we could go next. Look at the row that totals 21 and work through, modelling with equations as you go:*

____ + 10 + ____ + 5 = 21.

We know that 10 + 5 = 15. 21 - 15 = 6, but it is in two equal parts.

Solutions:

The smiley face is worth 10.
The heart is worth 5.
The clover is worth 3.

Step 2 - Shape Puzzle

Each animal stands for a number. Find out what the numbers are and use them to solve the animal puzzles!

 + 12 = 20

21 -  = 14

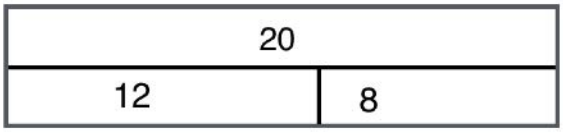
 x 5 = 25

 +  = _____

 +  +  = _____

How to help:

- *Using number lines or real-life objects such as counters or buttons can help if children are not sure.*
- *A very useful model to support children is the 'bar model' and will help them understanding missing number problems. An example for the first question would be:*



- *Model using equations when you have found out the missing number, for example:*

12 + 8 = 20
8 + 12 = 20
20 - 8 = 12
20 - 12 = 8

- *Use the answers that you have found to solve the two puzzles at the bottom of the page.*
- *If children find it difficult, substitute values for the missing numbers that are easier, e.g. 1, 2, 5 or 10.*
- *If children are confident, ask them to make some animal puzzles for you!*

Solutions:

 *= 8*

 *= 7*

 *= 5*

Well done - you have solved all of the year 2 logic and reasoning problems in this booklet and you are an expert problem-solver!

Head over to www.stopsproblemsolving.co.uk and check out the COVID19 zone for more games and problems.