Sequenced Teaching of Problem Solving

HOME LEARNING MATERIAL

Year 1

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 one main problem to work through with your child and one other supporting problems at the same level 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.

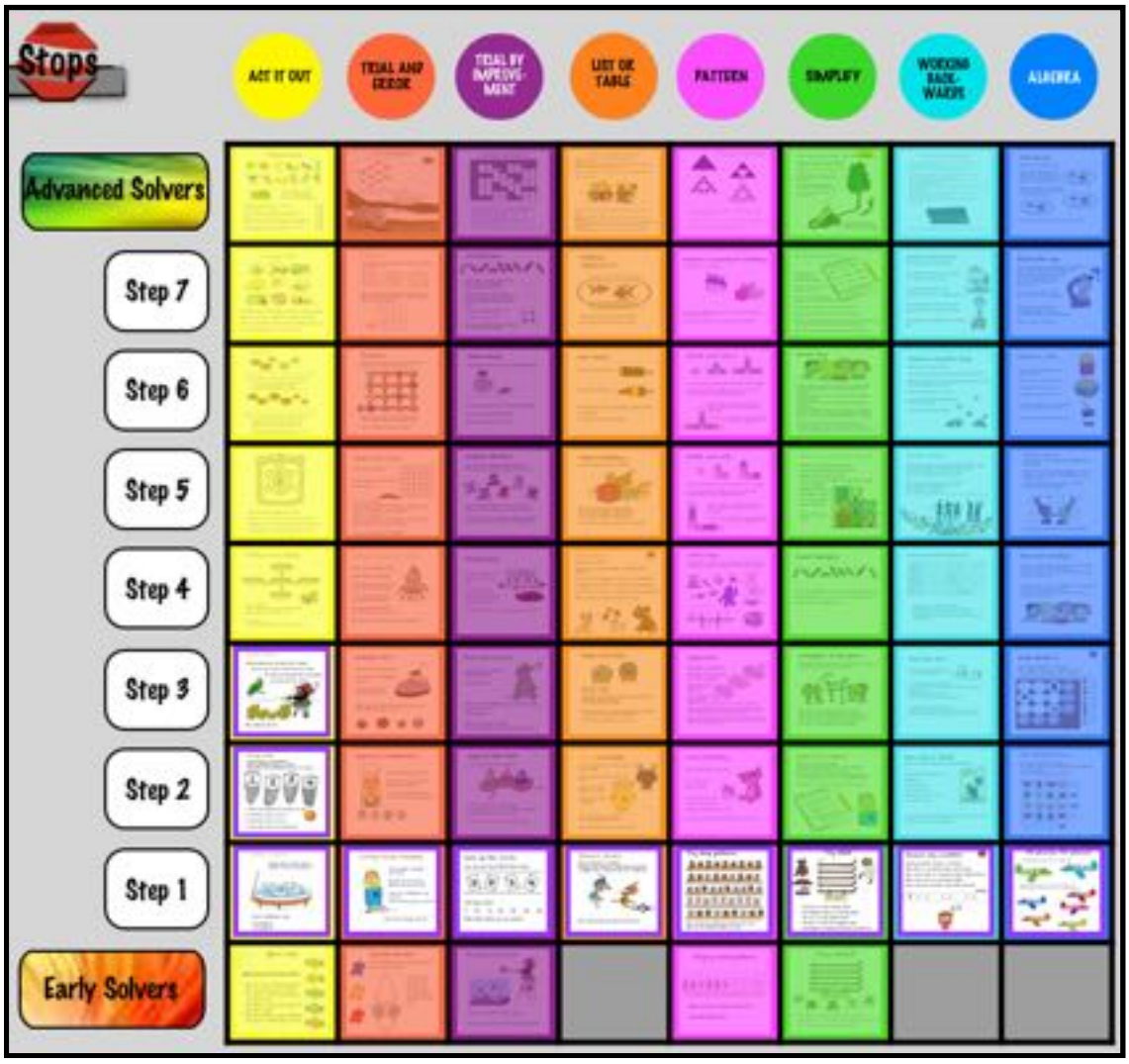
- Allow children time to think through for themselves, do not be tempted to do too much for them.

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’.

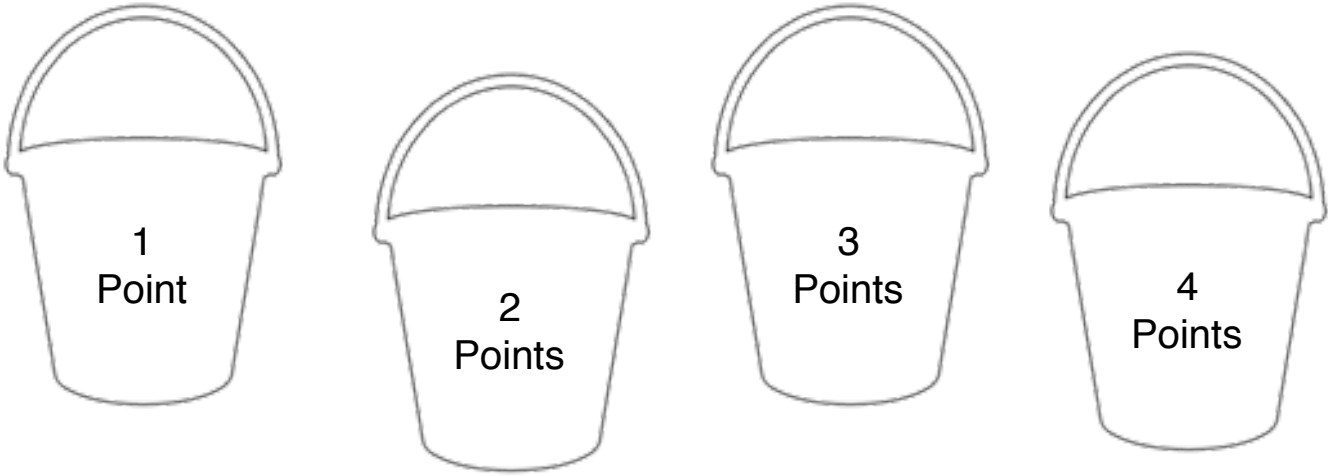
Below is our grid, with the recommended year 2 problems highlighted. This book will provide support and companion problems to the year 2 set of problems that your child is studying at school.



STRATEGY A - ACT IT OUT/MAKE A MODEL

STEP 1 - Bucketball

Let's make a game. Each bucket is worth a number of points. If you can land a ball in the bucket, you will score the points!



Can you find two different ways to score 5 points?

Can you find two different ways to score 6 points?

Can you find two different ways to score 7 points?

What is the highest score you can make with 3 balls?

How to help:

- It is not essential to set this problem up with actual buckets and balls but it would be much more fun!
- The problem does not specify how many balls can be thrown. Try first using two balls and then move to three or even four depending on how confident the child is.
- Allow the child to play around with the game first, practice making any totals with two and then three balls.
- The child can throw more than one ball in the same bucket
- Encourage the child to 'plan', e.g. instead of throwing the balls and adding the totals, ask: "Which two numbers could we aim at to make 5?"
- If they are unsure, try making a total of 3 with just two balls.
- If they are confident, ask what are the highest totals that can be made with 4 or even 5 balls.
- When completed, you can move to step 2 or try one of the other step 1 problems below as further practice.
- It is not necessary to find all possible solutions. Children should explore the different possibilities, understanding that there can be more than one solution to the problem.

Solutions:

Many solutions are possible, especially if you use more than 3 balls. These are example solutions if using 2 and 3 balls:

To score 5 points: 1 +4, 2 + 2, 3 + 2, 3 + 1 + 1, 2 + 2 + 1
To score 6 points: 2 + 4, 2 + 2 + 2, 3 + 2 + 1, 4 + 1 + 1
To score 7 points: 4 + 3, 4 + 2 + 1, 3 + 3 + 1

STEP 1 – A Sweet Treat

You can buy a sweet for 7p but you must pay for it exactly with coins.

How can you pay exactly 7p with coins?

Can you find 3 different ways?

Tips: allow children to use real coins or enlarged toy money if you have it.

Solutions:

5p + 2p

5p + 1p + 1p

2p + 2p + 2p + 1p

2p + 2p + 1p + 1p + 1p

2p + 1p + 1p + 1p + 1p + 1p

1p + 1p + 1p + 1p + 1p + 1p + 1p

STEP 2 - Slam Dunk!

You have three balls to shoot at these baskets. Each basket has a score. All of the shots must land in a basket and more than one ball can land in the same hoop.

Can you find two different ways to score 7?

Can you find two ways to score 10?

What is the lowest score you can get with three shots?

Can you score 2? Why?

How to help:

- This problem may be more difficult to physically recreate but it can be ‘modelled’ using buttons and cups, counters and bowls or whatever you have at home. This helps children to learn that a real-life situation can be represented mathematically. Children may prefer to simply use pencil and paper as their model.

- The problem does specify exactly how many shots are allowed, making it more challenging than step 1.

Solutions:

Three ways to score 7: 3 + 3 + 1, 2 + 3 + 2, 1 + 4 + 2

Two ways to score 10: 4 + 4 + 2, 3 + 3 + 4

Lowest score with three shots is 3. The question tells us that all three shots must land in a basket

You cannot score 2, unless one of your shots does not land in a basket. The lowest score is three shots in basket 1, giving a score of 3.

STEP 2 – Bus Ride

You can take a ride on a bus for between 15p and 20p.
You can only pay with three exact coins.

Which amounts between 15p and 20p can you pay with exactly 3 coins?

How to help:

- use real or toy money
- encourage your child to record their attempts in a notebook

Solutions:

15p - three 5p pieces
16p - 10p, 5p and 1p
17p - 10p, 5p and 2p
18p - cannot be made with 3 coins
19p - cannot be made with 3 coins
20p - 10p, 5p and 5p

STEP 3 - Bricks in the wall

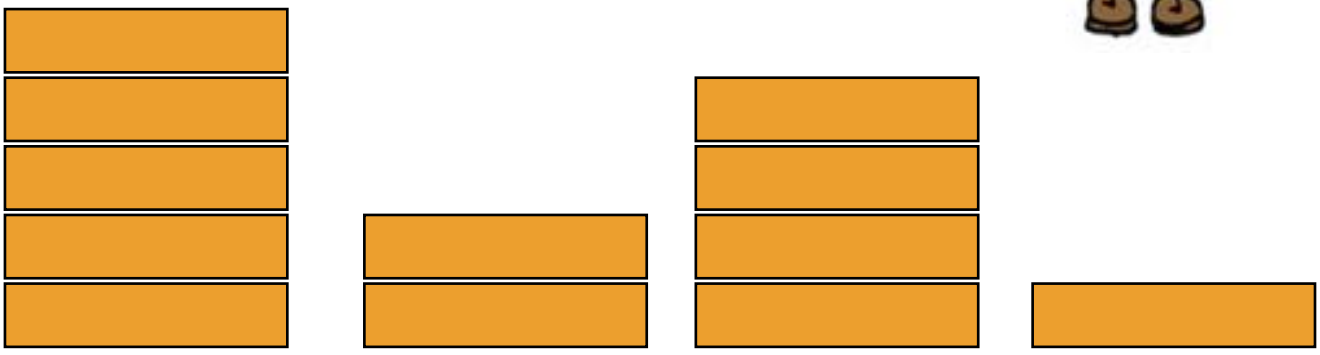
Josh has made some piles of bricks.

He can move one or more bricks at a time.

He made all the piles the same height.

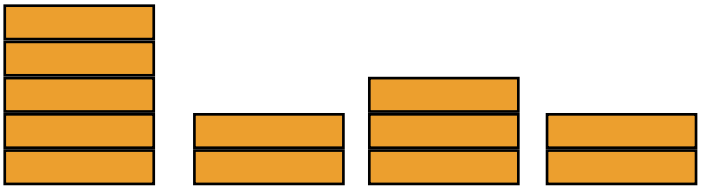
He made just two moves.

How did he do it?

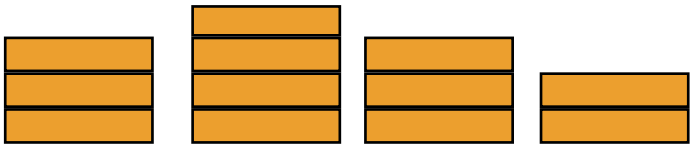


How to help:

- If you have any toy building bricks at home, this would be fun to set up and explore
- Explain and model how we could more one brick at a time, then more than one brick.
- If the children are not sure, set up the problem again more simply, for example one of the two below which can be solved in two moves:



or even one move, to build their confidence:



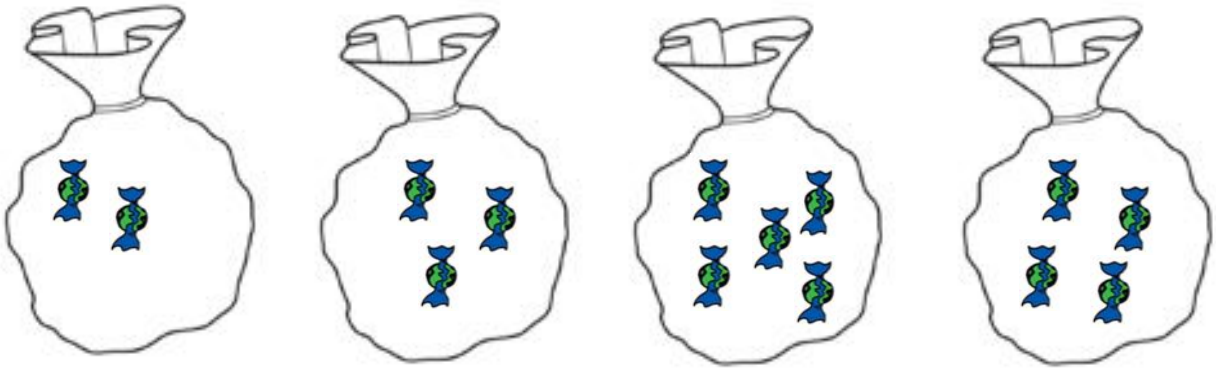
- As children grow in confidence, you can add complexity by adding more bricks (4 piles of 5 bricks, for example) and more moves.

Solutions:

Move one brick from pile 3 to pile 2
Move two bricks from 1 to pile 4

STEP 3 - BAGS OF SWEETS

You have 4 bags of sweets. Each bag has a different number of sweets in it. Can you empty the sweets out into 2 bowls so that each bowl has the same number of sweets?



2 sweets | 3 sweets | 5 sweets | 4 sweets

How to help:

- Set up the problem practically, using counters or buttons instead of sweets
- Encourage the child to use the practical resources to try different solutions
- Encourage them to use jottings to draw the solution, as well as using the resources, using the blank circles above as 'bowls'

Solution:

7 sweets in each bowl

STRATEGY B - Trial and Error

Step 1 – At the shop

Aisha went to the shop.

She bought a lollipop.

It cost 11p.

She paid for it exactly.

Which coins did she use?

Can you find more than one way?

How to help:

- Have some coins to hand, either real coins or toys
- The coins can be picked at random and totals established, using a ‘trial and error’ strategy
- Help children to record their trials. You can draw coins, write amounts or keep successful trials to one side while they make another
- With a ‘trial and error’ strategy, always re-enforce the idea that making mistakes is good - this is how we investigate and find things out.

Solutions:

To make 11p, 11 solutions are possible. Children do not have to systematically find all solutions, but they should realise there is more than one way to solve the problem. Finding three or four solutions is more than enough.

1p + 1p + 1p + 1p + 1p + 1p + 1p + 1p + 1p + 1p + 1p

2p + 1p + 1p + 1p + 1p + 1p + 1p + 1p + 1p

2p + 2p + 1p + 1p + 1p + 1p + 1p + 1p

2p + 2p + 2p + 1p + 1p + 1p + 1p

2p + 2p + 2p + 2p + 1p + 1p

2p + 2p + 2p + 2p + 2p + 1p

5p + 1p + 1p + 1p + 1p + 1p

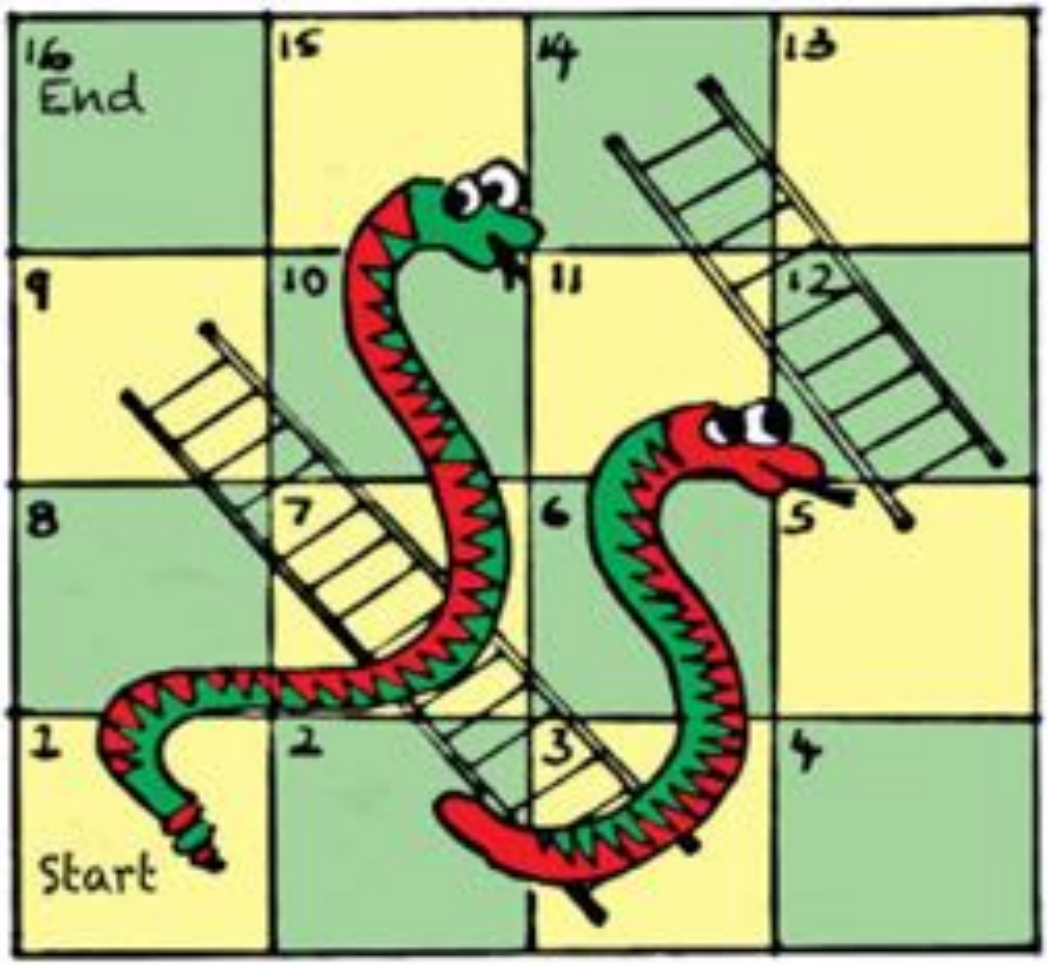
5p + 2p + 1p + 1p + 1p

5p + 2p + 2p + 1p + 1p

5p + 2p + 2p + 2p

5p + 5p + 1p

Step 1 - Roll The Dice



Your counter is at the start. You have two moves. You land on 7.

Which two numbers could you roll to land on 7?

Can you find 3 different ways?

How to help:

- You can play some real snake and ladders and try this problem at the start of the game
- Try rolling the dice and seeing if you can get 7 with two rolls
- Children may begin to use the ‘work backwards’ strategy to find two numbers that total 7
- be careful - if you roll a 3 you will climb the ladder to 9!

Solutions:

To make 7 with two dice rolls, 6 solutions are possible:

1 and 6

2 and 5

3 and 4 - although this will not work on this particular snakes and ladders board

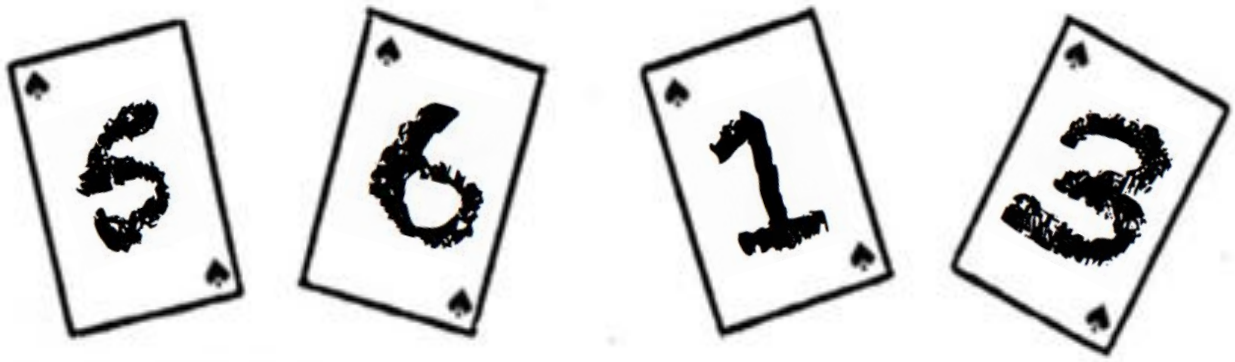
4 and 3

5 and 2

6 and 1

STRATEGY C - Trial by Improvement

Step 1 - Card Tricks



Can you add the numbers on the cards to make these totals:

10

12

14

How to help:

- This strategy requires children to be a little more systematic. Pick numbers at random first, for example adding 5, 6 and 1. You get 11 - this is too high to make 10, so lets look at using some smaller numbers.
- Record successful trials on a sheet or in a problem-solving jottings book
- If children find it hard, reduce the total number, e.g. totals of 7 and 8.

Solutions:

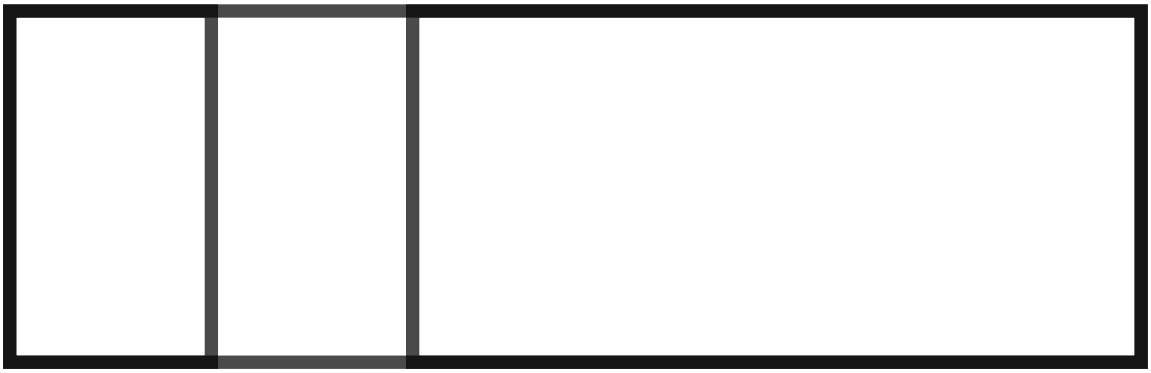
10 = 6 + 3 + 1

12 = 5 + 1 + 6

14 = 5 + 6 + 1 + 3

Step 1 - How many rectangles?

How many rectangles can you count in this shape?



How many rectangles can you count in this shape?

How to help:

- Ensure that children know the meaning of the word ‘rectangle’ and can recognise the shape.
- Allow children to make trials first, and tell them if they are too high or too low with their trial. Then they can return and try again.
- Steer them towards seeing the different types of rectangle one at a time so that their trials can be improved.
- If children find it hard, use colouring pencils to draw the borders of the different size rectangles.

Solutions:

In the first shape, there are three single rectangles, two rectangles can be made by joining two rectangles together and one large rectangle. The total is 6 rectangles.

In the second shape, there are 9 rectangles.

STRATEGY D - Make a list or table

Step 1 - Choose your fruit

Aisha and Roman can choose any two fruits. They have an apple, a banana or cherries. They can choose one each.

Show which fruits Aisha and Roman could choose.

How to help:

- Use real or toy fruits to bring the problem to life and make it more interesting
- Encourage children to pick one fruit for Aisha and another for Roman.
- Put the fruits back and make another choice for Roman and Aisha
- Show children how to record a simple list to make sure we don't repeat ourselves. For example:

Aisha has an apple, Roman has cherries
Roman has cherries, Aisha has a banana

- It is not necessary to find all possible solutions. It is more important that children learn to begin to record their trials in a simple list

Solutions:

There are 6 different combinations:

Alsha	Apple	Apple	Banana	Banana	Cherries	Cherries
Roman	Banana	cherries	Apple	Cherries	Apple	Banana

Step 1 – What's the number?

Roman has a list of three numbers.

The digits of each number add up to 6.

None of the digits is zero.

Can you write the numbers in Roman's list?

How to help:

- Start by thinking of some numbers that make , 6 e.g. 3 and 3, 4 and 2. Begin to record as a list.
- If children find it difficult, reduce the number to 4. Extend to 7 if they are confident or finding it easy.
- Encourage children to find two 2-digit numbers for each combination, e.g. 24 and 42
- The key learning here is to record your trials.

Solutions:

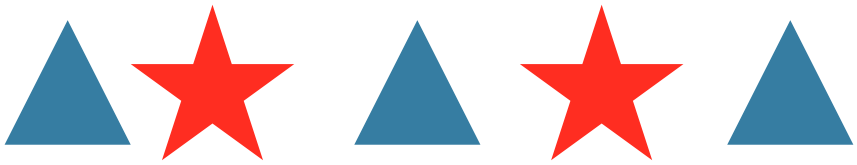
The numbers on Romans list are:

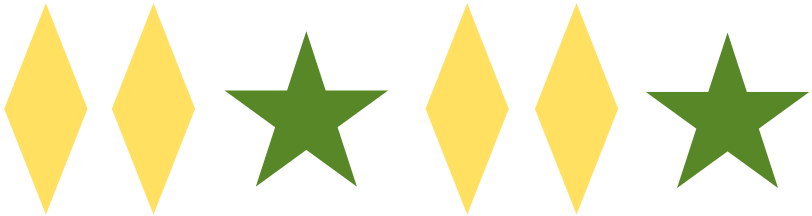
15
24
33
42
51

STRATEGY E - Find the pattern

Step 1 - Shape Patterns

What will be the next three shapes in each row?





How to help:

- Encourage children to name each shape and describe the pattern before predicting what comes next.
- You could try making your own, more complex patterns with lego or coloured counters as an extension activity

Solutions:

First row: yellow square, red circle, yellow square

Second row: red star, blue triangle, red star

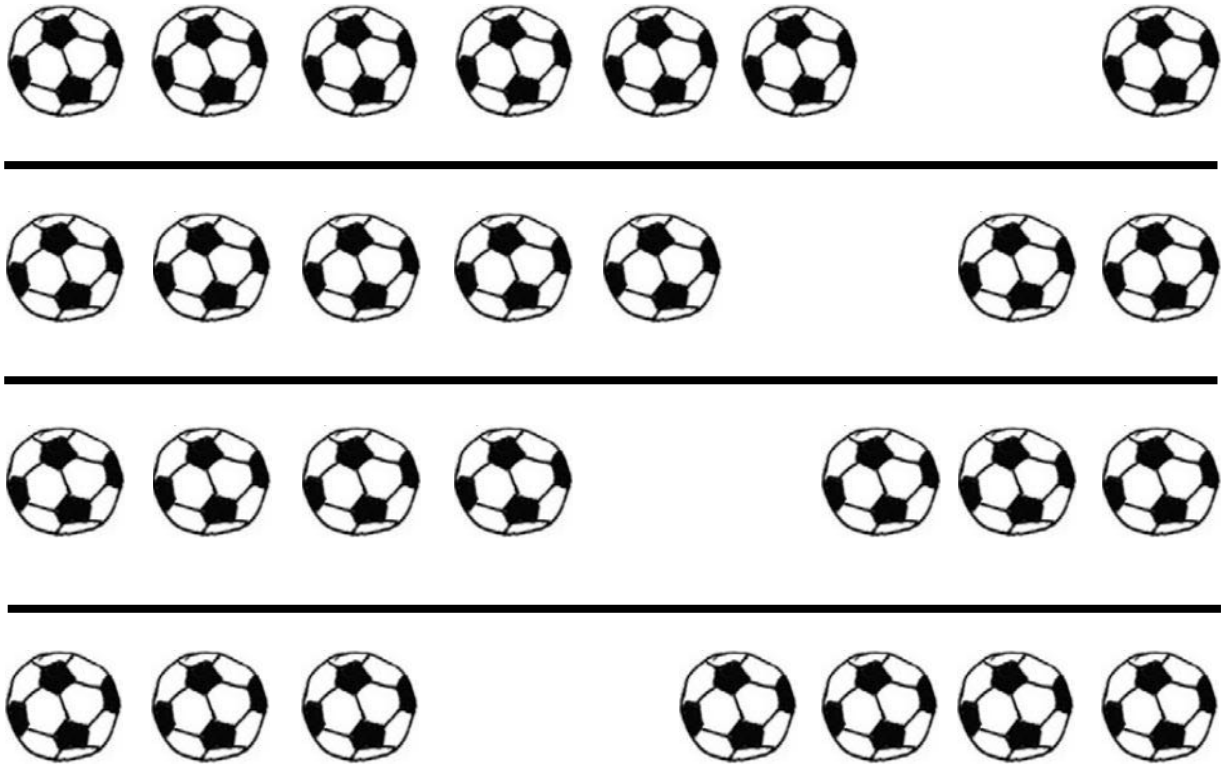
Third row: purple circle, green triangle, red rectangle

Fourth row: yellow ‘diamond’, yellow ‘diamond’, green star

Note: the yellow shape in the fourth row is a parallelogram but ‘diamond’ is an acceptable description at this age.

Step 1 – Football Crazy

Can you make the next two patterns?



How to help:

- Support children to describe the pattern verbally and explain what comes next and why. Establish that there are always 7 footballs in each row but they are arranged differently.
- You could use toys or counters to make similar patterns, or challenge them to make a pattern for you to solve

Solution:

The next row will have two footballs on the left, the final row will have one.

STRATEGY F - Simplify the problem

Step 1 - Toys on the shelf

Read the clues and see if you can put the toys away on the correct shelves.

boat

car

ball

teddy bear

The car is above the boat
The teddy bear is on the top shelf
The ball is below the teddy bear
The boat is on the bottom shelf

How to help:

- Children can cut out and copy the picture, write on the shelf in words or you could recreate the problem with real toys at home.
- Read all of the clues through with the child and identify which we can use first.
- Cross out clues when they have been ‘used’, to simplify the problem

Solution:

From top to bottom: teddy bear, ball, car, boat

Step 1 – How many presents?

Three friends all give each other a present.

How many presents are there in total?

If 4 friends each give each other a present, how many presents would there be?

How to help:

- Encourage children to simplify the problem: look at each person at a time and think about how many presents they would buy. You could record this using jottings or by using toys or counters to represent the presents.
- Children can then move on to the second problem using the same ideas.
- If children are finding it difficult, look just at two people or move on to 5 or 6 people if they are finding the problem easy.

Solution:

For three friends, each of them would buy two presents each, making a total of 6 presents.

For four friends, each of them would buy three presents each, making a total of 12 presents.

STRATEGY G - Simplify the problem

Step 1 - Baking cookies

Aisha has baked some cookies.

She ate 1 cookie.

She gave 3 cookies to her friend.

She now has 2 cookies left.

How many cookies did she bake?

How to help:

- Ask children to start of with what we know: we know she has two cookies left. She gave her friends 3 cookies. If your child is ready, you could show this as a 'missing number' equation:

  $\square - 3 = 2$

- Use counters or cubes to find out the answer and establish that she had 5 cookies (after she had eaten one!)

- Repeat the process. She had some cookies, she took one away and now she has 5, how many did she have to begin with?

- Use a number track (example below) to support counting forwards and backwards if children are not sure. "I count back one and end at 5, where did I start?"

Solution:

Aisha baked 6 cookies.

Step 1 - Market Stall

Aisha's mum sells fruit at the market.

She sold 5 oranges in the morning.

She then sold another 6 oranges in the afternoon

She now has 7 oranges left to sell.

How many oranges did she start with?

How to help:

- Start with what we know: she had 7 oranges left. She had sold 6 oranges and was left with 7. We can write this as a missing number equation:

$$\square - 6 = 7$$

- Model to your child how this can be solved by adding, using counters to represent the oranges. Establish that after the morning she had 13 oranges.

- Repeat the process:

$$\square - 5 = 13$$

- This process can be tricky for children, give them time to experiment and make mistakes until they understand how we can work backwards to find a solution.

Solution:

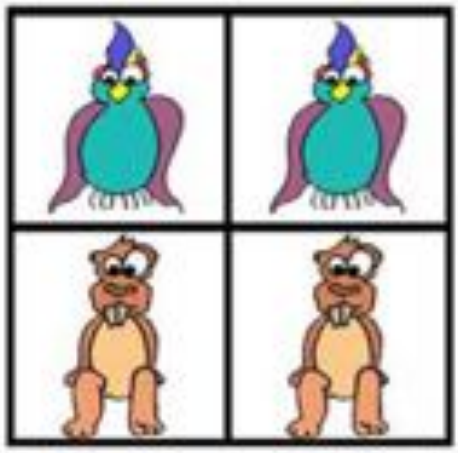
Aisha's mum started the day with 18 oranges.

STRATEGY G - solve algebraically

Step 1 – Animal Puzzles!

Can you find out what number each animal is worth in these puzzles?

Each row and column add up to the number at the side.



6

8

7 7

2 ?

4 ?

10 6

How to help:

- children may need support in understanding the nature of the problem. Explain that the picture of the parrot stands for a missing number. Two parrots together add up to 6. What could the missing number be? Children could use knowledge of halving or even trial and error to establish the correct answer.
- In the second problem, children must find the totals after they have found the value of the vulture.
- A picture representing a number may be initially tricky for children, but this is a great way of laying early foundations for understanding of the concept of algebra later on.

Solution:

Puzzle 1: the parrot is worth 3, the beaver is worth 4.

Puzzle 2: the vulture is worth 5. The first row totals 7, the second row totals 9.

Step 1 – Shapes and numbers, numbers and shapes

Find the values of  and

7 +  = 10

 + 5 = 10

Now can you solve these puzzles:

 + = ?

 –  = ?

How to help:

- Use a number track (example below) to support children in establishing what the triangle and circle are worth.
- Use pen to write the numbers that the shapes represent on the shape when you have solved the problem.

1	2	3	4	5	6	7	8	9	10

Solution:

The triangle is worth 3, the circle is worth 5.

Well done - you have solved all of the year 1 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.