CARS IN A GARAGE

You Need

- Four [4] toy cars
- Paper to cover unused garages (not supplied)

Your Task

1. Use three [3] cars in three [3] garages.

   Find all the ways to park the cars with one car in each garage.

   Record all the ways in your journal.

Welcome to PARK 'N' PLACE Garages

2. Use four [4] cars in four [4] garages.

   Find all the ways to park the cars and record in your journal.

Challenge

Imagine you had five [5] cars in five [5] garages.

Find all the ways to park the cars and record in your journal.

Imagine you had one hundred [100] cars in one hundred [100] garages.

Find all the ways to park the cars and record in your journal.

COUNTER ESCAPE

You Need

- Three [3] counters in one colour & three [3] counters in another
- One [1] cube dice

This is a game for two players.

Your Task

Each player places all three counters on the picture.

The counters can be placed anywhere. For example, you could place all of them in C, or two [2] in A and one in B, or any other way you want.

Rules

- Players take turns rolling the dice.
- *If the roll is 1*, one counter can be removed from Box A.
- *If the roll is 2 or 3*, one counter can be removed from Box B.
- *If the roll is 4, 5, or 6*, one counter can be removed from Box C.
- The winner is the first person to remove all their counters.

A	B	C

Challenge

Decide the best way to place the counters so they are likely to be removed in the least number of rolls.

CONSECUTIVE SUMS

You Need

- Twenty-six [26] discs numbered from 0 to 25

Your Task

1. Using two consecutive numbers, how many ways can you place the discs?

◯ + ◯ =

Rules

- Discs on the left of the equal sign [=] must be consecutive numbers, eg: 3 & 4 are consecutive and 7, 8, 9 & 10 are consecutive.
- The answer after the equal sign must be one of the discs you have.

Challenge

2. Repeat the challenge for three consecutive numbers.

◯ + ◯ + ◯ =

3. What happens if there are four consecutive numbers?

◯ + ◯ + ◯ + ◯ =

ROW POINTS

You Need

- Two 5x5 grids - one for each student
- Thirteen [13] counters for each student

Rules

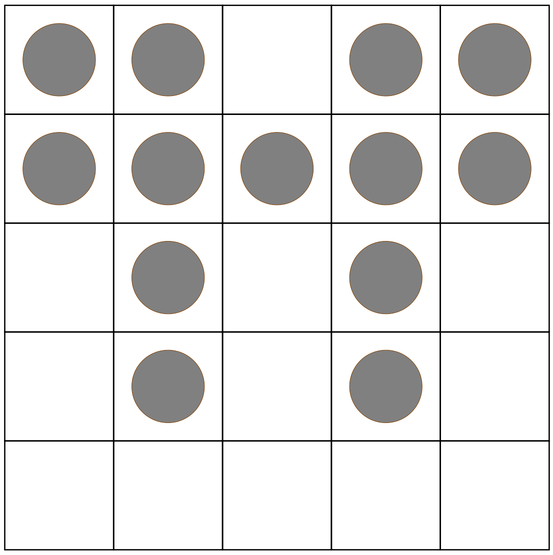
Each player places all their thirteen counters on the board to score points:

- any 5 in a row scores 5 points
- any 4 in a row scores 4 points
- any 3 in a row scores 3 points

Example: The arrangement shown scores nineteen [19] points.

Your Task

1. Make some arrangements and work out the point score. Record in your journal.
2. Try to make an arrangement that scores exactly fourteen [14] points.
3. What is the lowest score?
4. What is the highest score?

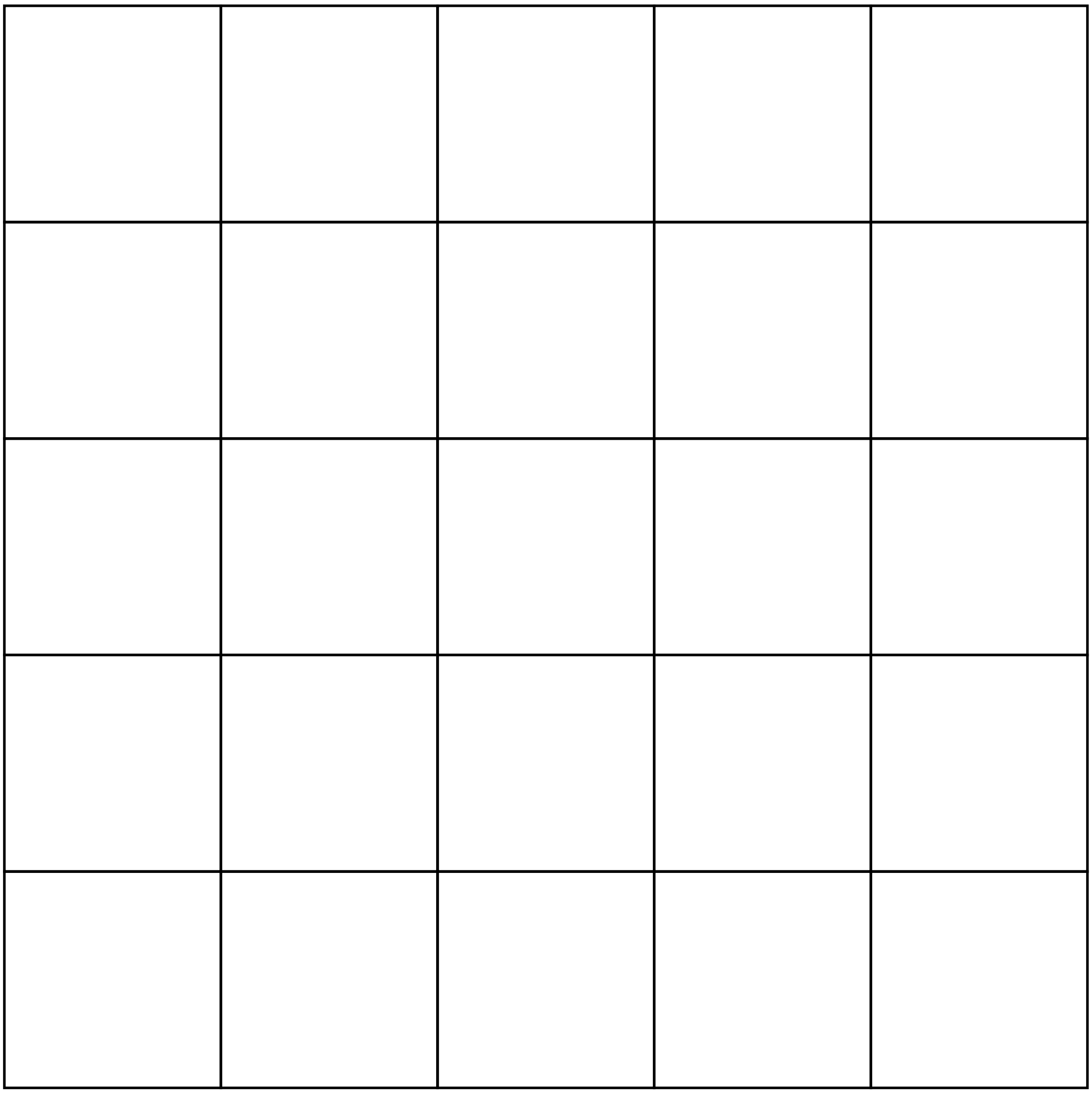


Challenge

How do you know you have found the highest score?

Try to make all the scores between the highest and the lowest.

Row Points



LINING UP

You Need

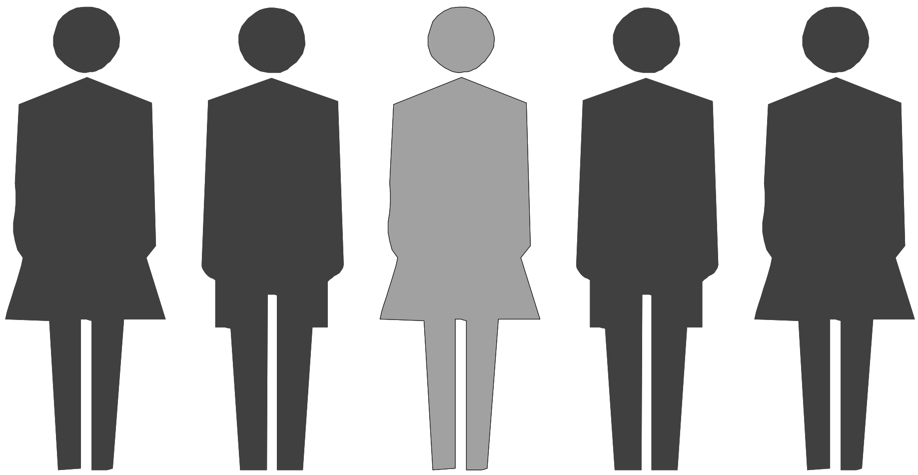
- Thirty-seven [37] 'people' - one [1] is different

Your Task

1. Your class is lining up in one line.

   You are 17th from each end.

   How many people are in your class?



2. How many people if you are 7th from each end?
3. How many people if you are 12th from each end?

Challenge

If I tell you any number from each end, can you tell me how many people in the line?

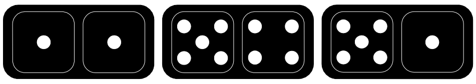
The number of people in the line is always odd. Why?

DOMINO TRAILS

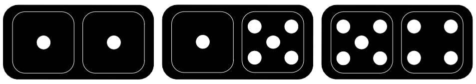
You Need

- One [1] set of Double Six dominoes
- One [1] playing board, marking pen and wiping cloth
- Recording sheet

This is a domino trail.



This is a *matching* domino trail.



Dots match where the dominoes touch.

Your Task

1. Write a number in the circle on the playing board.

   Make a 5-domino trail that has your number as the total of dots.
2. Now try to make a *matching* domino trail that has your number of dots.
3. Change the number in the circle and do Questions 1 & 2 again.
4. Repeat Questions 1 & 2 a few times using different circle numbers.

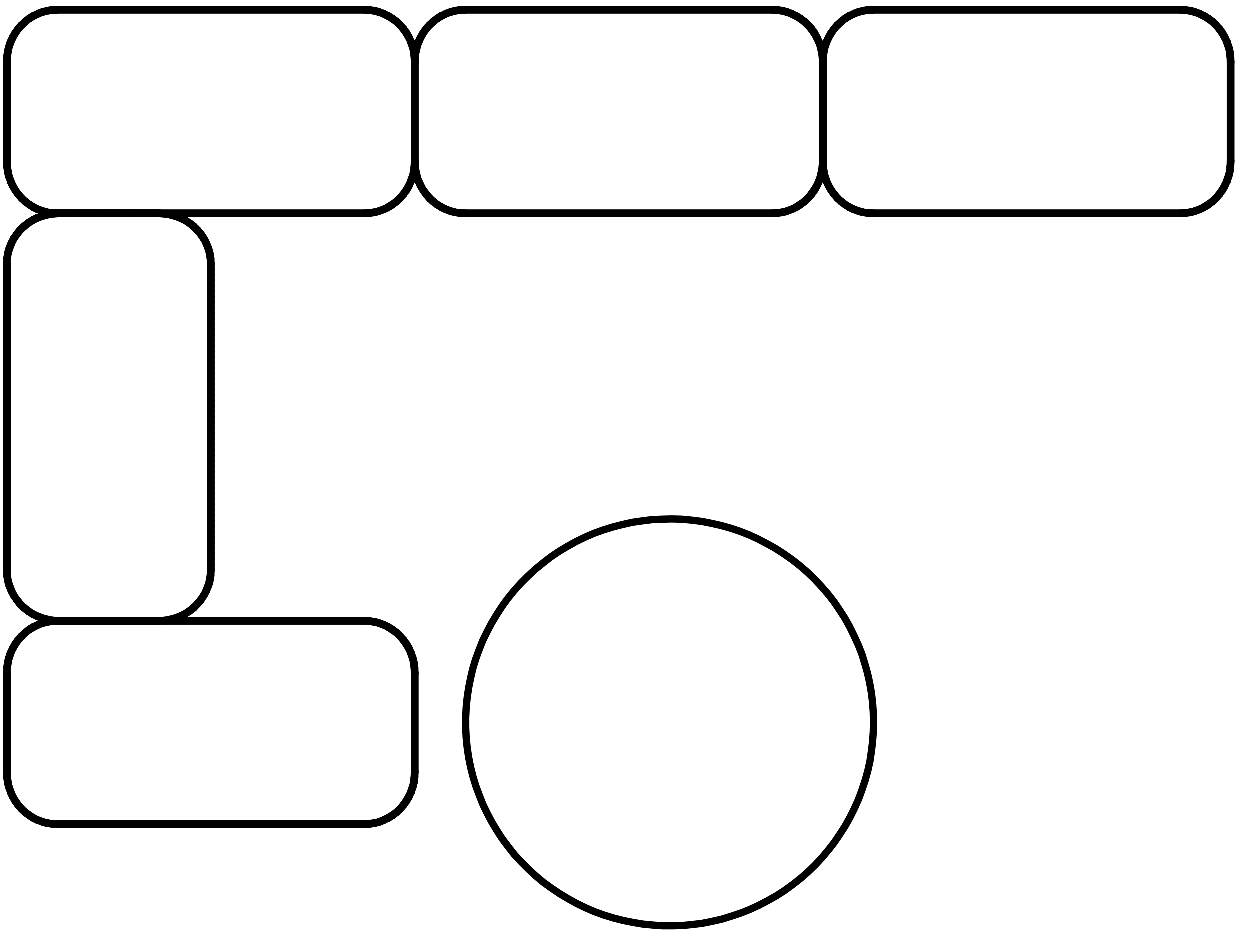
Challenge

What is the largest possible circle number for a five [5] domino trail?

What is the smallest possible circle number for a five [5] domino trail?

Choose your own length of domino trail and explore the totals. Record.

Domino Trails



TRUTH TILES 2

You Need

- Five [5] tiles numbered 3, 4, 5, 6, 7

Your Task

1. Place any four [4] tiles in the frame below to make a true equation.

2. Try to find other solutions.

Challenge

How many solutions are there?

How do you know when you have found them all?

$$\square + \square - \square = \square$$

SAME OR DIFFERENT

You Need

- Twelve [12] blocks: six [6] in each of two colours such as red & blue
- A 'bag' to hide the blocks

This is a game for two players.

Rules

- Decide who is Player A and who is Player B.
- Place 2 red and 2 blue blocks into the bag. This is the (2, 2) game.
- Without looking, each player takes one [1] block from the bag.
- Player A wins a point if the colours are the SAME.
- Player B wins a point if the colours are DIFFERENT.

Your Task

1. Play several times and decide if the (2, 2) game is fair.

   Fair means both players have an equal chance of winning.

2. What happens if the combination of blocks in the bag is changed?

   For example: (4, 3) = 4 red/3 blue ...or (5, 2) ...or (6, 1) ... (or 6, 5) or...

Challenge

Using up to six blocks of each colour, there are only two different combinations of blocks that give a fair game.

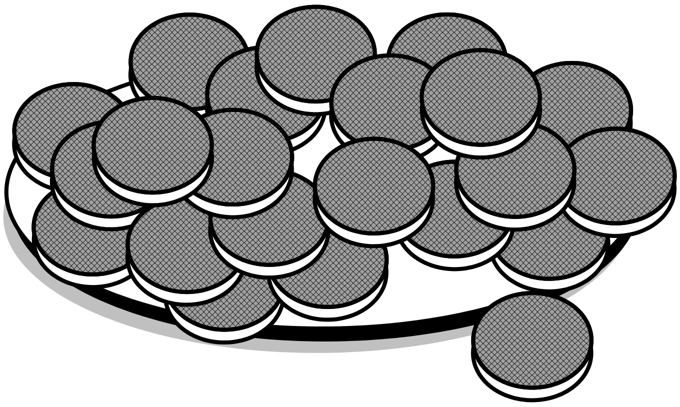
Your challenge is to find those two games.

COOKIE COUNT

You Need

- About eighty [80] 'cookies'
- One [1] 'plate'

This task is inspired by *The Doorbell Rang*, Pat Hutchins, Puffin, 1988



Make your own plate using this number of cookies.

Your Task

1. Two [2] friends are about to share the cookies. How many each?
2. Two more friends arrive before any are eaten. How many each now?
3. Another two friends arrive before any are eaten. How many each now?
4. Suppose another four [4] friends arrive before any eating?

   How many do they each get now?

Challenge

Make your own plate with any number of cookies.

- Choose how many people come to visit ...1st time ...2nd time ...
- Work out how many each person gets when they share.

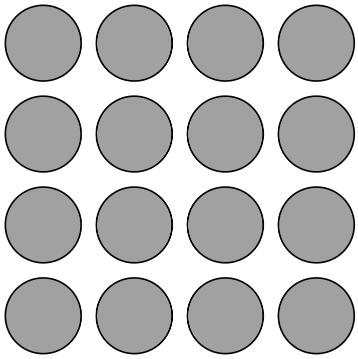
Record your puzzle and its answers in your journal.

TACTICAL

You Need

- Sixteen [16] counters all the same colour
- One [1] playing board

This is a game for two players.



Rules

- Start the game with one counter on each circle.
- Players take turns to remove counters.
- Counters can be removed from one row *or* one column each time.
- If more than one counter is taken, the counters must be next to each other.
- The person who takes the last counter *loses*.

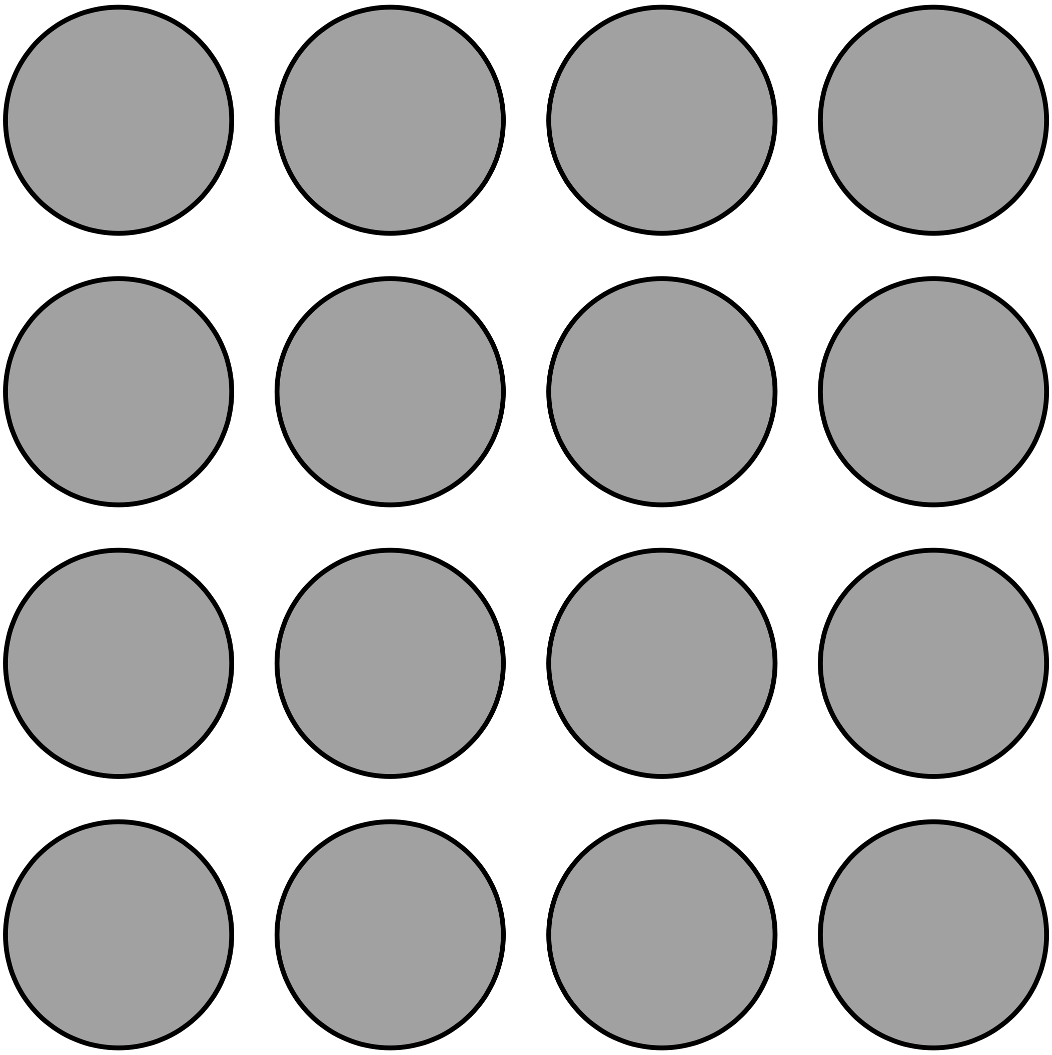
Your Task

1. Play the game a few times.
2. Discuss how you know when you are going to lose.
3. Create and record three [3] ways to place the final counters so the next move will force an opponent to lose.

Challenge

Develop and test some winning strategies.

Tactical



TWO COLOURS GAME

You Need

- Two [2] sets of thirteen [13] counters in different colours
- One [1] playing board

This is a game for two players.

Rules

- Take turns to place counters
- Place only one counter at a time.
- First player who *cannot* place a counter *loses*.
- Counters next to each other...

this way or this way

...must be different colours.

Your Task

1. Play the game a few times.
2. Discuss how you know when you are going to lose.
3. Create and record three [3] ways to place the final counters so the next move will force an opponent to lose.

Challenge

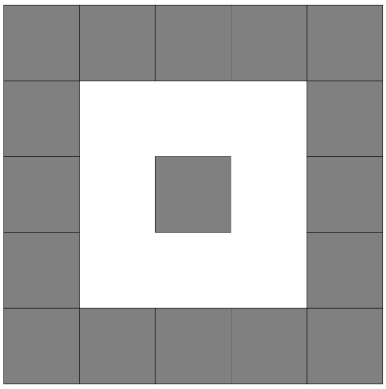
Develop and test some winning strategies.

Two Colours Game

SQUARES AROUND SQUARES

You Need

- Twenty-four [24] squares in Colour A & twelve [12] in Colour B
- Recording sheet



Using unit squares (Size 1), you will be making squares around squares like this. Each new square is a different colour.

Your Task

1. Start with a single square (Size 1). Build two more squares around it. Record.
2. Explain how to find the total number of squares used. Can you check it another way?
3. Explain how to find the number of squares of each colour. Can you check it another way?
4. Explain how to find the number of squares in the outside border. Can you check it another way?
5. Repeat questions 1 - 4 starting with a Size 2 square in the middle.

Challenge

If someone told you any size for the largest square, explain in two ways how to find:

- the total number of unit squares used.
- the number of unit squares of each colour.
- the number of unit squares in the outside border.

CAN STACK

You Need

- About twenty-two [22] 'cans'

The Story

Handy Harry has to stack cans for a supermarket display.

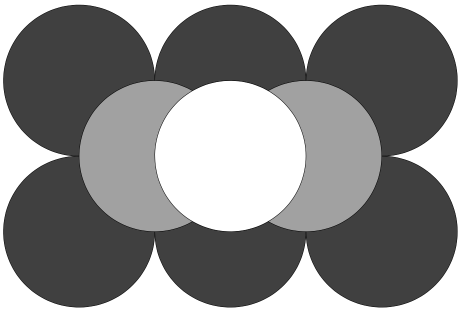
It is not working out well.

"Oh Harry," cries the boss,

"you can't build a display

like that! It will fall over

too easily. Start it like this."



Top View

Your Task

Harry keeps the pattern going.

- How many cans will be needed for the fourth layer?
- How many cans will be needed for the fifth layer?
- How many cans will be needed for the tenth layer?

Challenge

How many cans does Harry need altogether to build the display ten [10] layers high?

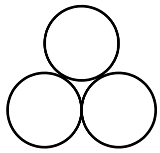
PLATE TRIANGLES

You Need

- Thirty-six [36] plates and floor space
- Thirty-six [36] counters numbered 1 to 36

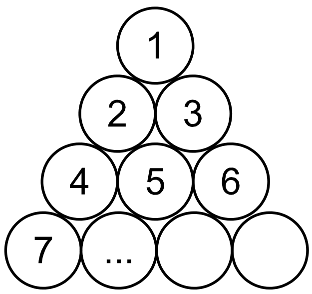
Your Task

1. Use three plates to make a triangle.
   The plates must touch each other like this.

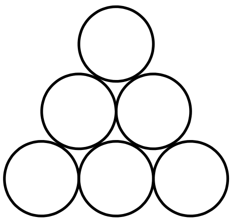


2. Add more plates to make the next size triangle.
   How many plates did you add?
3. Make a triangle which is one more size bigger.
   How many plates did you add?
4. Predict how many plates you would add to make the next triangle ...and the one after ...and the one after ...and the one after ...
5. Record the number of plates added in each step. Look for a pattern.

6. Build a plate triangle with *all* thirty-six plates.
   Place counters on them *all* as in this picture.



7. Look for number patterns through the layers.
   Record the patterns you see.



8. Use this 6-plate shape and place counters 8 to 13 on the triangle so each side adds to 33.
9. Now use the counters 1 to 6 and make each side add to the same number.
   Find the two possible totals.

Challenge

Choose any six consecutive numbers and place them on the plates so the sides add to the same number. Can you find two totals?

You Need

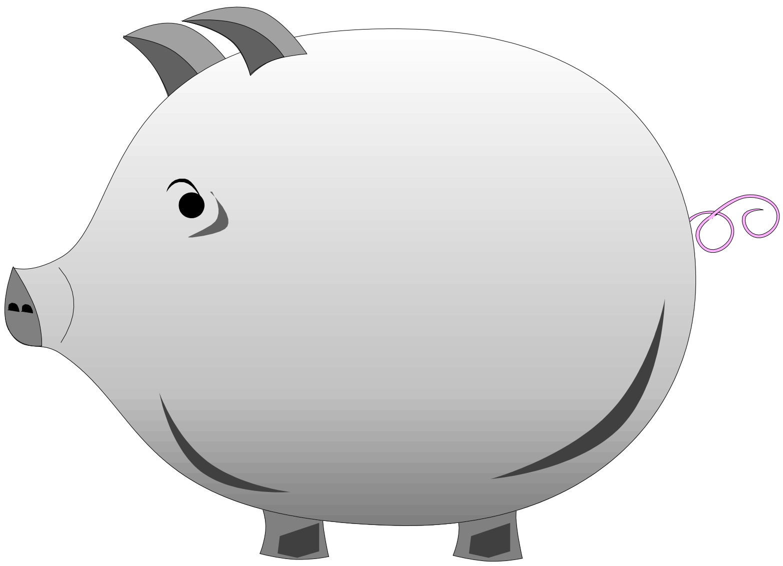
- Two [2] sets of animals
  - three [3] of one type and six [6] of another
- Twelve [12] pop sticks to use as fencing

The Story

Three unfriendly animals must be put into separate pens to stop them fighting. Fencing can only be put end to end. It cannot cross over.

Your Task

1. The farmer made three pens using seven [7] pieces of fencing. How?



Challenge

The farmer had six animals. She made six pens of *equal* size using twelve pieces of fencing. How?

THE FARMER'S PUZZLES

TRUTH TILES 1

You Need

- Nine [9] tiles numbered 1 to 9

Your Task

1. Make *all three equations true* at the same time.

$$\square + \square = \square$$

$$\square - \square = \square$$

$$\square \times \square = \square$$

2. Find two [2] more solutions.

Challenge

How many solutions are there?

How do you know when you have found them all?

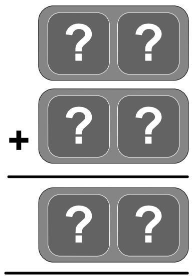
DOMINOES

You Need

- One [1] set of twenty-eight [28] dominoes

Your Task

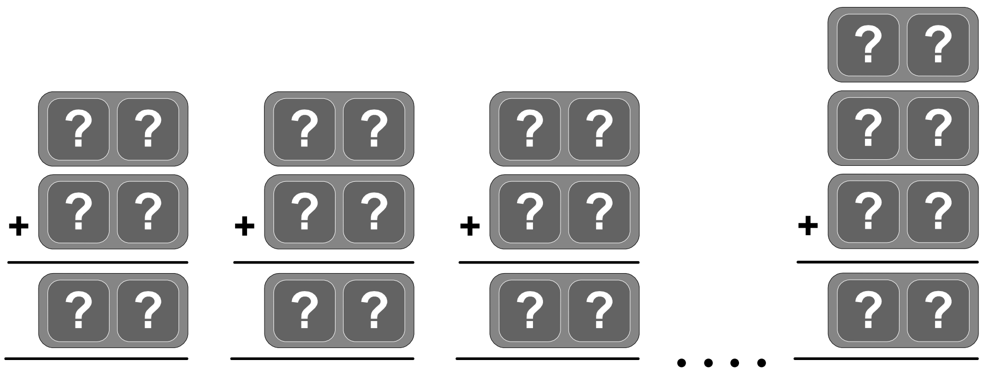
1. Place three [3] dominoes so that they make a correct addition.



2. Now try to do it so that there *is* carrying.

Challenge

Arrange all twenty-eight dominoes into nine [9] sums which are all correct additions.



This can be done with *no carrying* and it can be done with *some* carrying.

DICE DIFFERENCES

You Need

- One [1] playing board for each player
- Six [6] counters for each player
- Two [2] dice

The Story

Think of the counters as prisoners being put in cells. Together they plan a strategy so that all of them are released in as few rolls as possible.

Your Task

1. Each player puts their six prisoners in any cells on the board.

   You can put one in each cell, six in one cell or any other way you want.
2. Take turns to roll the two dice and calculate the difference.

   eg: The difference between 4 and 6 is 2.

   The difference between 5 and 1 is 4.

   Each player can release *one* prisoner from the cell with the same number as the difference.

   Keep a record of the number of rolls to release all the prisoners.
3. Play several times with each player using the same strategy for placing.

   Who do you think has the better strategy?

Challenge

There are many strategies for placing the prisoners.

Which one do you think is best? Why?

Dice Differences

0	1	2	3	4	5

Dice Differences

0	1	2	3	4	5

Mathematics Task Centre Task 34

Dice Differences

0	1	2	3	4	5

Mathematics Task Centre Task 34

Dice Differences

0	1	2	3	4	5

Mathematics Task Centre Task 34

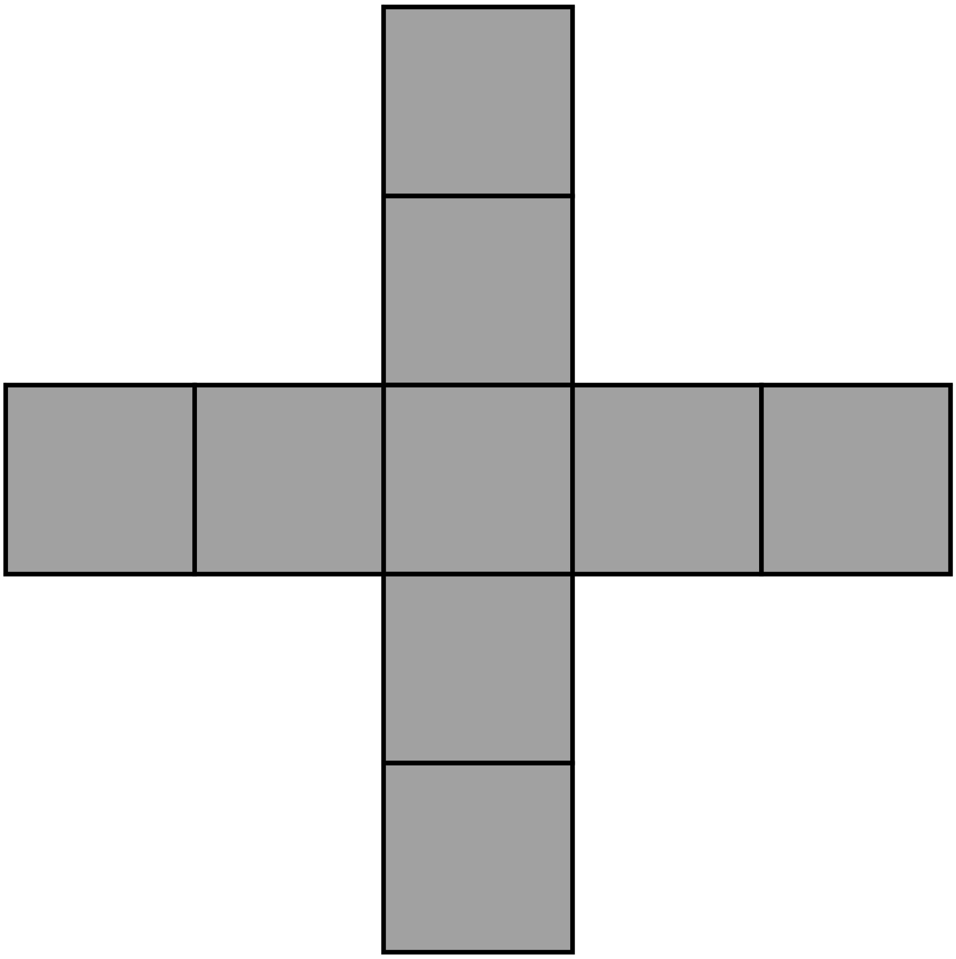
CROSSES

You Need

- Nine [9] tiles numbered 1 - 9

Your Task

1. Place the nine tiles so that both arms of the cross add to the same number.



2. Find three [3] more ways to do it.

Challenge

What happens if you make crosses with the tiles numbered 1 - 5?

FRACTION MAGIC SQUARE

You Need

- Nine [9] tiles, marker and wiping cloth
  Side A numbered $^{1}/_{3}$, $^{2}/_{3}$, 1, $1^{1}/_{3}$, $1^{2}/_{3}$, 2, $2^{1}/_{3}$, $2^{2}/_{3}$, 3
  Side B numbered $^{1}/_{6}$, $^{5}/_{24}$, $^{1}/_{4}$, $^{7}/_{24}$, $^{1}/_{3}$, $^{3}/_{8}$, $^{5}/_{12}$, $^{11}/_{24}$, $^{1}/_{2}$

Your Task

1. Place Side A tiles on the grid so each row, column and long diagonal adds to the same number. This makes it a Magic Square.

2. Double these numbers and write them in the matching cell of the grid. What is the sum of each row, column and long diagonal now?

Challenge

Make a Magic Square using Side B numbers.

THE MUSHROOM HUNT

You Need

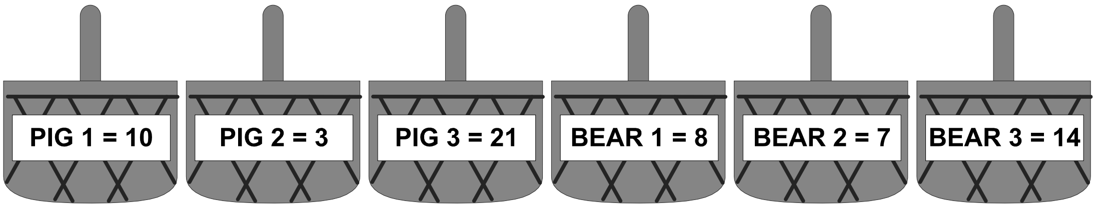
- Sixty-three [63] 'mushrooms' and six [6] 'baskets'

The Story

The three [3] pigs and the three [3] bears went mushroom hunting. At the end of their hunt they discovered:

- the total number of mushrooms they collected was 63.
- by choosing different combinations of baskets they could make every number of mushrooms from one up to sixty-three.

For example, *pretend* this is what each animal collected:



The total of these baskets is 63 AND they can combine baskets to make *some* of the numbers from 1 to 63, for example:

- PIG 1 + PIG 2 = 13
- PIG 1 + PIG 2 + PIG 3 = 34
- PIG 2 + BEAR 1 + BEAR 3 = 25

BUT can these baskets be used to make *every* number from 1 to 63?

If they can't, then the example is *not* what was in each basket.

Challenge

What number of mushrooms must have been in each of the six baskets?

CRISS-CROSS NUMBERS

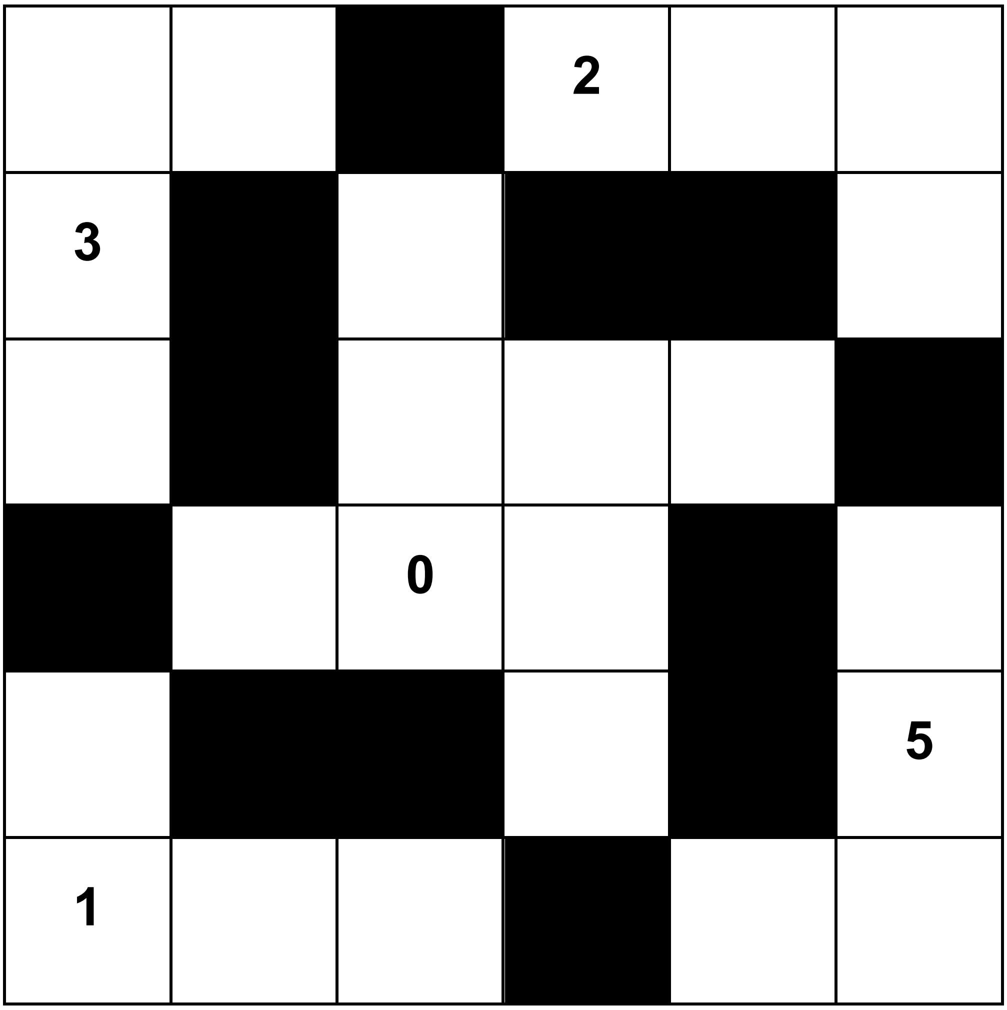
You Need

- Nineteen [19] counters numbered:
  1, 1, 2, 2, 3, 4, 4, 5, 5, 6, 6, 7, 7, 7, 8, 8, 8, 9, 9

Challenge

Make:

71	176	240	951	802	438
231	17	46	51	925	498



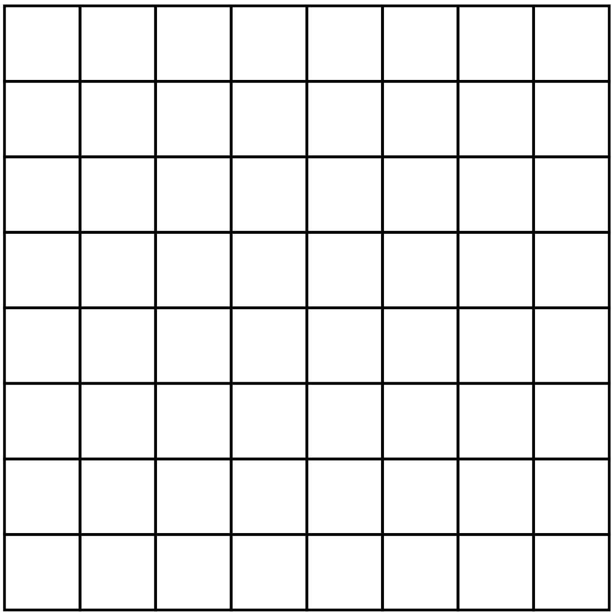
As you find the position of each number, record in your journal how you figured it out.

SCALE DRAWING

You Need

- One [1] board, marker and wiping cloth

Pretend the big board has shrunk to this size.



Your Task

1. Draw the picture as it would be on this smaller board.

2. Now draw an object on the small board that you might find near the house.
3. Pretend the small board has expanded again to the size of the big board. Draw your object as it would be on the larger board.

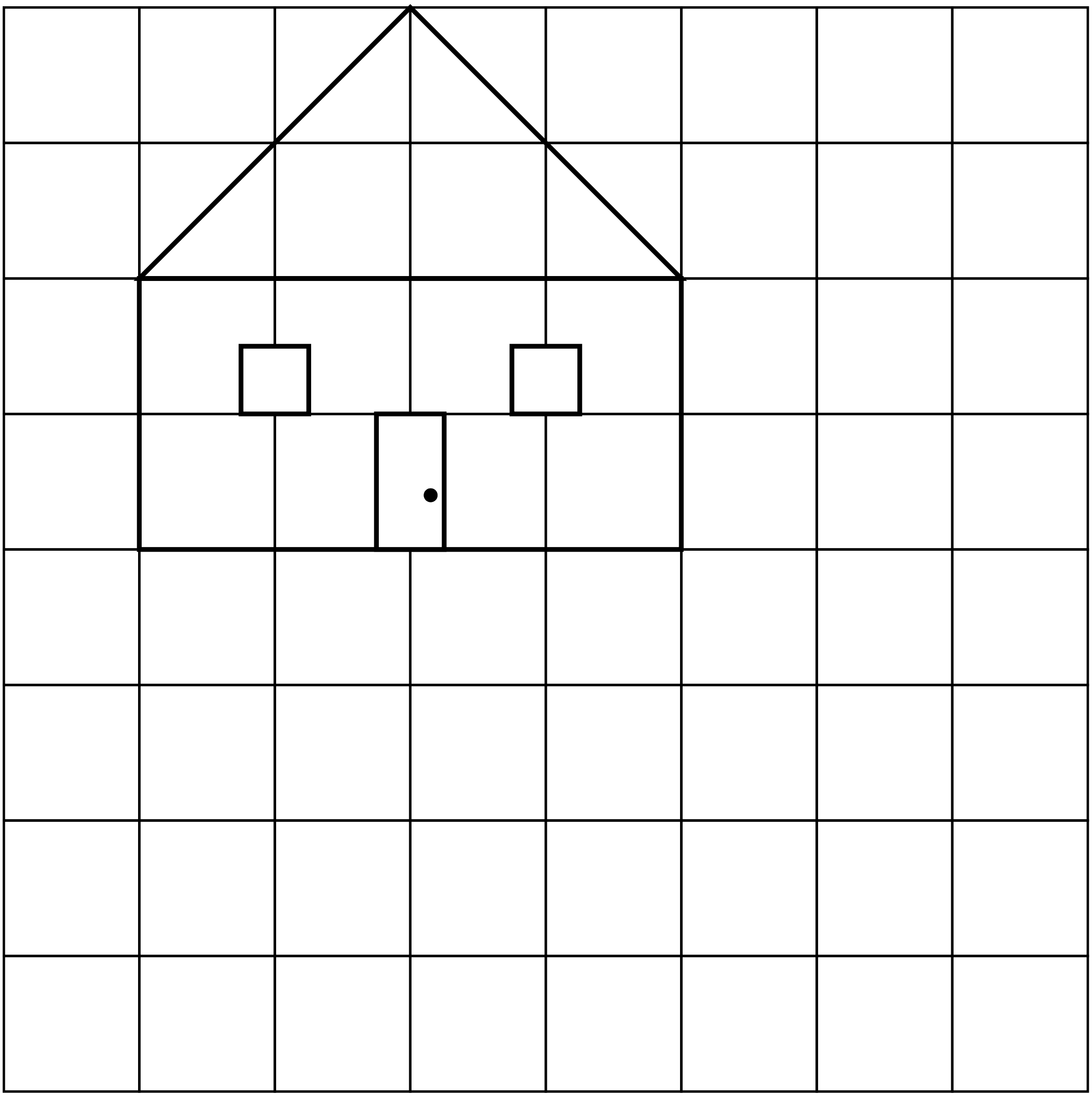
Challenge

Pretend area is measured with the size of the squares on the smaller board.

Count squares to find the area of the smaller house.

Predict and check the area of the bigger house.

Scale Drawing Board



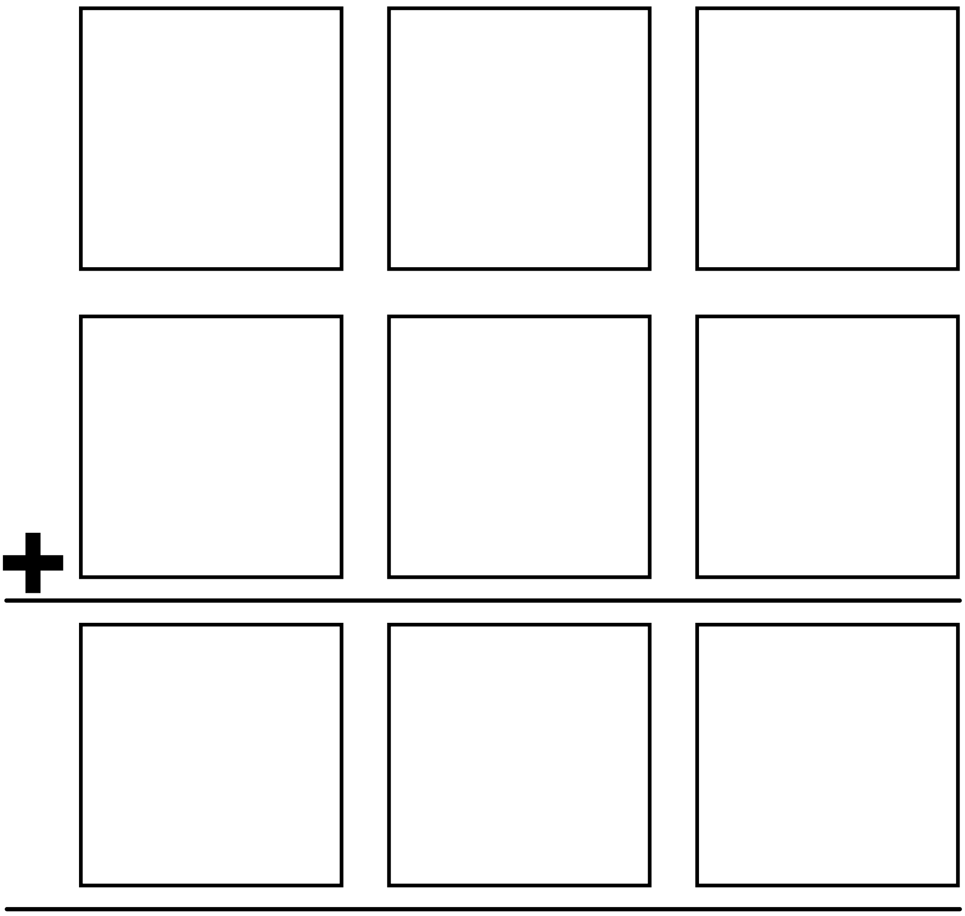
NUMBER TILES

You Need

- Nine [9] tiles numbered 1 - 9

Your Task

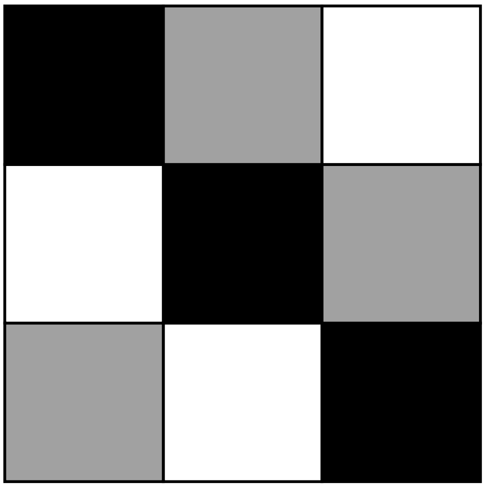
1. Place the nine tiles to make a correct addition sum.
2. Find five [5] more ways to do it.



LATIN SQUARES

You Need

- Twenty-five [25] coloured cubes
  - five [5] each of five different colours



In a Latin Square each row column and diagonal has one [1] cube of each colour.

A 3 x 3 Latin Square is made of nine [9] cubes in three [3] colours.

Your Task

1. Make a 3 x 3 Latin Square.

   Record in your journal.
2. How many solutions are there?

   How do you know when you have found them all?
3. Make a 4 x 4 Latin Square. Record.
4. Make a 5 x 5 Latin Square. Record.

ERIC THE SHEEP

You Need

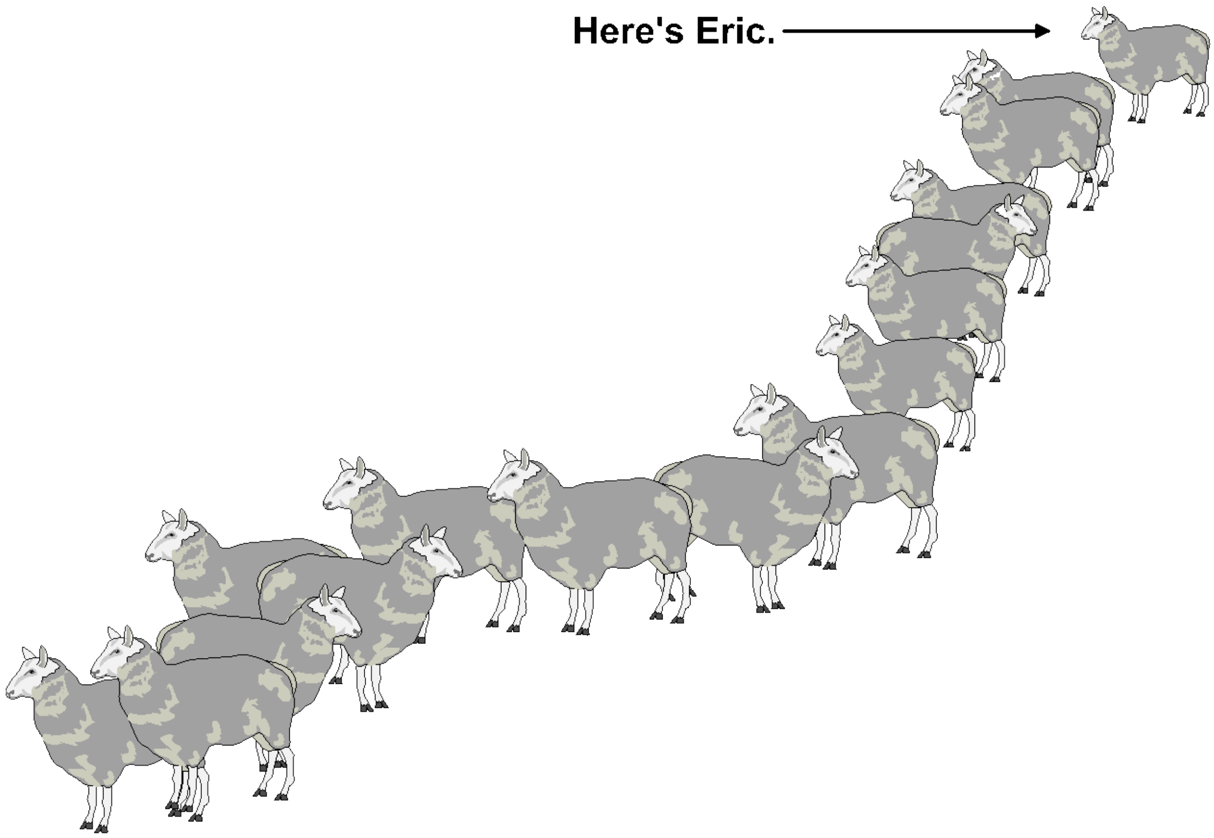
- Fifty [50] counters to be sheep and one [1] 'Eric'

The Story

Eric is at the end of a long line of sheep that are waiting to be shorn. It is hot in the sun and Eric doesn't want to wait his turn. So, every time the shearer turns her back to shear the front sheep, Eric sneaks past two sheep in the line.

Challenge

If there are fifty [50] sheep *in front* of Eric, how many will be shorn before Eric reaches the front of the line?



DUELLING DICE

You Need

- Four [4] dice with special numbers:
  Red: 0, 1, 7, 8, 8, 9 Green: 1, 2, 3, 9, 10, 11
  Blue: 5, 5, 6, 6, 7, 7 Black: 3, 4, 4, 5, 11, 12

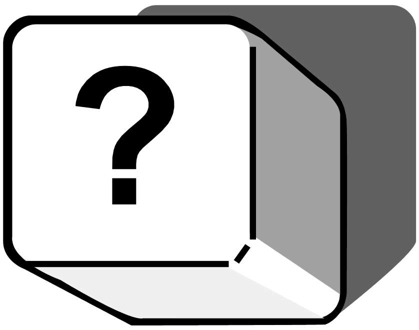
This is a game for two players.

Rules

- Each player chooses one dice to be theirs.
- Both players roll their dice.
- The player who rolls the higher number wins a point. (Draws are ignored.)
- The winner is the first player with seven [7] points.

Challenge

Which dice is the best to choose as yours?



RED & BLACK CARD GAME

You Need

- One [1] pack of playing cards

This is a game for two players.

Rules

- Shuffle the cards and deal half to each player.
  Players keep their cards face down.
- Take turns to place the top card face up between the players.
- Start from zero [0] and say the running total as you play.
  Black cards are positive (add to the score).
  Red cards are negative (subtract from the score).
- Player A wins if the score reaches $^{+}15$ [positive 15].
  Player B wins if the score reaches $^{-}15$ [negative 15].
- Ace = 1 and Royal cards (J, Q, K) = 10.

Your Task

1. Play several games.
   Keep a record of the number of turns for each player in each game.
2. Predict the number of turns you expect in a Target 15 game?
   Explain in your journal.

Challenge

What happens if the target is changed?

A company wants to sell this game. They want to advertise that it is a great game because it always lasts about five [5] turns each.

What number should be chosen as the target?

TAKE A CHANCE

You Need

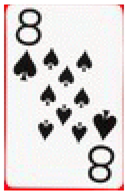
- One [1] pack of playing cards and about forty [40] counters

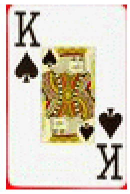
---

This is a game for two players.

Rules

- Start with ten [10] counters each. The rest are in the bank.
- Shuffle the cards and turn the top two [2] face up with a space between like this:





- Each player has to guess the chance that the next card will be <u>between</u> these end cards. In the example only 9, 10, J, Q will work.

  Players risk 0, 1, 2 or 3 counters on the chance that the next card is between.
- Turn over the next card to check.

  If correct, a player takes their counters back plus the same number from the bank. If wrong, a player loses the counters they risked.
- Collect all the cards, shuffle and play again.
- The game ends when a player collects twenty [20] counters and wins OR a player loses all their counters.

Challenge

Work out a strategy to decide how many counters to risk each time.

Just for fun you might like to find the total value of the pack if Ace = 1, J = 11, Q = 12, K = 13. Can you check your answer another way?

FLIGHT DEPARTURES

You Need

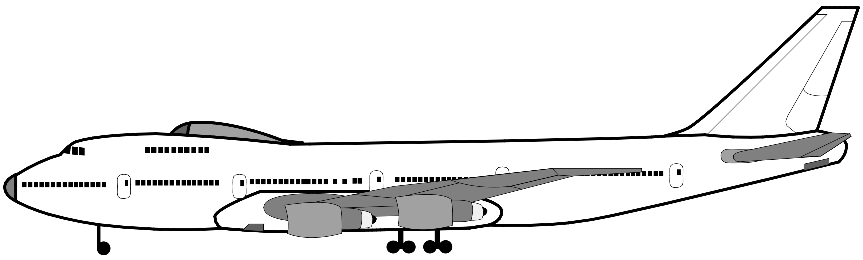
- Four [4] aeroplanes

The Story

The computers are down at Melbourne airport. No one can see the departure timetable. Oh dear!
"Don't worry," said Patricia Pilot. "I remember the rules."

Rules

- Plane 3 is not last.
- Plane 2 leaves before Plane 4.
- Plane 1 does not leave first.
- One of the planes leaves between Plane 3 and Plane 4.
- Plane 1 leaves before Plane 4.



Your Task

1. Work out the order in which the planes took off.

Challenge

How many solutions are there? How do you know?

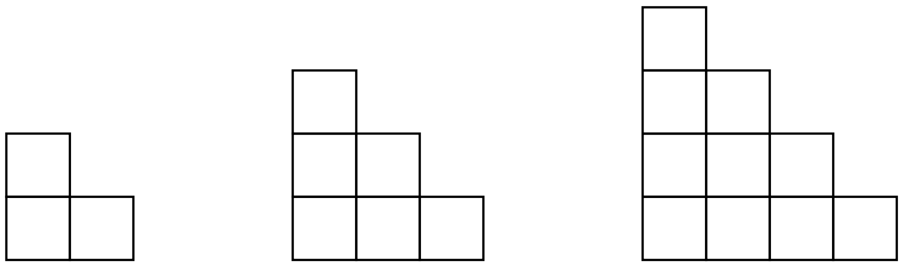
STAIRCASE

You Need

- Thirty [30] cubes

Your Task

1. Staircases are made from cubes like this:



The picture shows Sizes 2, 3 and 4.

2. Copy this table into your journal.

   Enter the data for Sizes 2, 3, 4 and 5.

Number of Steps	1	2	3	4	5	10	100
Number of Cubes	1						

Challenge

1. Work out the number of cubes in a 10 step staircase.

   Can you check it another way?

   (Hint: Build two Size 5 staircases and make a rectangle.)

   Enter the data for Size 10 into the table.

   Write a short report with drawings.

2. Work out the number of cubes in a 100 step staircase.

   Can you check it another way?

   Enter the data for Size 100 into the table and add add to your report.

WHICH FLOOR?

You Need

- One [1] block to use as an elevator

ROOFTOP

10TH	FLOOR
9TH	FLOOR
8TH	FLOOR
7TH	FLOOR
6TH	FLOOR
5TH	FLOOR
4TH	FLOOR
3RD	FLOOR
2ND	FLOOR
1ST	FLOOR
GROUND	FLOOR

The Story

Bronwyn entered the elevator.

She went down five [5] floors, up six [6] floors and down seven [7] floors, then finally got out on the second floor.

Your Task

Which floor did she enter the elevator?

Challenge

What happens if she didn't get out on the second floor?

On which other floors might she have entered the elevator?

HAVE A HEXAGON

You Need

- One [1] playing board and two [2] dice
- Three [3] sets of six [6] counters in different colours

Challenge

Discover which hexagon is likely to be covered with counters first. You play the game to collect data. Before you start each game, both players *guess* which hexagon will be covered first.

Rules

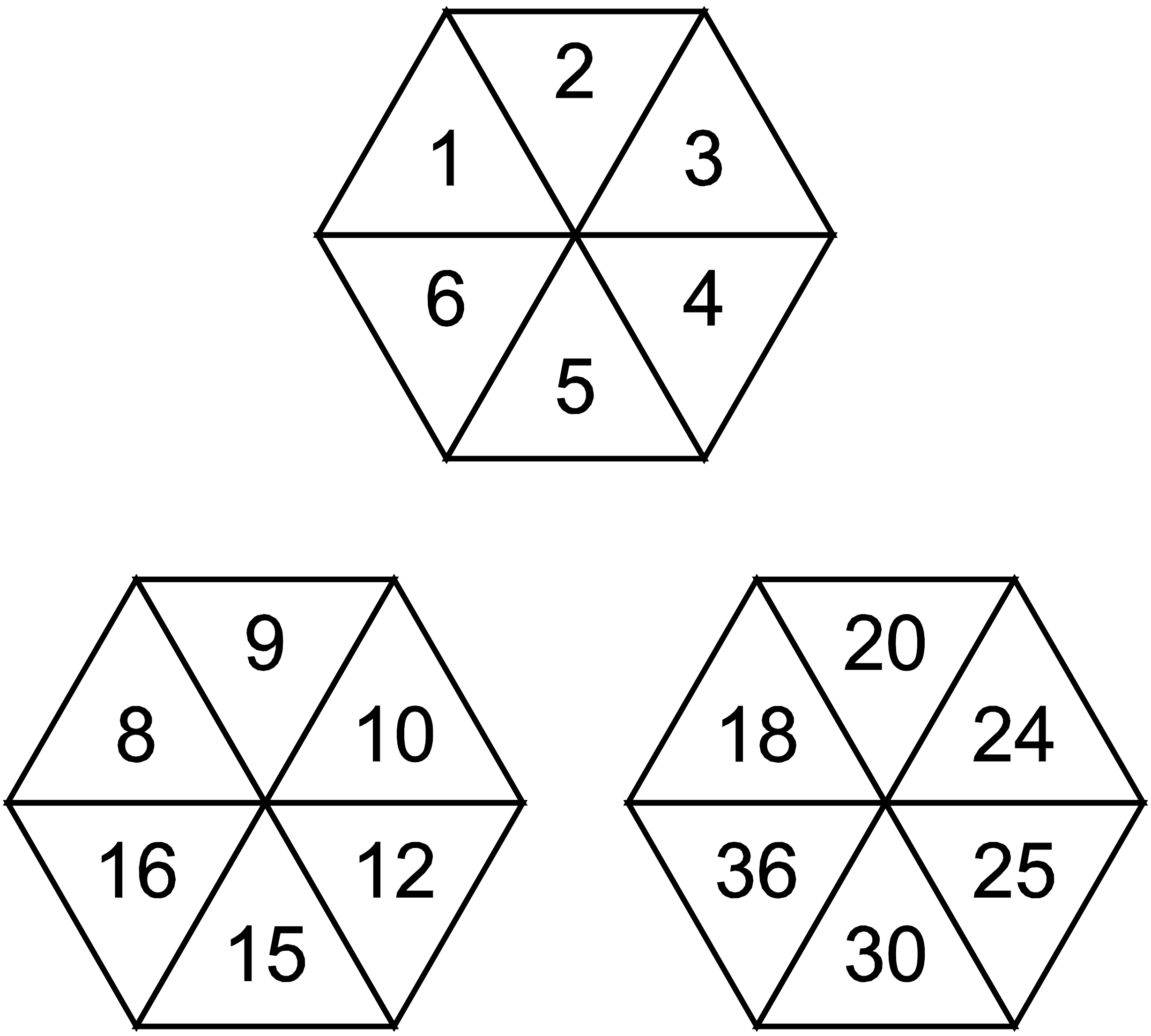
- Choose which hexagon you want to be which colour.
  eg: Left = red, Centre = blue, Right = yellow
- Take turns to roll the dice and multiply the numbers.
- Place the correct colour on the hexagon that has the answer.
- Only one counter can go in each triangle.
- Play until one hexagon is covered.

Your Task

1. Play several games and record:
   - which hexagons were guessed.
   - which hexagons were covered first.
   - any other information that might help you discover which hexagon is likely to be covered first.

2. Write a short report explaining which hexagon and why.

Have A Hexagon



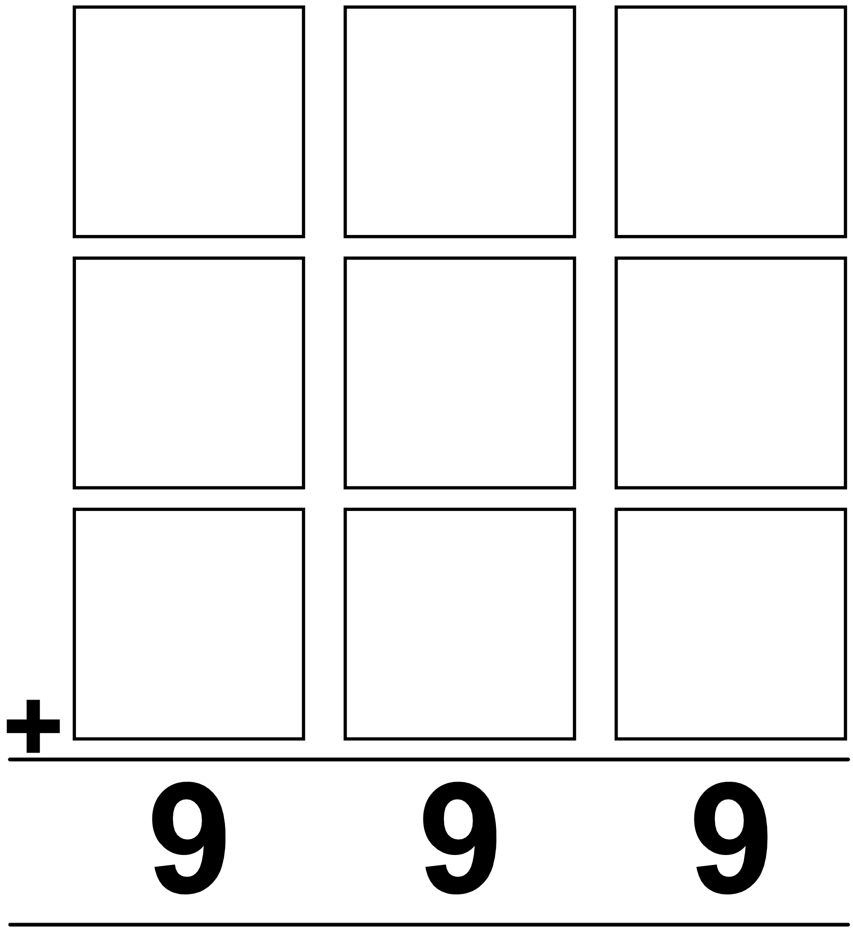
FAY'S NINES

You Need

- Nine [9] tiles numbered 1 - 9

Your Task

1. Place the nine tiles so the total is 999 [nine hundred and ninety-nine].
2. Find five [5] more ways to do it.



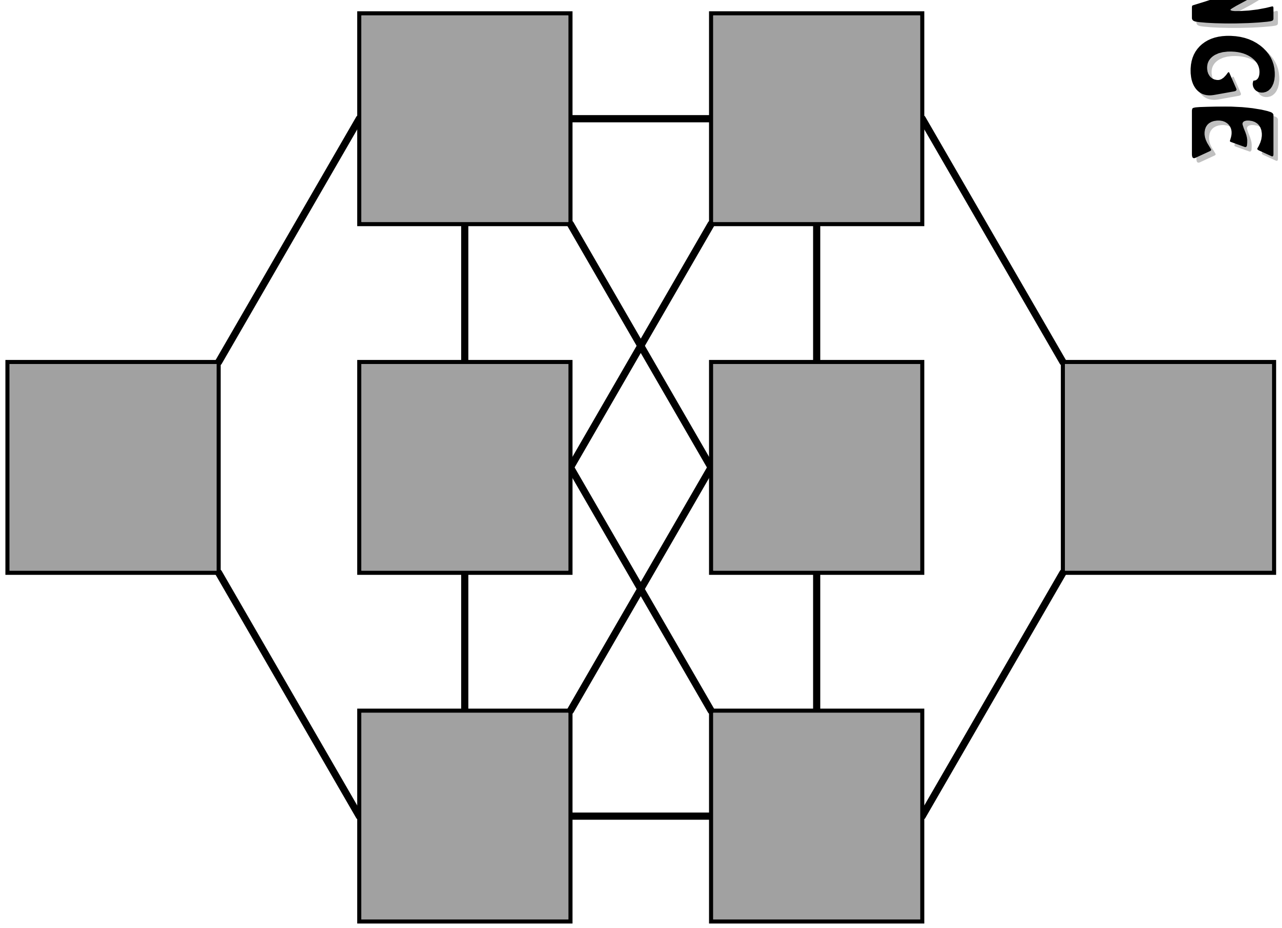
CHALLENGE

You Need

- Wooden cubes numbered 1 to 8

Your Task

1. Place the cubes on the board so that no lines connect numbers with a difference of 1.



Example: 6 and 5 have a difference of 1. They *must not* be connected.

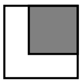
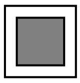
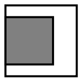
TWO SQUARES

You Need

- Three [3] squares: red (4cm), yellow (5cm) & blue (6cm)

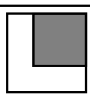
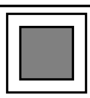
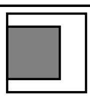
Your Task

1. The yellow square can be arranged on top of the blue in these ways:

 OR  OR 

2. In each case the area of the uncovered part is the difference between the two areas. One way to calculate this is: $6^2 - 5^2 = 6x6 - 5x5 = 36 - 25 = 9$
   Find three other ways to calculate the difference between these areas.
   (Hint: Use the different diagrams and divide the uncovered area into parts.)
3. Repeat Question 2 for red on blue and red on yellow and record.

4. Copy this table into your book. In each case calculate, in three ways, the difference between the areas of the two squares.

	7cm and 4cm	7cm and 5cm	8cm and 6cm	8cm and 7cm	9cm and 3cm
					
					
					

Challenge

Calculate $87^2 - 33^2$.

If I tell you the size of any two squares, can you calculate the difference between their areas?

Can you do it in three different ways? Which is the simplest method?

SEE-SAW

You Need

- One [1] of each of these objects and your own ruler.
  bolt, washer, rock, pencil, pop stick, coloured cube, wooden block

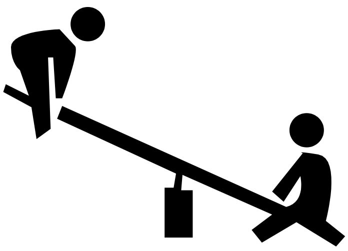
Your Task

1. Use the ruler and the wooden block to make a see-saw which is balanced.
2. Find out how to balance the bolt and the pop stick.
3. Now try to balance the bolt with each of the other objects.
4. Use the rock on one side.
   Try to balance all the other objects with the rock.

Challenge

Write a paragraph to explain what you have found out.

Use pictures to help you explain.



13 AWAY

You Need

- Twenty-one [21] counters

This is a game for two players.

Rules

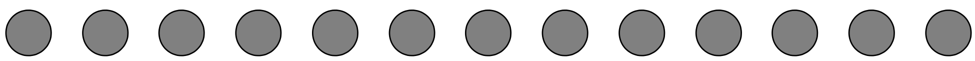
- Make a collection of thirteen [13] counters.
- Take turns to remove counters from the collection.
  You may remove 1 or 2 or 3 counters each turn.
- The loser is the person who takes the last counter.

Your Task

1. Play a few games.
2. Try to work out a strategy to always win.

Challenge

What happens if the pile is 21 counters and you may remove 1 or 2 or 3 or 4 each turn?



BACK TO BACK BUILDING

You Need

- About twelve [12] large linking cubes

Rules

- Person A and Person B sit back to back.
- Each person has the same number of cubes, say 4 or 5.
- Person A makes an object with cubes but Person B is *not allowed to look.*

Your Task

1. Person A has to *tell*, not show, Person B how to make a copy of the object.
   Person B can only say 'Yes' or 'No' or 'Please repeat'.
2. When you both think the copy is correct, you may compare your objects.
3. List the language that made the copy easier to build.
4. List the language that made the copy harder to build.

Challenge

Swap roles and repeat the task a few times. Your challenge is to find the best language to help you make an accurate copy.

DOUBLE STAIRCASE

You Need

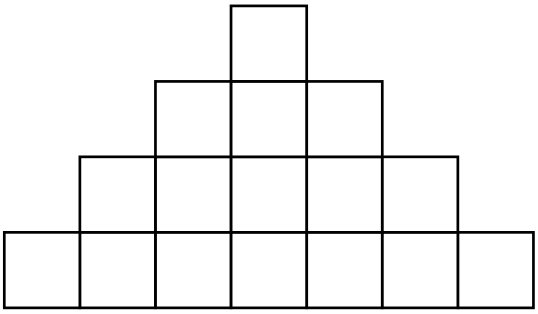
- Eighteen [18] cubes

Your Task

1. Make this staircase with your cubes.

   Imagine a staircase in this design is ten [10] steps high.

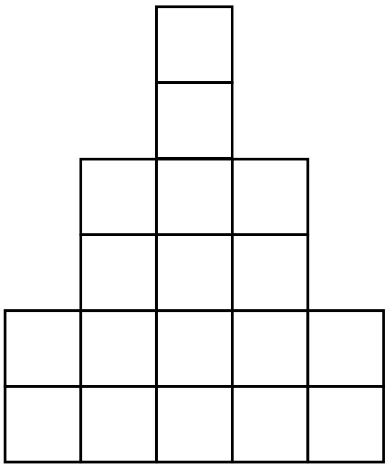
   Work out the number of cubes needed to build it.



2. Make this staircase with your cubes.

   Imagine a staircase in this design is ten [10] steps high.

   Work out the number of cubes needed to build it.



Challenge

Choose one [1] of the staircases.

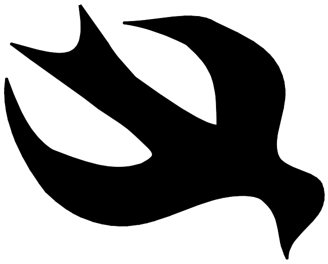
Work out the number of cubes to build it 100 steps high.

FOUR & TWENTY BLACKBIRDS

You Need

- At least twenty-four [24] 'blackbirds' and one [1] Royal Garden

The Story



When the pie was opened and the birds began to sing, the Queen decided she loved their song. So the King had some feeding platforms built in the Royal Garden. Each morning the Queen went to the garden to listen to the singing and each morning she counted 24 blackbirds. She also noticed there were always nine [9] along each line.

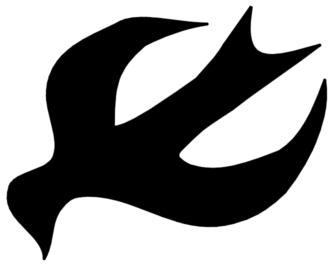
Your Task

1. One morning the birds were arranged like this:

7	2	0
1		5
1	4	4

Find five more ways 24 birds could have been arranged in lines of 9.

Challenge

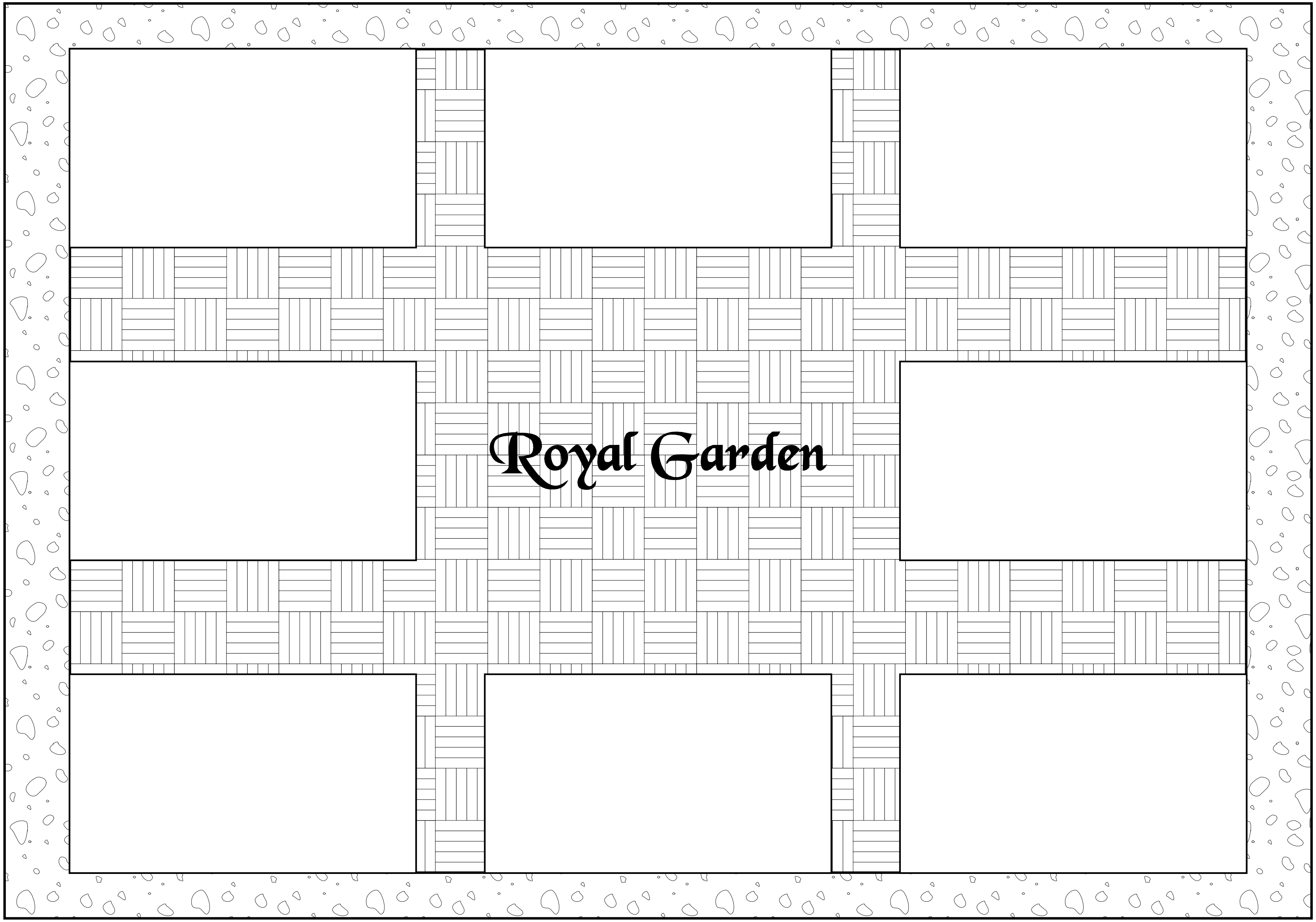


- How many ways are there altogether?
- How do you know when you have found them all?

After a few weeks the Queen only counted the number along each line. There were always nine, so she just *assumed* there were twenty-four blackbirds altogether. But there weren't!

- What other numbers of blackbirds can be arranged in lines of nine [9]?

Four & Twenty Blackbirds



FRIED RICE

You Need

- Two [2] containers: 50g and 30g capacity
- One [1] container of rice and one scoop

The Story

Mr. Wang asked three [3] guests for dinner. He's making his special rice dish. It needs ten [10] grams of rice for each person, so he has to measure forty [40] grams. But...

Your Task

1. Mr. Wang only has the packet of rice and *two* containers - one holds 50 grams and one holds 30. How can he measure out 40 grams?
2. How many solutions are there? How do you know when you have found them all?
3. Just before he started preparing, all of Mr. Wang's guests rang up and apologised because they couldn't come. He was the only one left for dinner. He decided to measure 10 grams for himself anyway. How did he do it?

Challenge

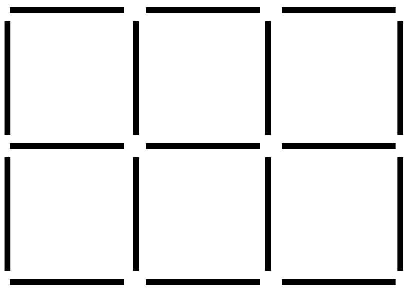
Find all the other amounts of rice Mr. Wang could *exactly* measure using only the 30g and 50g containers.

SIX SQUARE PUZZLE

You Need

- Seventeen [17] rods

Every puzzle starts with this arrangement.



Your Task

1. Remove five [5] rods and leave

...four [4] squares the same size.

2. Remove four [4] rods and leave

...four [4] squares the same size.

3. Remove three [3] rods and leave

...four [4] squares the same size.

4. Remove five rods and leave three squares.
5. Remove four rods and leave three squares.
6. Remove seven rods and leave a square within a square.

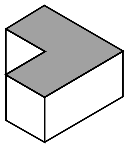
TRICUBES

You Need

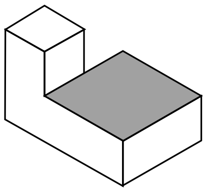
- Four [4] tricubes and a recording sheet

Your Task

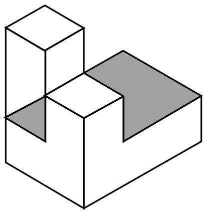
1. Place the purple tricube like this.
   Copy the diagram onto the recording sheet.



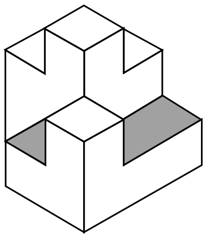
2. Add a red tricube like this.
   Copy the diagram onto the recording sheet.

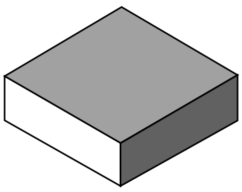


3. Now add a yellow tricube.
   Copy the diagram onto the recording sheet.



4. Lastly add a blue tricube.
   Copy the diagram onto the recording sheet.





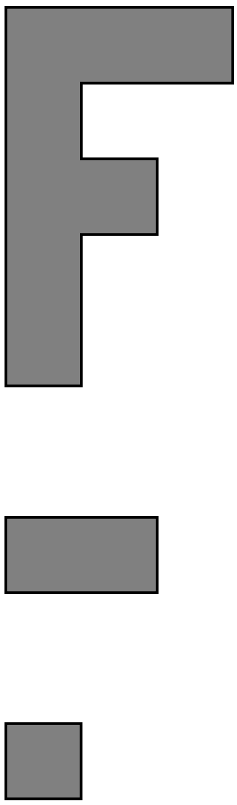
5. Colour your pictures in any way to help you see them as a solid 3D object. For example in this diagram the shading shows the surfaces.

SYMMETRIC SHAPES

You Need

- Two [2] sets of shapes
  ... each set is an F, a rectangle and a square
- Recording sheet

Your Task



1. Use the F and the rectangle to make a shape with line symmetry.
   Now add the square in two different ways so the shape still has line symmetry.
   Draw diagrams to show how to do it.
2. There are three more ways to combine the F, the rectangle and the square to make shapes with line symmetry.
   Each way uses all three shapes.
   Find the three ways and draw diagrams to show how to do each way.

Note: Shapes must join edge to edge with corners touching.

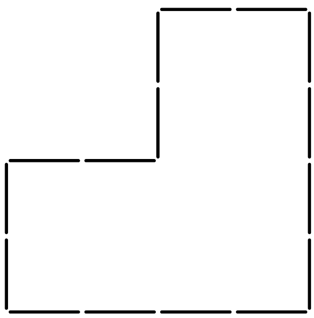
FARMYARD

You Need

- Sixteen [16] red sticks, four [4] blue sticks, eight [8] yellow sticks all the same length

The Story

Two farmers have land in this shape.



Make the diagram with red sticks

Your Task

1. Farmer A wants to divide his land equally between his three sons. Add four blue sticks to make three sections of identical size and shape.

2. Farmer B wants to divide her land equally between her four daughters. Starting with the land shape above, add eight yellow sticks to make four sections of identical size and shape.

BUTTON SORT

You Need

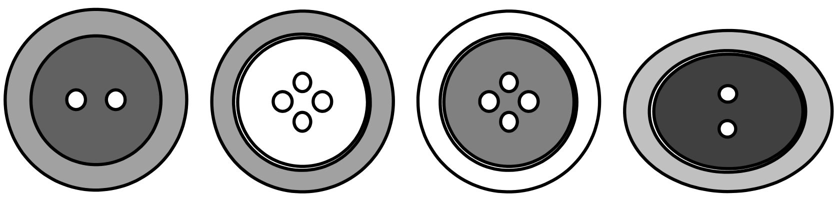
- One [1] container or bag of buttons
- Two [2] playing boards

Your Task

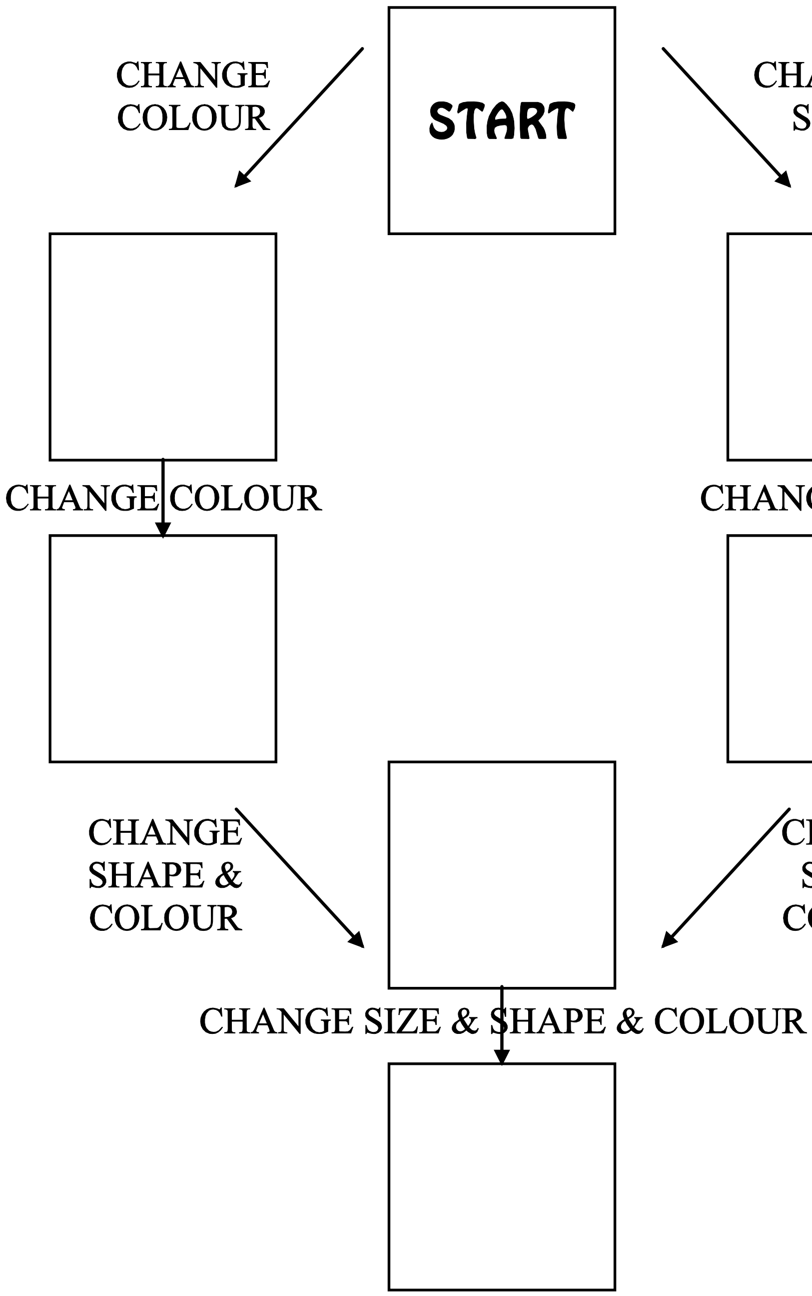
1. Each person closes their eyes and selects five [5] buttons.
2. Working together, try to make a button trail on the *Which Way?* board that obeys the rules.
   - If you cannot do it with your ten [10] buttons, look for an extra button in the container.
   - If that doesn't work, draw a picture of the button you need on a small piece of paper.

Challenge

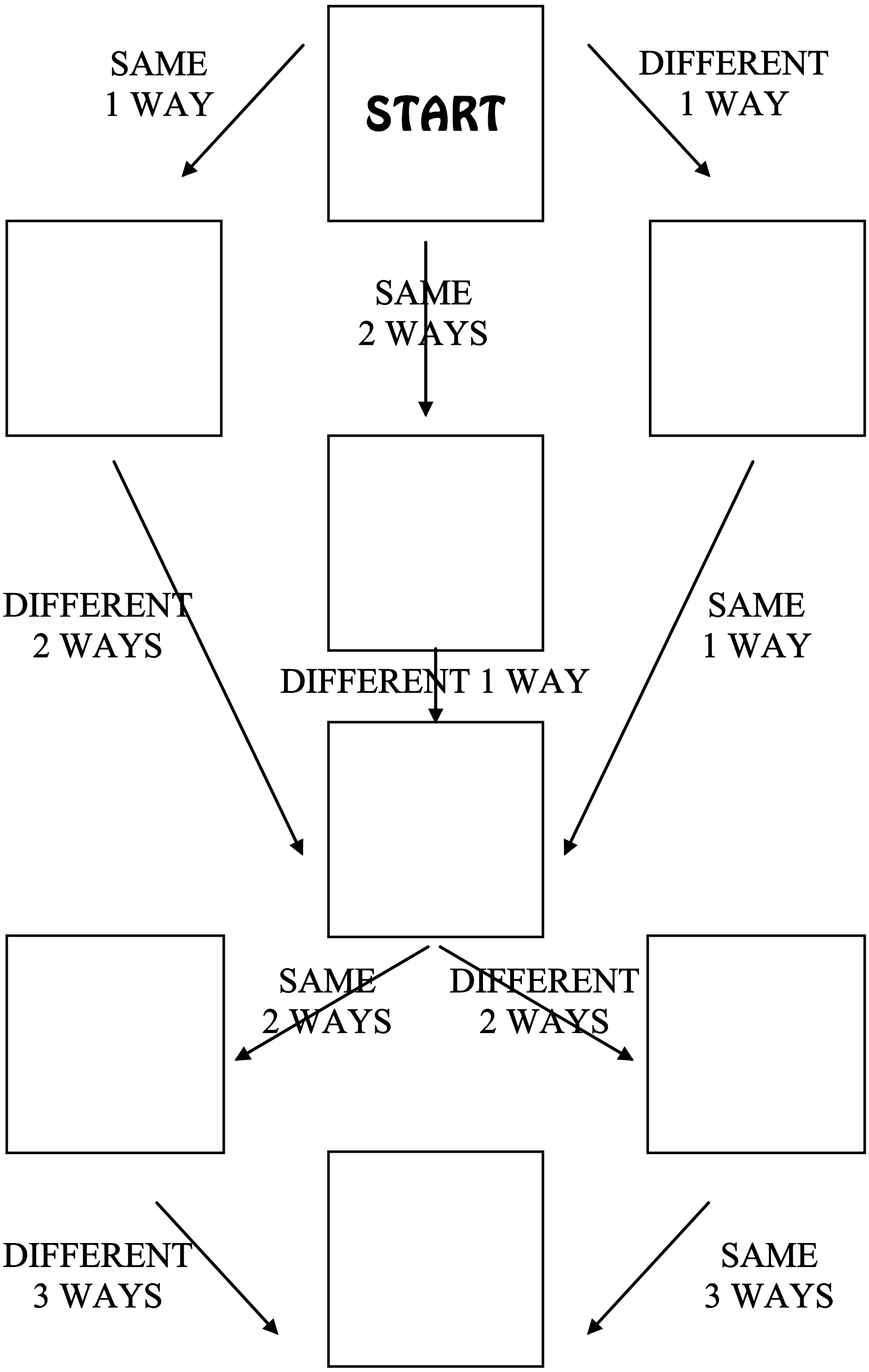
Repeat the task for the *Same or Different* board.



Button Sort ... Which Way?



Button Sort ... Same or Different

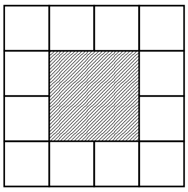


TRICUBE CONSTRUCTIONS A

You Need

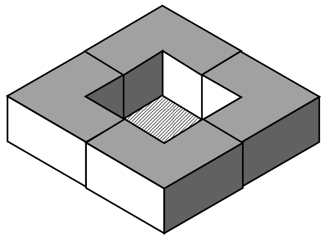
- Four [4] tricubes and a recording sheet

This is a *looking down view* of a building made with *all four* tricubes.



 = empty space

An *isometric view* of the building would look like this:

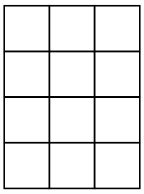


Your Task

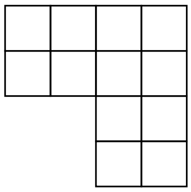
1. Make each building below from four tricubes.

   Draw its isometric view on the recording sheet.

a)

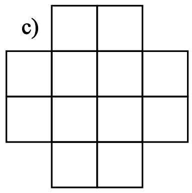


b)



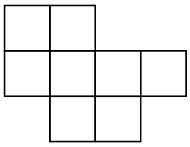
(2 ways for this one)

c)



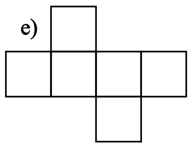
(2 layers high)

d)



(2 layers high)

e)



Challenge

Make your own tricube building.

Draw its looking down view and its isometric view.

Show your partner the looking down view and ask them to make your building.

Does it turn out like your isometric view?

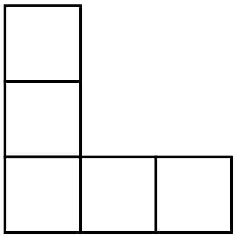
WHICH VIEW?

You Need

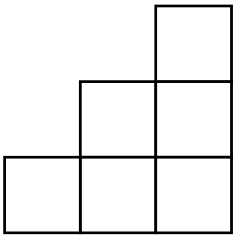
- Seventeen [17] cubes

Your Task

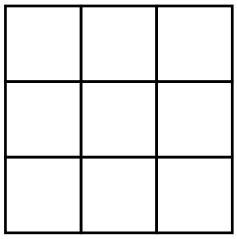
1. These pictures are different ways of looking at the same object.



FRONT VIEW



SIDE VIEW

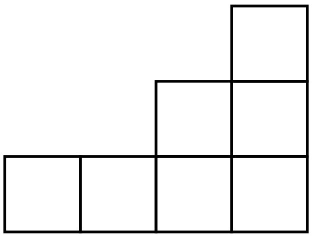


TOP VIEW

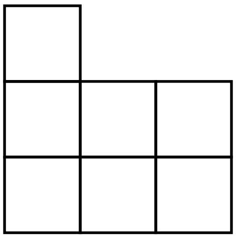
Use twelve [12] cubes to build an object which has these views.

Are there other ways to make a twelve cube object with these views?

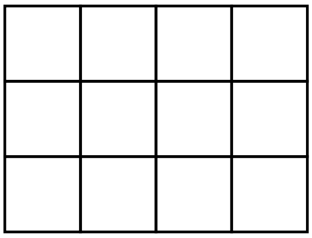
2. Now use all seventeen cubes to build an object with these views.



FRONT VIEW



SIDE VIEW



TOP VIEW

Challenge

Make your own object and draw its front, side and top views.

- Give your drawing to your partner and challenge them to build your object from its views.
- Is there more than one answer for your views?

TANGRAM TEASERS

You Need

- Seven [7] tangram pieces

Your Task

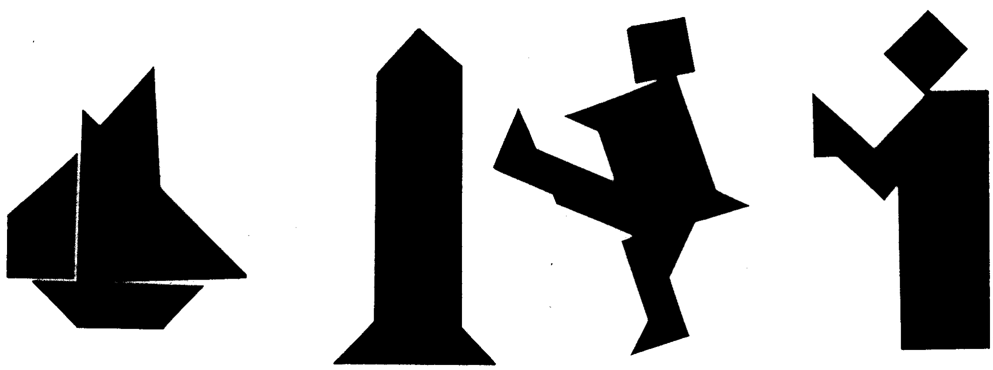
1. Use all seven pieces to make:
   - a square
   - a triangle
   - a rectangle

Challenge

Use all seven pieces to make each of the shapes below.

Rules

- Pieces must always be next to each other
  - not on top.
- Each time you make a shape ask someone to check, then carefully trace the pieces to record how they fit.



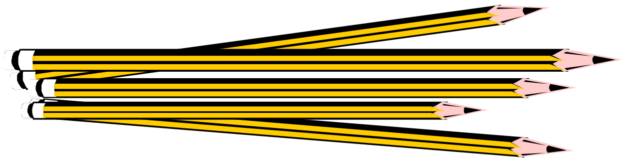
A DOLLAR TO SPEND

You Need

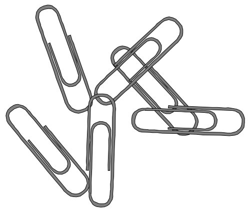
- Ten [10] pencils
- Twenty [20] hairpins
- One hundred [100] paper clips

Your Task

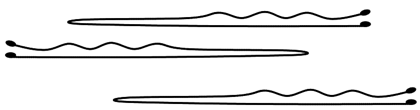
Price List



Pencils: 10¢ each



Paper Clips: 2 for 1¢



Hairpins: 5¢ each

1. Mix up all the items and take a handful. How much would your handful cost?
2. How much would it cost to buy all the items listed above?
3. Josephine bought one hundred items from the Price List. She spent $1·00. What did she buy?

Challenge

- How many solutions are there?
- How do you know when you have found them all?

TIME SWING

You Need

- Three [3] different size steel nuts and some string
- Your own timer or watch that shows seconds

The Story

Joshua loves the way old clocks use pendulums to keep accurate time. He noticed that different clocks have pendulums of different sizes and shapes. He decided to find out how the differences affect the timing.

Your Task

1. Make a pendulum of any length using the string and nuts. Design an experiment to measure the time it takes to swing once.
   Measure and record the length of the string.
2. Make a pendulum that takes twice as long to swing as your first one did. Measure and record its length.
3. Make a pendulum that consistently measures one swing per second.
4. Try to make a pendulum that swings at the same rate as your heart beat.

Challenge

In your journal, try to explain how the design of a pendulum affects the time for one swing.

THIRTY-ONE

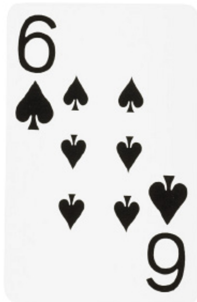
You Need

- Twenty-four [24] playing cards
  (1 to 6 from each suit)

This is a game for two players.

Rules

Arrange the cards on the table in four suits like this:



1	2	3	4	5	6
1	2	3	4	5	6
1	2	3	4	5	6
1	2	3	4	5	6

- Players take turns to turn one card face down and say the running total.
  Example: if Player A turns over 5 and Player B follows by turning over 6, A says 'five' and B says 'eleven'.
- Continue playing until one player makes the total 31.
- If you go over 31 you lose.

Challenge

Try to find a winning strategy.

FIRST DOWN THE MOUNTAIN

You Need

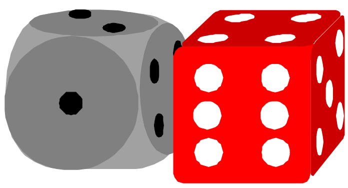
- Two [2] dice, eleven [11] 'people'
- Playing board

Rules

- Place a climber on each of the eleven numbers.
- Take turns to roll the two dice.
- Add the numbers and shift the climber on that square down one space.

  Example: Rolling 3 + 6 means the climber that started on 9 moves down one step.

Your Task



1. Predict which climber you think will win, then race to check.
2. Record the number of the climber that wins.
3. Play the game ten [10] times and record the winner.

Challenge

Prepare a report to explain whether you think this game is fair. Include more evidence to support your explanation.

FIRST DOWN THE MOUNTAIN

					7					
				6		8				
			5				9			
		4						10		
	3								11	
2										12
WIN	WIN	WIN	WIN	WIN	WIN	WIN	WIN	WIN	WIN	WIN

RICE, RICE, RICE

You Need

- One [1] full container of rice
- One [1] identical empty container
- One spoon and one cup

The Story

At the end of the term Mrs. Koetsier had so many extra jobs to do that she thought of a way to keep her class busy. She put 500 grams of rice into a container and asked her students to count the grains. Her students were able to *estimate* the number of grains in just a few minutes.

Challenge

Without opening the container, your challenge is to find at least two ways the students might have estimated the number of grains.

Test your two ways and prepare a report comparing your answers.

Note

- For this task you may use anything in your classroom that will help, eg: pan scales or a calculator or ... (but check with your teacher first).

DOCTOR DART

You Need

- Nine [9] blocks ... three [3] with 8, two [2] each with 9, 10 & 11

9	11	8
11	8	10
8	10	9

The Story

Doctor Dart is on an adventure. She must get through the anti-gravity door, but the Evil Professor has locked the door with a key pad like this. She can only get through the door if she works out his puzzle.

Rules

- She may only press a number if it is on top of a column.
- When she presses a top number it disappears and the one below becomes top. (Remove the block to show this happening.)
- She may only press three [3] numbers.
- She gets a total score by adding three tries like this:

  The first try scores the number pressed.

  The second try scores twice the number pressed.

  The third try scores three times the number pressed.

Your Task

1. Make the keypad by standing the blocks on top of each other.
2. If she pressed numbers down the right hand column, what would be her total?
3. The total to open the door is 60 points. How can she get it?

Challenge

What is the highest total she can get with three presses? ...lowest?

Find all the possible totals.

What are the two totals between the highest and lowest that can't happen?

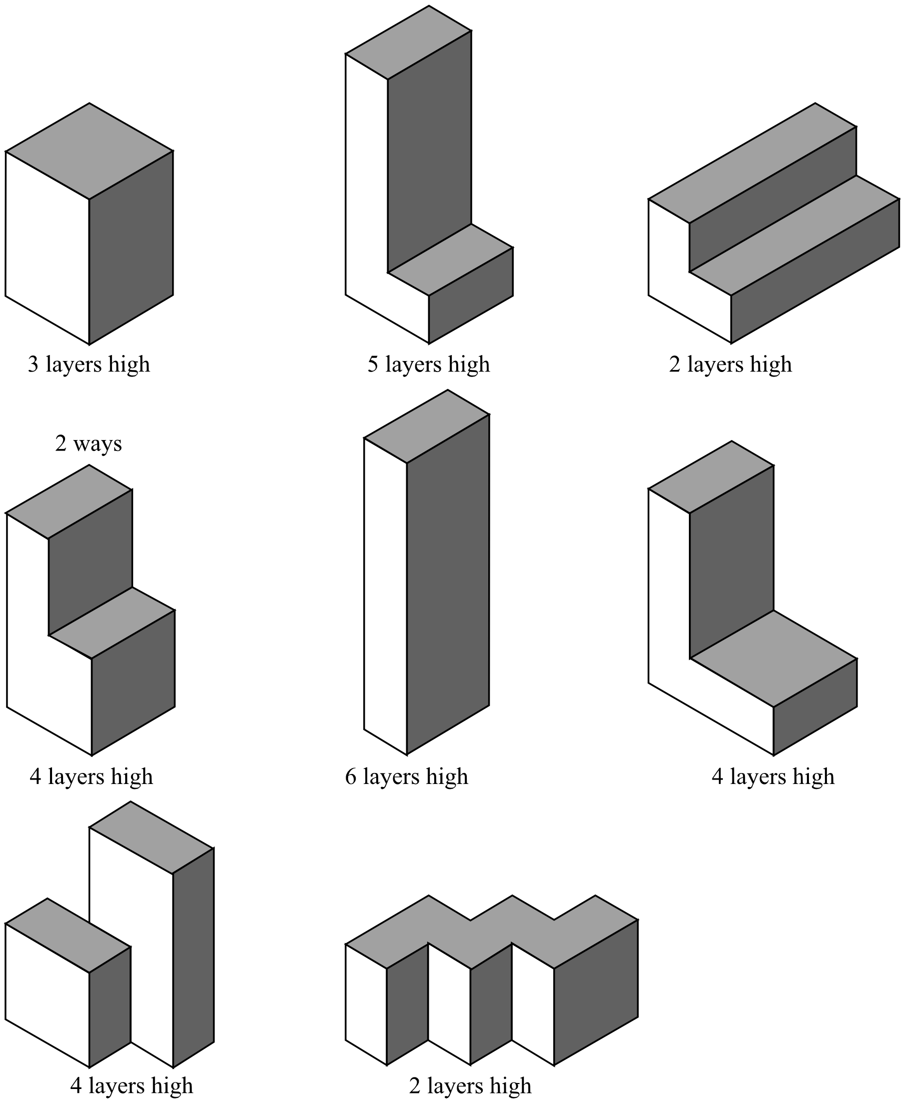
TRICUBE CONSTRUCTIONS B

You Need

- Four [4] tricubes, one [1] extra card and a recording sheet

Your Task

1. Make each 'building' using all four tricubes.



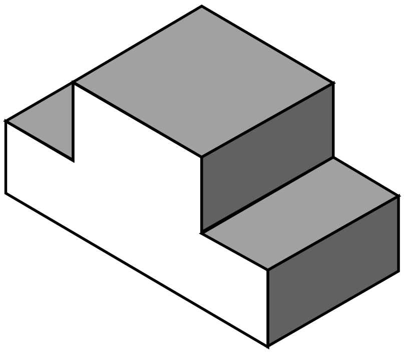
Challenge

Try the ones on the extra card.

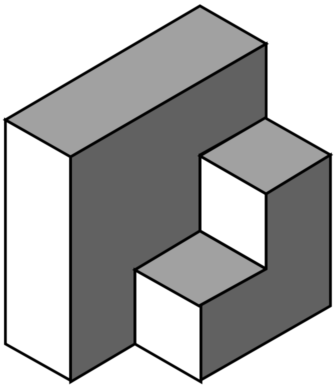
Make some buildings of your own. Draw them on the recording sheet.

Challenge your partner to make your buildings.

Tricube Constructions B

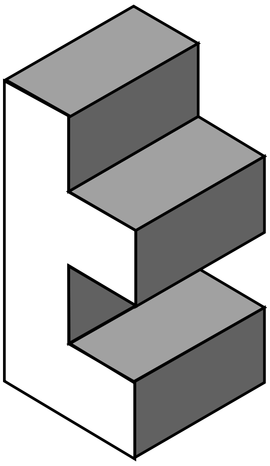


2 layers high

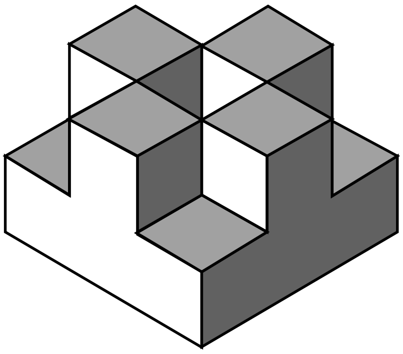


3 layers high

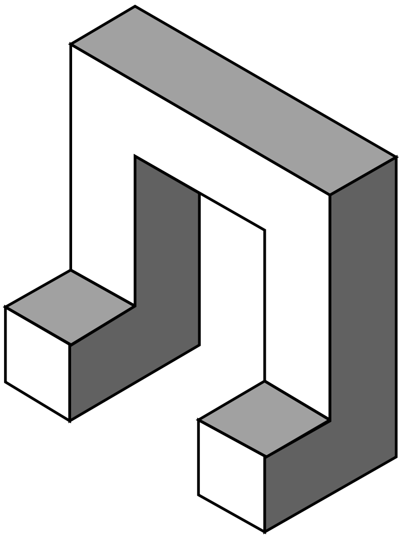
2 ways



4 layers high



2 layers high



4 layers high

MAGIC SQUARES

You Need

- Sixteen [16] tiles numbered 1 to 16
- One [1] 3 x 3 grid and one [1] 4 x 4 grid
- Felt pen and wiping cloth

Your Task

1. Place the tiles on Board A so that each row, column and long diagonal adds to the same answer.
   - This is called a Magic Square.
   - Record it in your journal.
2. Lift off each tile one at a time and write double its number in the same position. Add each row, column and long diagonal. Is it still a Magic Square?
3. Wipe the numbers off and make the Magic Square again. This time lift off each tile and add five [5] to each number. Is it still a magic square?
4. Try Questions 1 - 3 again using the 4x4 board.

Challenge

The total for each row, column and long diagonal in a 3x3 Magic Square is 45. Find the Magic Square.
Can you check your answer another way?

Magic Squares A

Magic Squares B

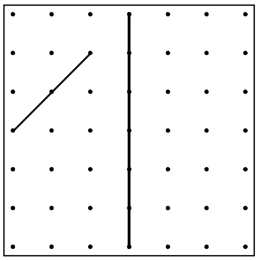
REFLECTIONS

You Need

- One [1] geoboard and some rubber bands

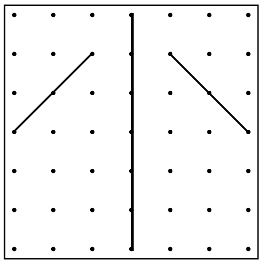
Your Task

1. Place one rubber band in the centre of the geoboard and another one beside it like this:

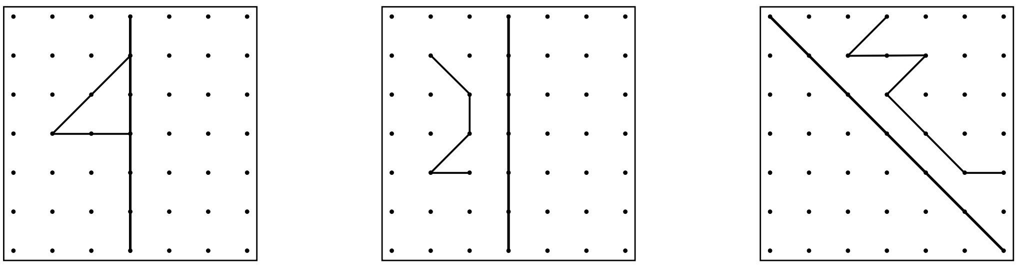


2. Pretend the centre rubber band is a mirror.

   The reflection of the other band in the pretend mirror is like this:



3. Create reflections for these arrangements and record them in your journal:



Challenge

Explore your own reflections and record your most interesting ones.

MARTIAN MATHS

You Need

- Six [6] round shapes, four [4] square shapes and five [5] triangular shapes

The Story

On Mars they have found a different way of counting.

They write:

16 like this: ▲ ▲ ▲ ●

51 like this: ■ ■ ●

28 like this: ■ ● ● ●

Your Task

1. Work out what Earth number each shape stands for.
2. Make these numbers in the Martian way.

   a) 86

   b) 39
3. Make up some Martian numbers of your own.

Challenge

Use the shapes to make and record all the Martian numbers from one [1] to twenty-five [25].

- Look for patterns.

HOW MANY THINGS?

You Need

- One [1] 25ml cup and a container of small things
- One [1] board and a balance scale if available

The aim of the task is to work out how many things
without actually counting them all.

Your Task

1. Guess the number of things and record your guesses.
2. Fill the 25ml cup with things and count how many things are in the cup. Now find out the number of cupfuls you can make using all the things. Calculate the total of the things using this method and write down your answer.

   DON'T COUNT ALL THE THINGS YET.
3. Use the board and cover one square of it with things. Count the things on this square. Now pour all the things onto the board and count the number of squares that are covered. Multiply the number of things in one square by the number of squares covered. Write down your answer.

   DON'T COUNT ALL THE THINGS YET.
4. Use a balance scale to weigh 50 things, then weigh all the things. Work out the total number of things using these two results. Write down the answer.

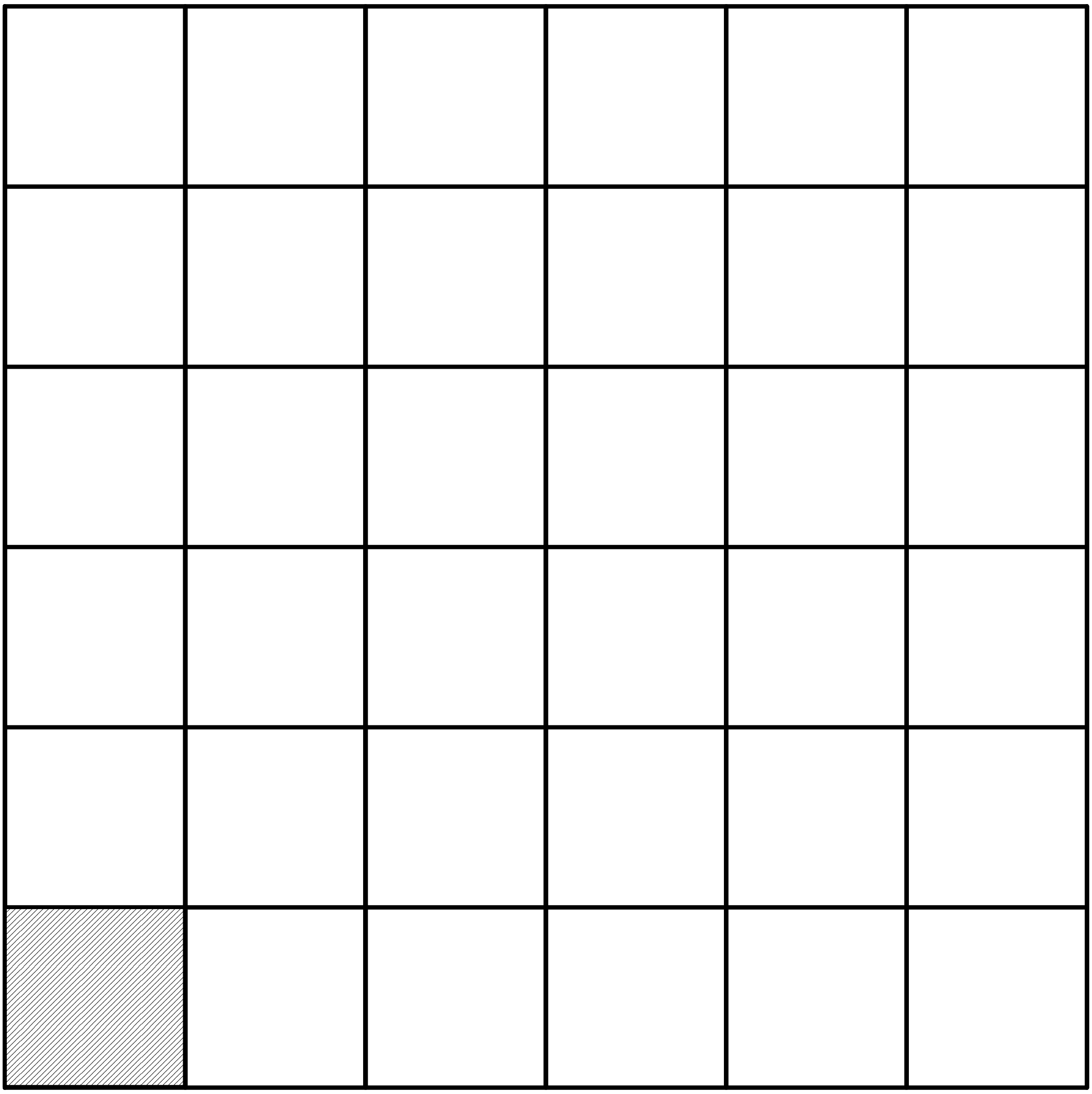
Challenge

NOW YOU CAN COUNT ALL THE THINGS

to find out how accurate these estimation methods were.

- What will you record in your journal?

How Many Things?



FOUR CUBE HOUSES

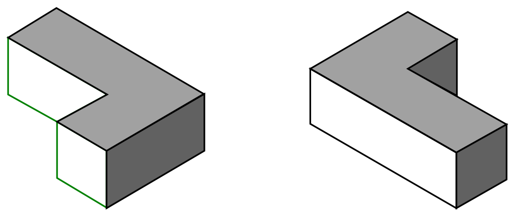
You Need

- Four [4] wooden cubes
- Four Cube Houses board, marker and cloth
- Recording sheet

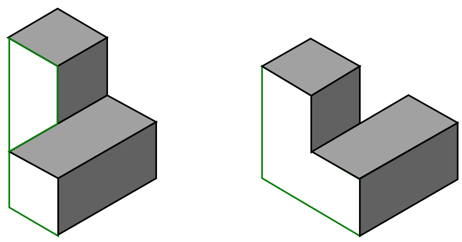
The Story

An architect has the bright idea of building houses from cubes. She decides that four cubes is a good number for each house. She can make several different house shapes that way. The houses are designed so the cubes fit together face to face.

House designs are the same if one building can be rotated around a vertical axis to make the other building.



These houses are the same because one can be rotated to make the other.



These houses are not the same. They *cannot* be rotated to make each other.

Your Task

1. How many different four cube houses are there? (Hint: There are more than 10 but less than 20.)
   - Each time you make a new house draw it on the board.
   - When you get the drawing correct, copy it to the recording sheet.

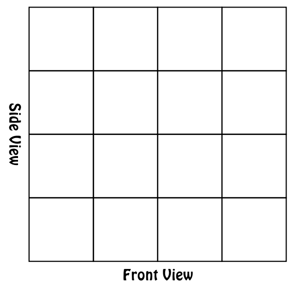
Four Cube Houses

BUILDING VIEWS

You Need

- About twenty-five [25] wooden cubes (2cm) and one [1] grid board

The Story

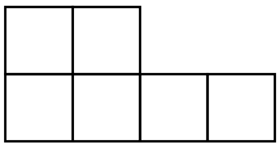


A builder has a 4 x 4 grid on which he will build rooms. The cubes are the rooms.

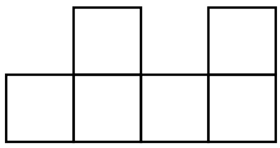
Your Task

1. Place the cubes to get these views of the finished building:

Front View



Side View



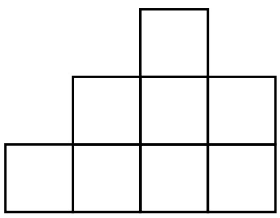
2. What is the smallest number of cubes he could use to get these views?

Hint: The rooms do *not* have to be connected.

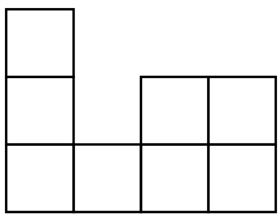
Challenge

Make the building with these views:

Front View

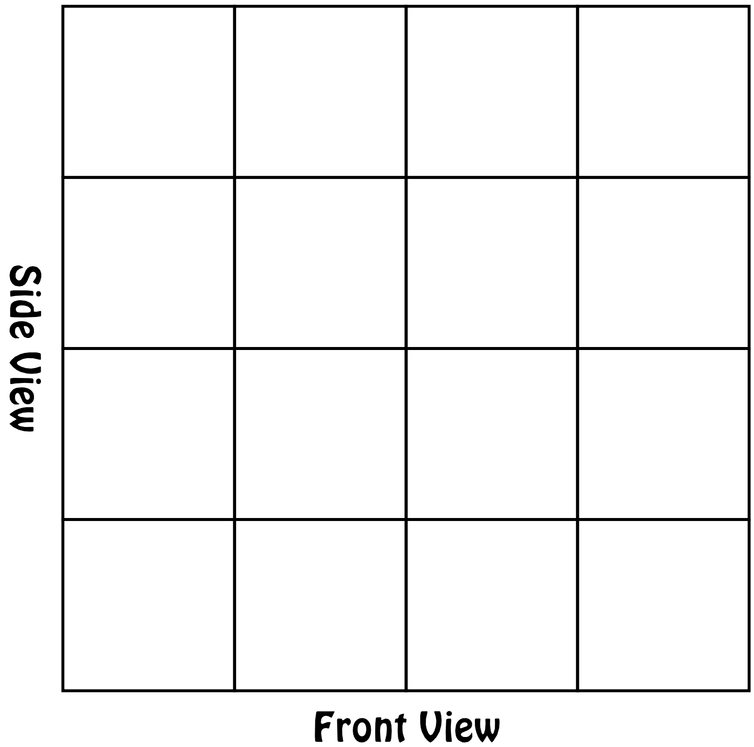


Side View



- What is the smallest number of rooms it could have?

Building Views Grid



SOMA CUBE 1

You Need

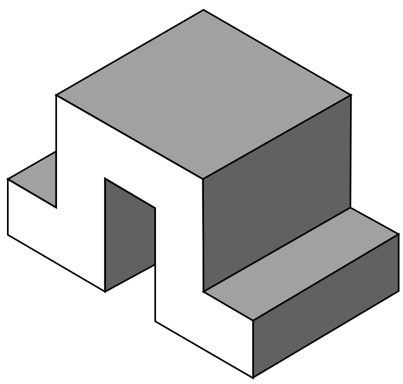
- Eight [8] click-together cubes
  ...two [2] sets of four [4]
  ...one [1] set for each person

Your Task

1. Using 1, 2, 3 or 4 cubes it is possible to make twelve [12] objects. Make and sketch all of them.
   (You don't have to find them all now. You can return to this task.)
2. How many cubes will you need to make all the objects that are *not* a straight line or a square?
3. Find more click-together cubes in the classroom and make *all* the pieces that are *not* a straight line or a square.
   - These are the pieces of a Soma Cube.
   - The Soma Cube was invented by Piet Hein in 1927.
   - Task 161 challenges you to make his cube.

Challenge

Make this tunnel with your Soma Cube pieces.

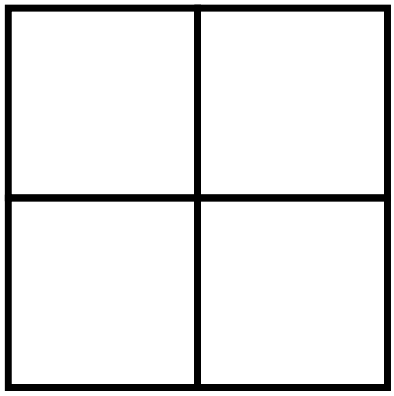


HOW MANY SQUARES?

You Need

- Twenty-five [25] square tiles and a recording sheet

Your Task



1. Use four tiles [4] to make a 2 x 2 square...
   Count the total number of squares and write the answer on your recording sheet.
2. Make a 3 x 3 square and count all the squares. (Don't forget the 2 x 2 ones.)
   Write the answer on your recording sheet.

---

3. Work out the answers for 4 x 4 and 5 x 5 squares and write them on the recording sheet.
4. Look for patterns in your answers and use them to predict the number of squares for 8 x 8. Can you check your prediction another way?

Challenge

If I tell you any size square (S x S), can you tell me how to work out the total number of squares formed?

Another way to ask this is:

Suppose F is the total number of squares formed and S is the size of the largest square. Then, F = ...?

NUMBER GAME

You Need

- One [1] pack of playing cards and your own calculator

Rules

- Shuffle the pack and deal seven [7] cards to each player.
- Turn the next card face up and put the pack aside.
- The face up card is the Target.
- Number cards have their own value and
  Ace = **1**, **J**ack = **11**, **Q**ueen = **12**, **K**ing = **13**.

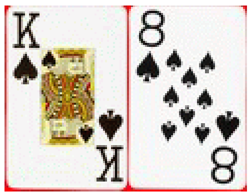
Your Task

1. Make and record number stories (equations) to equal the Target.

   Example: If the Target is 13 and you have been dealt **A, 4, 7, 9, 10, J, Q** you could make:

   - **10 + (7 - 4)** = 13, or
   - **Q + A** = 12 + 1 = 13, or
   - **(QA ÷ J) + (10 ÷ [9 - 4])** = (121 ÷ 11) + (10 ÷ 5) = 11 + 2 = 13

   ### Scoring Rules

   These cards make 138.

   - 1 point for each card you use.
   - Double your score for each 3 or 4 or 5 digit number you use.
   - Double your score for each division (÷) you use.
     10 + (7 - 4) = 13 scores **3 points**.
     Q + A = 13 scores **2 points**.
     (QA ÷ J) + (10 ÷ [9 - 4]) = 13 scores 6 x 2 x 2 x 2 = **48 points**
     because it uses 6 cards and has one 3 digit number and two divisions.

2. Play five [5] games and total your scores.

   The person with the higher total wins.

SQUARE NUMBERS

You Need

- Thirty-six [36] blocks: one [1] Colour A, three [3] Colour B, five [5] Colour C, seven [7] Colour D, nine [9] Colour E, eleven [11] Colour F
- Recording sheet

Your Task

1. Make a square with the red and blue blocks.

   This is really two squares - red (area 1) and red/blue (area 4).
2. Add the yellow blocks to make a square with area nine [9].
3. Continue making squares until the colours show squares with areas 16, 25 and 36.
4. Colour the grid on the Recording Sheet to show how the squares grow.

---

5. How many blocks would you need to make the next square?
6. The numbers 1, 4, 9, 16, 25 are called Square Numbers.

   Finish the equation on the Recording Sheet.
   (Hint: Look at your model.)

   Can you do it another way?

   Can you do it using only square numbers?

Challenge

Work out the twentieth [20th] square number and explain how you did it.

COLOURED SQUARES

You Need

- Sixteen [16] coloured tiles - 4 each in 4 colours - and playing board

Your Task

1. Arrange the tiles on the board so that when you look in:
   - each row
   - each column
   - each long diagonal

   you *cannot* see two colours the same.
2. Record your solution on square graph paper. Just put a small circle of colour in each square with your felt markers or coloured pencils.
3. Find a different solution and record it.
4. Compare your two solutions. Are they really different?

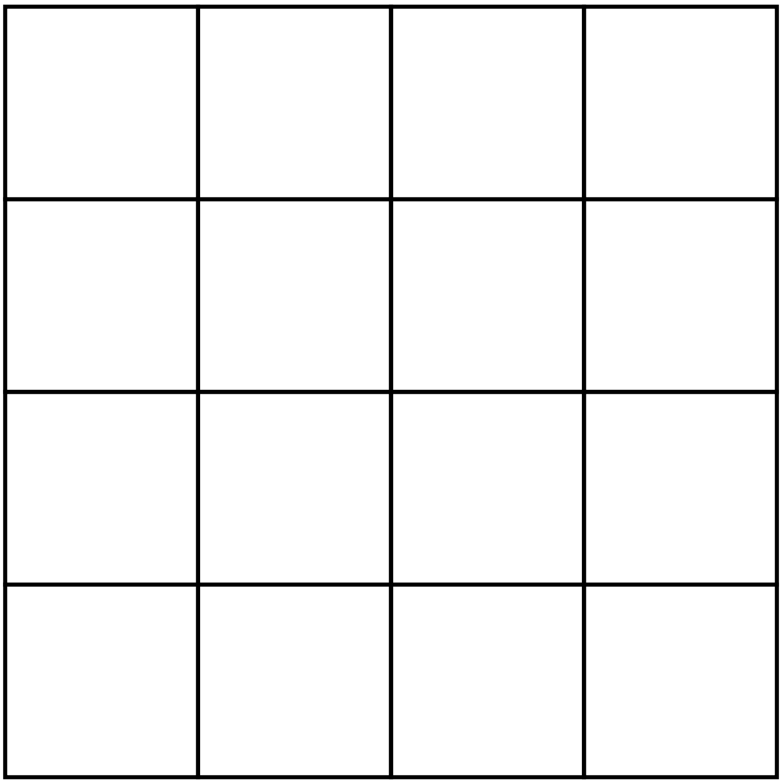
   They are the same if:
   - You can turn one around to make it look like the other.
   - You can put them side by side (any side) and make a reflection.
5. There are several different solutions. Find as many as you can.

Challenge

How many solutions are there?

How do you know when you have found them all?

Coloured Squares



CALENDAR

You Need

- Two [2] black cubes
- Dusting cloth and chalk

Challenge

Choose numbers to write on each cube so you can show *all* the day numbers of a calendar with either one or two cubes.

Example

1 on the upward face of one cube and **7** on the upward face of the other, as shown here, represents the 17th day of a month.

1	**7**

WHERE IS THE RECTANGLE?

You Need

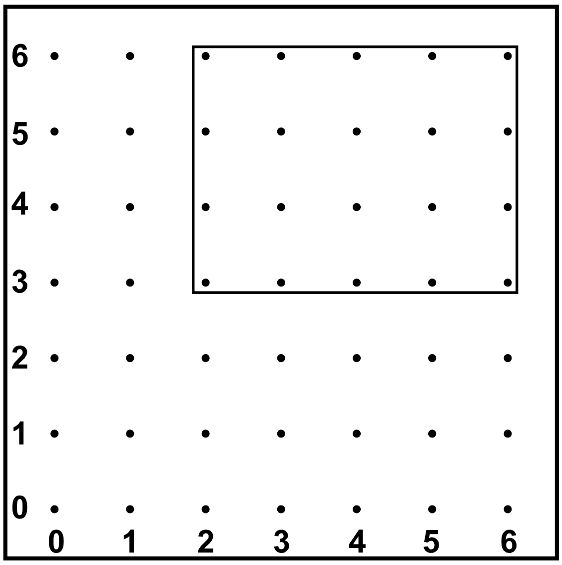
- One [1] geoboard and several rubber bands
- Recording board, marker and cloth

This is a game for two players.

The challenge is to find the corner co-ordinates of the rectangle.

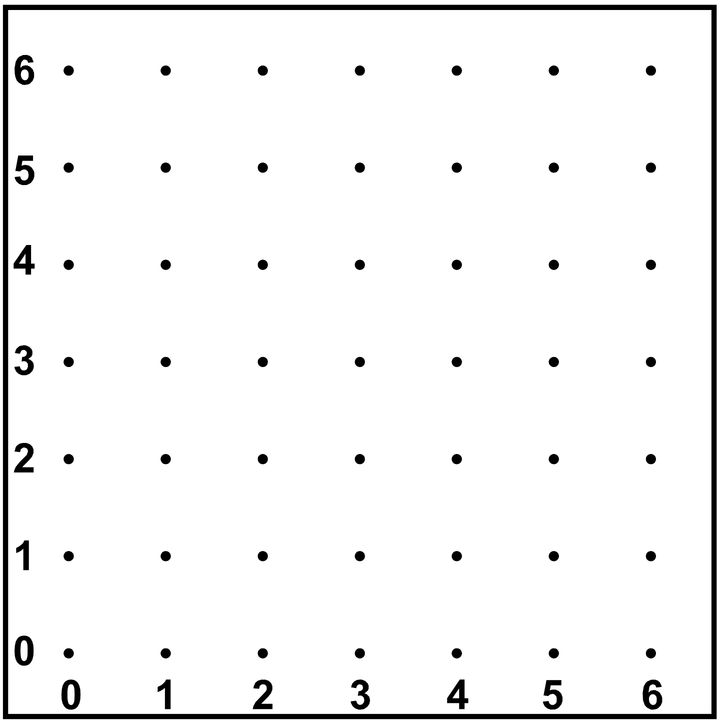
Rules

1. Player A secretly makes a rubber band rectangle on the geoboard.
2. Player A tells Player B the area of the rectangle.
   In this example, the rectangle has an area of twelve [12] square units.
3. Player B tries to guess the co-ordinates of one corner of the rectangle.
   Co-ordinates are pairs of numbers with the horizontal number first and the vertical number second, eg: the bottom left corner here is (2, 3).



4. Player A tells Player B whether the guess is *on the corner* or *inside* or *outside* the rectangle.
5. Guesses are recorded on the board.
   Play continues until the four corners are found.
   When finished, wipe the board clean and swap roles.

Where Is The Rectangle?



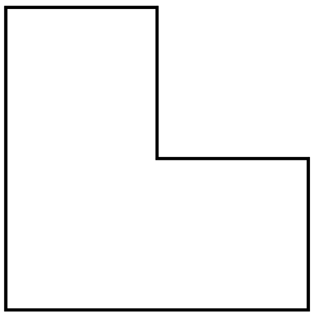
GUESS	IN, OUT, ON?

GUESS	IN, OUT, ON?

DIVIDING SHAPES

You Need

- Four [4] tricubes and some match sticks
- Recording sheet



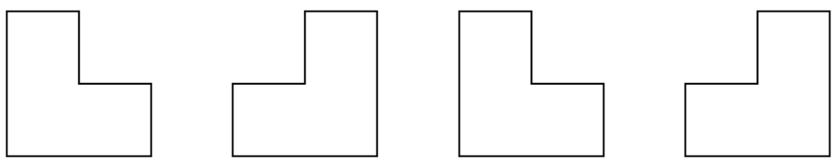
Place one [1] tricube on the table so it looks like this from the top.

Your Task

1. Use the matchsticks to make three [3] identical shapes on top of the tricube. Draw this on the recording sheet.
2. Now make two [2] identical shapes and record.
3. Now make six [6] identical shapes and record.

Challenge

Use all four tricubes to make a new shape that has the same top view as above.



12 COUNTERS

You Need

- Twenty-four [24] counters - twelve [12] each in two [2] colours
- Two dice

This is a game for two players.
The winner is the first to remove all their counters.

Rules

- Each player puts twelve counters on the board in any of the cells.
- Any number of counters may be placed in any cell.
- Both players may have counters in the same cell.
- Players take turns to roll the dice and add.
- If the player has counters in the cell with this total, *one [1] counter* may be removed.

Challenge

What is the best strategy for placing counters?

1	2	3	4	5	6
7	8	9	10	11	12

ICE CREAM FLAVOURS

You Need

- Eight [8] connecting cubes in each of three [3] colours to use as scoops of ice cream

The Story

- The ice cream shop sells triple-header ice creams like the one in this picture.

- The triple-headers must have one [1] scoop of each flavour.
- Different people arrange their scoops in different ways, for example:
  strawberry then vanilla then banana
  or
  vanilla then banana then strawberry

Challenge

If there are only three flavours to choose from, how many different ways can they be arranged on the cone? In your journal, explain how you know.

NIM

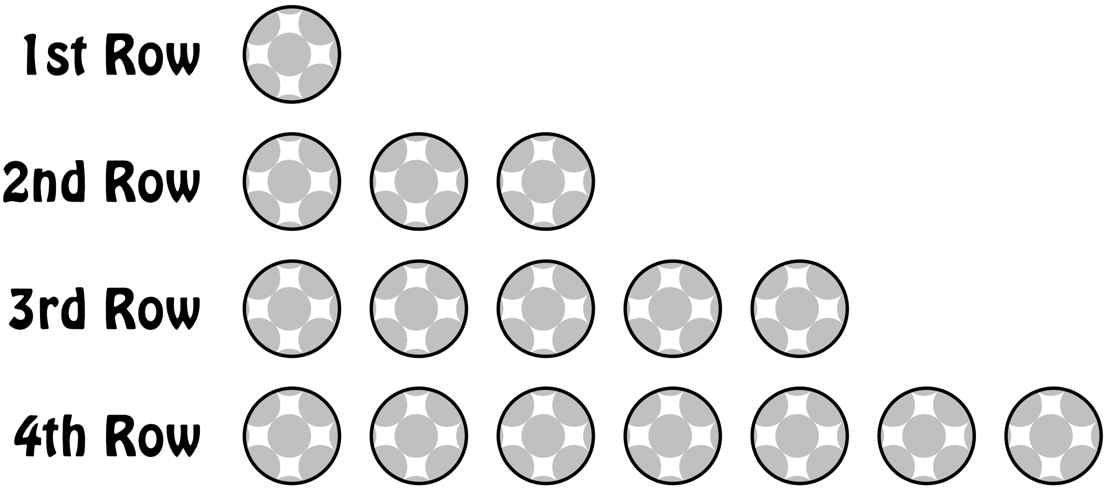
You Need

- Sixteen [16] counters

This is a game for two [2] players.

Rules

- Place the counters on your table like this:



- Take turns to remove one [1] or more counters from **one row**.
- The player who takes the last counter loses.

Challenge

Try to find a winning strategy.

BOB'S BUTTONS

You Need

- About sixty [60] 'buttons' in a bag

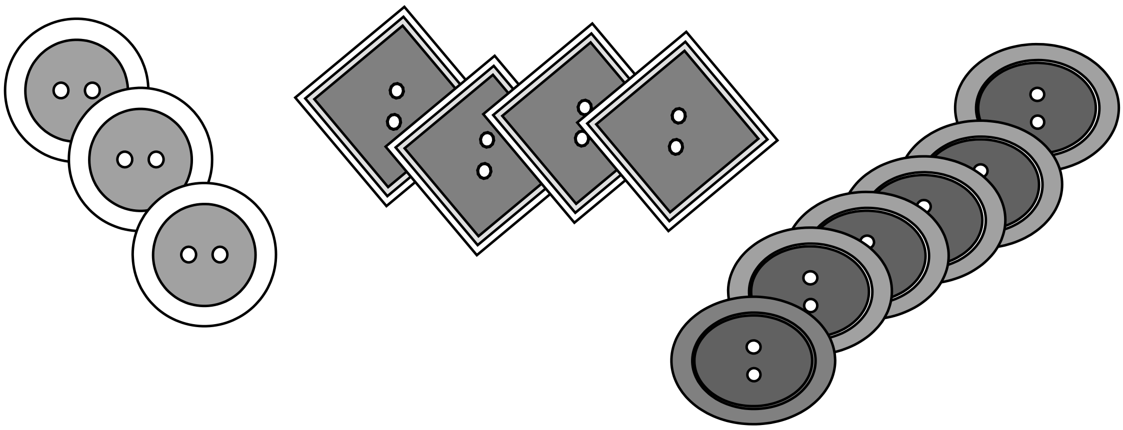
The Story

Bob has more than ten [10] buttons to share with his friends.

- If he shares them all among four [4] friends there will be two buttons left over.
- If he shares the same number among five [5] friends there will be one button left over.

Challenge

What is the smallest number of buttons Bob could have?



FARMYARD RACE DAY

You Need

- Six [6] farmyard animals and their race track
  (Animals may vary depending on availability.)

In these challenges 'lengths' means the divisions of the board.

Your Task

1. Here are the results of the first race at the Farmyard Race Day:
   - the dog did not run
   - the cow finished one length in front of the pig
   - the pig did not finish last
   - the duck beat the horse by 7 lengths
   - the cow finished 7 lengths behind the goat
   - the horse finished 3 lengths behind the cow

   What was the finishing position of each animal?
2. Which clue was unnecessary?

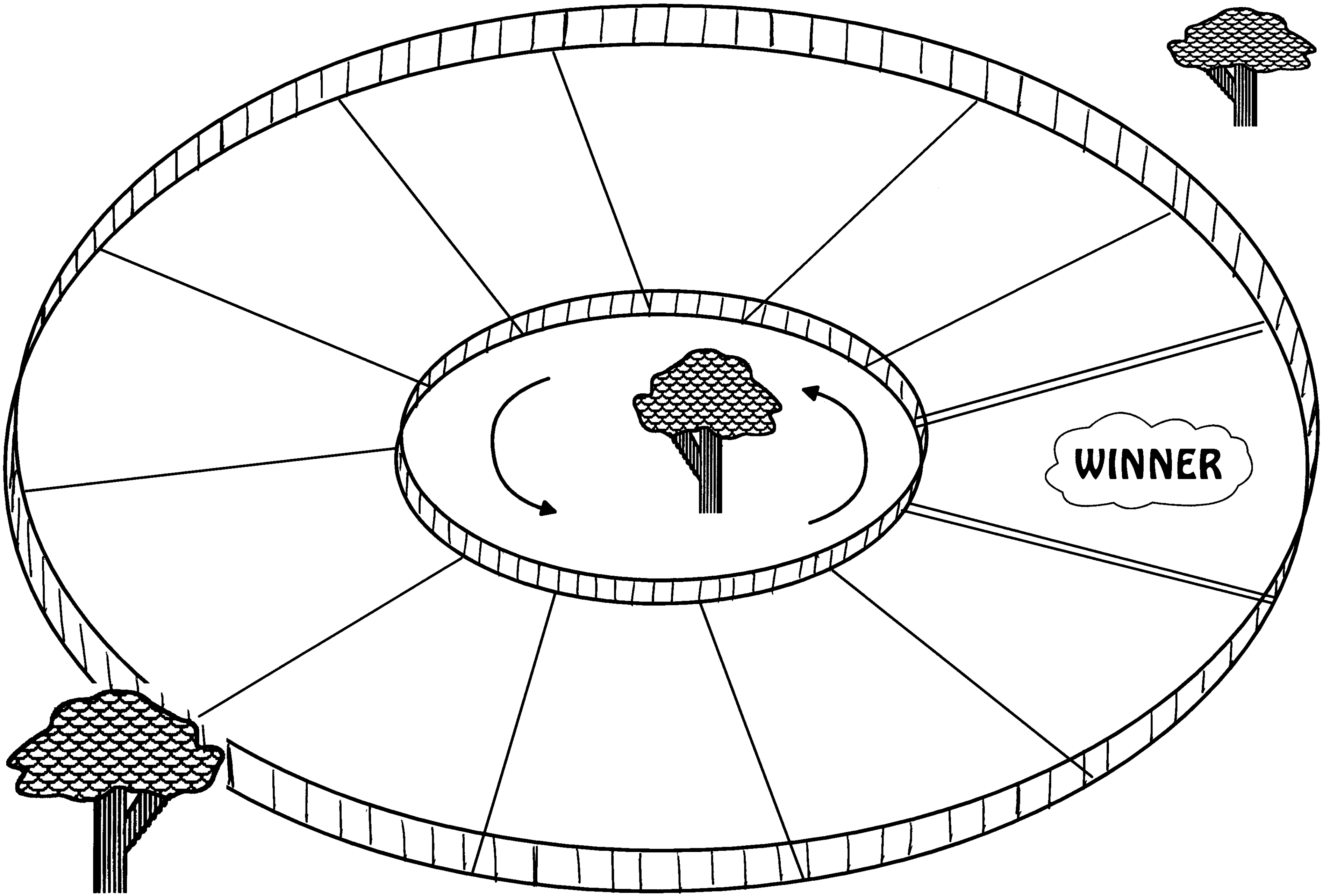
Challenge

The dog was sitting beside the track watching the second race.

- the winner was 6 lengths in front of the cow
- the goat finished 3 lengths in front of the duck
- the horse finished behind the cow, 4 lengths from the dog
- the cow finished 2 lengths behind the duck
- 3 animals had passed where the dog was sitting

What was the finishing position of each animal?

Where was the dog?



FARMYARD RACE DAY

HIGHEST NUMBER 1

You Need

- Two [2] playing boards and one [1] cube dice
- Two sets of playing cards numbered 1-6 (one red & one black set)

This is a game for two players.
One player has red cards, the other has black.
The aim is to make the largest three [3] digit number.

Rules

- Take turns to roll the dice.
- The number shows which card to place in any empty column.
  ...ONES column or TENS column or HUNDREDS column.
- Once the card is placed it cannot be moved.
- Continue playing until all three columns are filled.
- If you roll a number that you have already used, roll again.
- The winner is the player with the higher number.

Your Task

1. Play five [5] games.

   Record your score each time whether you win or lose.
2. Discuss strategies for choosing where to place your cards.

   For example if you rolled a 4 first, where would you put it and why?

   Record your strategies.
3. Play five more games using your strategies and record your scores.

Challenge

Total your score for the first five games. Check the total another way.

Total your score for the second five games. Check the total another way.

Have your strategies helped you to improve your score? Explain.

Highest Number 1

HUNDREDS	TENS	ONES

Highest Number 1

HUNDREDS	TENS	ONES

HIGHEST NUMBER 2

You Need

- Two [2] playing boards and one [1] ten-sided dice
- Two sets of playing cards numbered 1-9 (one red & one black set)

This is a game for two players.
One player has red cards, the other has black.
The aim is to make the largest three [3] digit number.

Rules

- Take turns to roll the dice. Roll again if you get zero [0].
- The number shows which card to place in any empty column.
  ...ONES column or TENS column or HUNDREDS column.
- Once the card is placed it cannot be moved.
- Continue playing until all three columns are filled.
- If you roll a number that you have already used, roll again.
- The winner is the player with the higher number.

Your Task

1. Play five [5] games.

   Record your score each time whether you win or lose.
2. Discuss strategies for choosing where to place your cards.

   For example if you rolled a 7 first, where would you put it and why?

   Record your strategies.
3. Play five more games using your strategies and record your scores.

Challenge

Total your score for the first five games. Check the total another way.

Total your score for the second five games. Check the total another way.

Have your strategies helped you to improve your score? Explain.

Highest Number 2

HUNDREDS	TENS	ONES

Highest Number 2

HUNDREDS	TENS	ONES

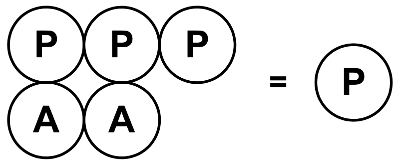
PROTONS & ANTI-PROTONS

You Need

- About sixty [60] counters in two colours
  One colour for protons and the other for anti-protons
- Playing board

The Story

Whenever equal numbers of protons and anti-protons meet they destroy each other.



For example, this meeting of three [3] protons and two [2] anti-protons is worth one [1] proton:

Your Task

1. Choose which colour to use for protons and which to use for anti-protons. Make the following meetings. Record the total value of each meeting in your journal.
   (a) 3P, 1A (b) 4P, 3A, 1P, 3A (c) 5A, 2P
2. The board shows 16 meetings. Place the correct number of counters on the numbered cells.

Challenge

Place the correct number of counters in all the other cells.

Hint: The correct answer has a total of 24A and 29P on the board.

Protons & Anti-Protons

+	3A	3P		
			2P	
2A		P		
		4P	0	2P
	4A			

WALK THE PLANK

You Need

- One [1] playing board and two [2] 'people'
- Two special dice: one marked B, B, B, S, S, S
  one marked F1, F2, F3, B1, B2, B3

The Story

You have to walk the plank on a pirate ship. But the Captain likes to torment his victims by making them play a game to find out if they will be eaten by sharks, or reach the safety of the boat! The rules of his game are:

Rules

- Stand your marker on the middle section of the plank.
- Roll the **Direction Dice** first.
  - **S** means face your marker towards the **S**harks.
  - **B** means face your marker towards the **B**oat.
- Roll the **Walking Dice** next.
  - **F1**, **F2**, **F3** mean walk forward **1**, **2**, or **3** steps (squares).
  - **B1**, **B2**, **B3** mean walk backward **1**, **2**, or **3** steps (squares).
- Keep rolling until you are sent to the sharks or are safe in the boat.

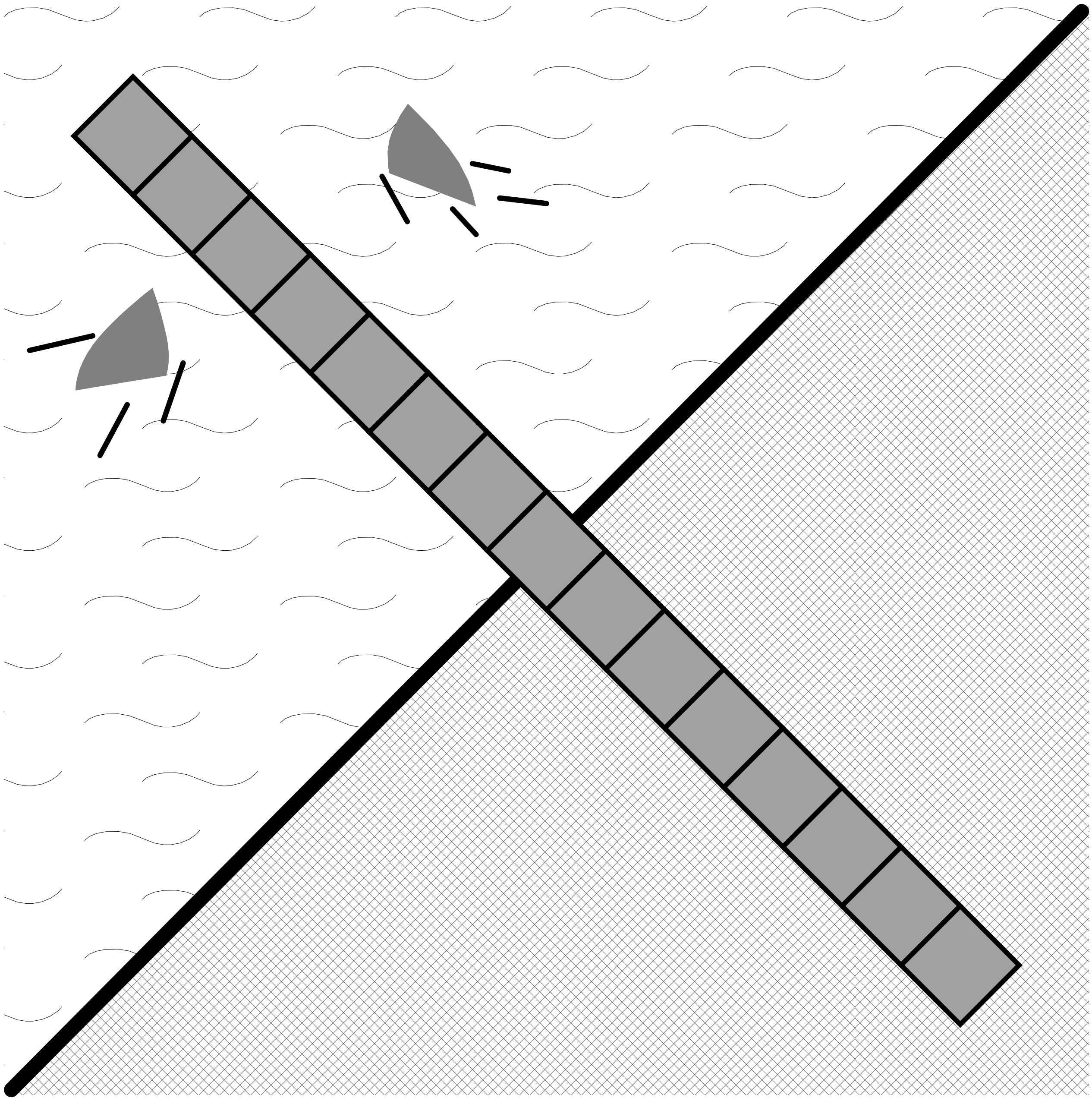
Your Task

1. Play several games and record what happens.
2. The plank on the board has seven [7] steps each way. Cover up one at each end and play again with six [6] steps each way.
3. Explore 3, 4, 5 steps each way.

Challenge

Which plank size makes the best game? Explain your answer.

Walk The Plank



WIN AT THE FAIR

You Need

- One [1] playing board, two [2] counters and two [2] dice
- Recording sheet

Pretend you pay $1 each time to play this fairground game. Play ten [10] times and enter your results on the recording sheet that other students have started. Then use the all the data gathered so far to answer the questions.

Rules

- Players take turns to move.
- Roll two dice, add the numbers and move as shown on the board.
- Continue rolling until you win some 'money'.
- Keep a tally of your winnings on the Recording Sheet.
- When you have played ten games enter your totals and then combine them with others to complete 'Totals So Far' on the Recording Sheet.

Your Task

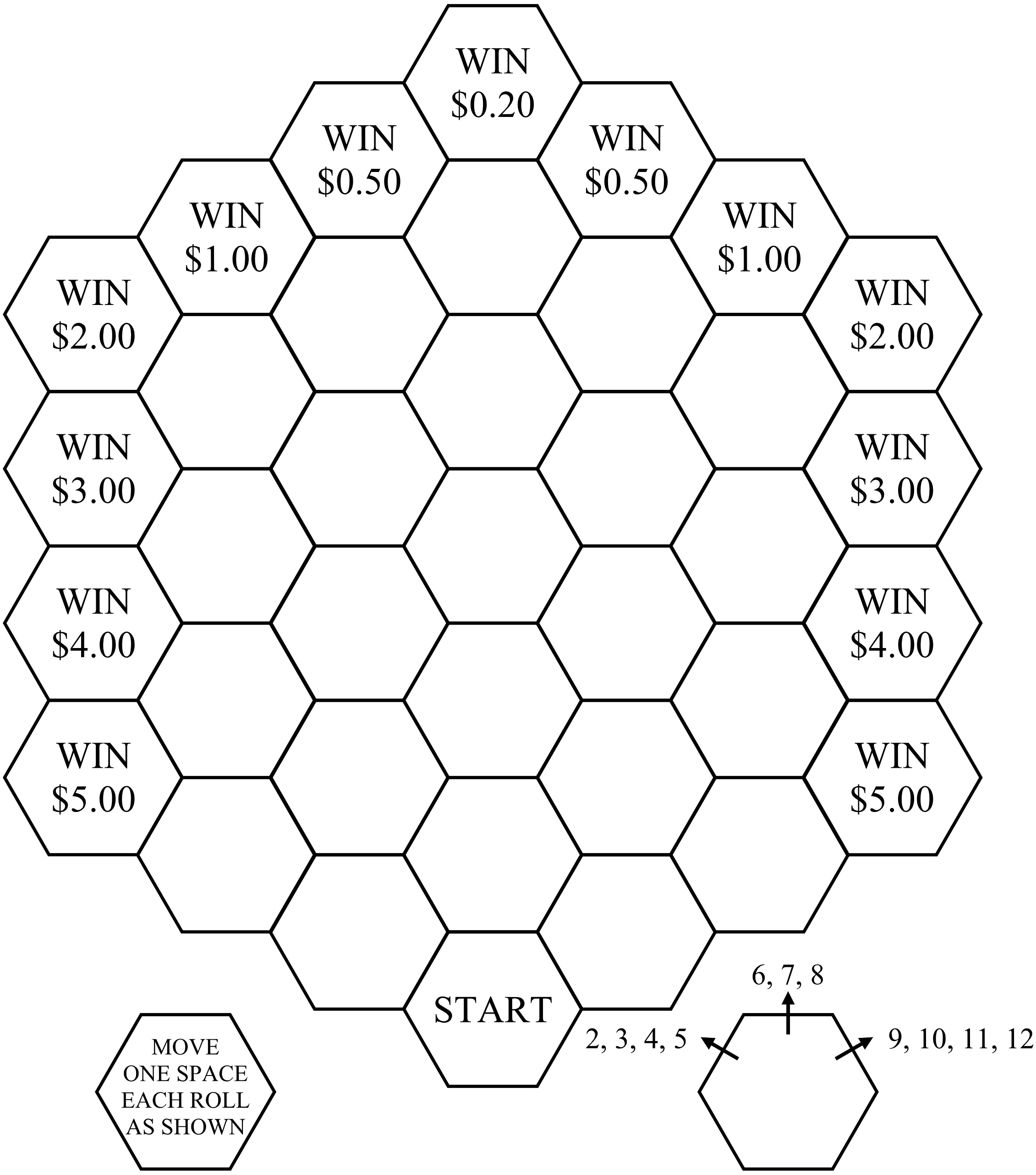
1. Which amount did *you* win most often?
   Which amount has been won most often by all the players so far?
   Which amount is the most likely win?
   In your journal explain why you think this amount is most likely.
2. Why do you think the largest prize has been placed where it is?
   Explain your answer in your journal.

Challenge

You paid $10 to play ten games. You might have won more than you paid.
That means the operator of the game loses money this time, but...

Will the operator of the game make a profit in the long run?

Win At The Fair



EIGHT QUEENS

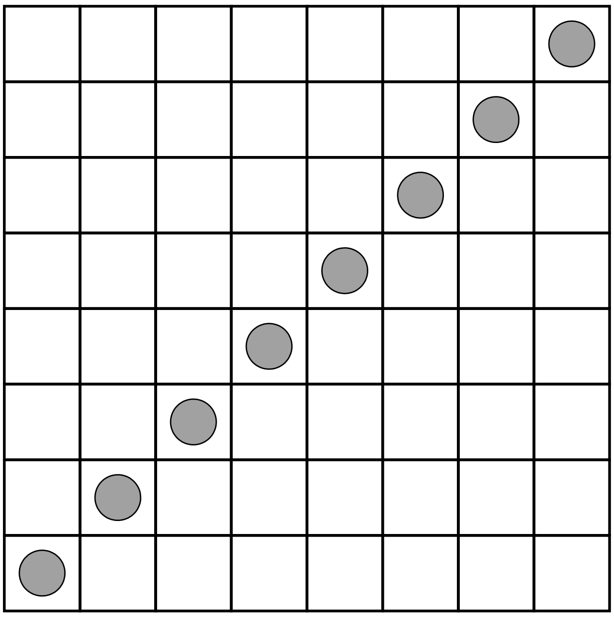
You Need

- One [1] 8x8 board
- Eight [8] markers

This is a famous puzzle that comes from chess, but you don't have to know anything about chess to solve it.

Challenge

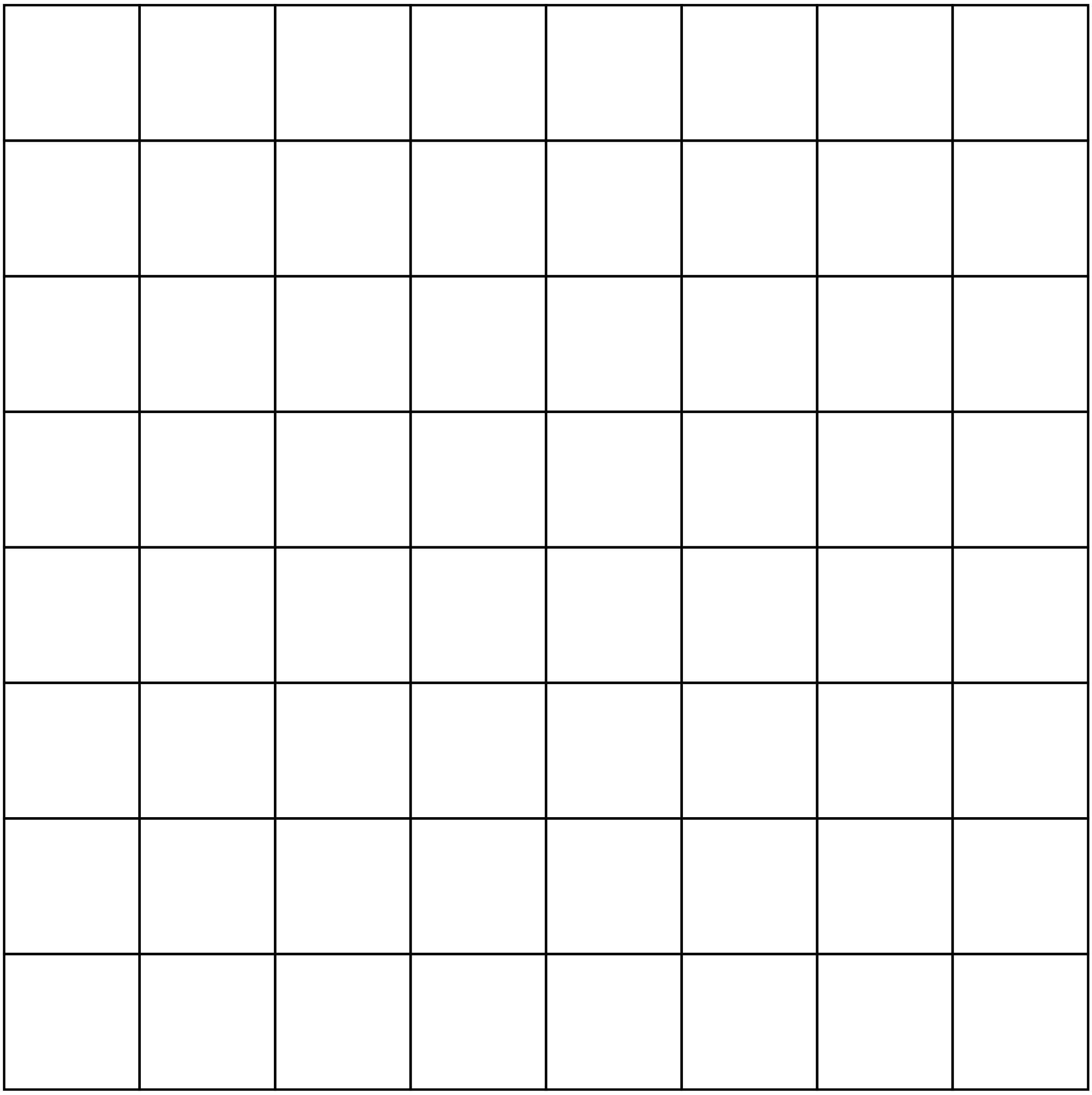
Place the eight markers on the board so that none share the same row or the same column or the same diagonal.



This is *not* a solution.

Can you explain why it isn't?

Eight Queens Board



FAMOUS MATHEMATICIANS

You Need

- Word board, felt pen and cloth
- List of mathematicians' names
- Recording sheet

The Word Board has the hidden surnames of eighteen [18] famous mathematicians.

- The names might be vertical, horizontal or diagonal.
- The names could be written backwards or forwards.

Your Task

1. Mark off each name as you find it on the Word Board.
2. Find out three interesting facts about the life of one of these people. Record these on the sheet.
   You may use any resource, including the Web.

Challenge

Find the names of three mathematicians living today, including one Australian.

Find out what you can about their personal lives (birth, family, home etc.) and record the information in your journal.

Famous Mathematicians

K	A	T	R	P	N	F	E	R	M	A	T
Y	O	U	N	G	O	S	R	E	N	C	E
E	P	V	A	L	E	O	E	U	I	C	L
D	A	U	A	Q	T	M	L	C	A	T	E
E	S	R	G	L	H	E	U	L	M	E	T
S	C	E	N	N	E	R	E	I	R	A	A
C	A	I	E	R	R	V	P	D	E	I	H
A	L	M	S	O	O	I	S	W	G	T	C
R	T	A	I	L	J	L	O	K	C	A	U
T	S	N	I	K	S	L	U	O	A	P	D
E	R	N	O	T	W	E	N	I	T	Y	E
S	D	E	D	E	K	I	N	D	M	H	A

Famous Mathematicians

Look for the surnames of these famous mathematicians.

AGNESI, Maria Gaetana	1718 - 1799	HYPATIA	c. 370 - 415 A.D.
DEDEKIND, Richard	1831 - 1916	KOVALEVSKAYA, Sofia	1850 - 1891
DESCARTES, René	1596 - 1650	LOVELACE, Ada Byron	1815 - 1852
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GAUSS, Carl Friederich	1777 - 1855	SOMERVILLE, Mary	1780 - 1872
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Mathematics Task Centre Task 135

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Mathematics Task Centre Task 135

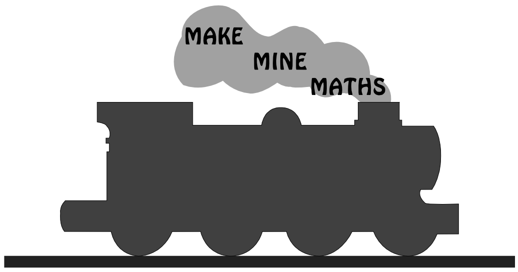
TRAINING FOR MATHS

You Need

- One [1] 'train engine'
- Four 2 unit carriages & eight 1 unit carriages

The Story

A maths train is made from an engine and a collection of long and short carriages. All trains have an engine, so that doesn't count when you talk about the length of a train. Each of these trains is a 3 unit train.



Your Task

1. Make and record all the six [6] unit trains.

Challenge

Explore making trains of other lengths.

In each case work out all the possible trains.

Look for patterns in your data and prepare a report.

SQUOUND

You Need

- Twelve [12] counters, one [1] playing board and a recording sheet

The *squound* is the part of the board where the *square* and *round* overlap.

Your Task

1. Place all twelve counters so there are 8 in the square and 9 in the circle. How many in the squound? Answer on the recording sheet.
2. Place all twelve counters so there are 10 in the square and 6 in the circle.
   How many in the squound? Answer on the recording sheet.
3. Place all twelve counters so there are 9 in the square and 6 in the circle. How many in the squound? Answer on the recording sheet.
4. Place all twelve counters so there are 11 in the square and 7 in the circle.
   How many in the squound? Answer on the recording sheet.
5. Examine your data.
   - Look for a pattern or connection that will help you work out any squound problem.
   - Record your hypothesis in words on the recording sheet.

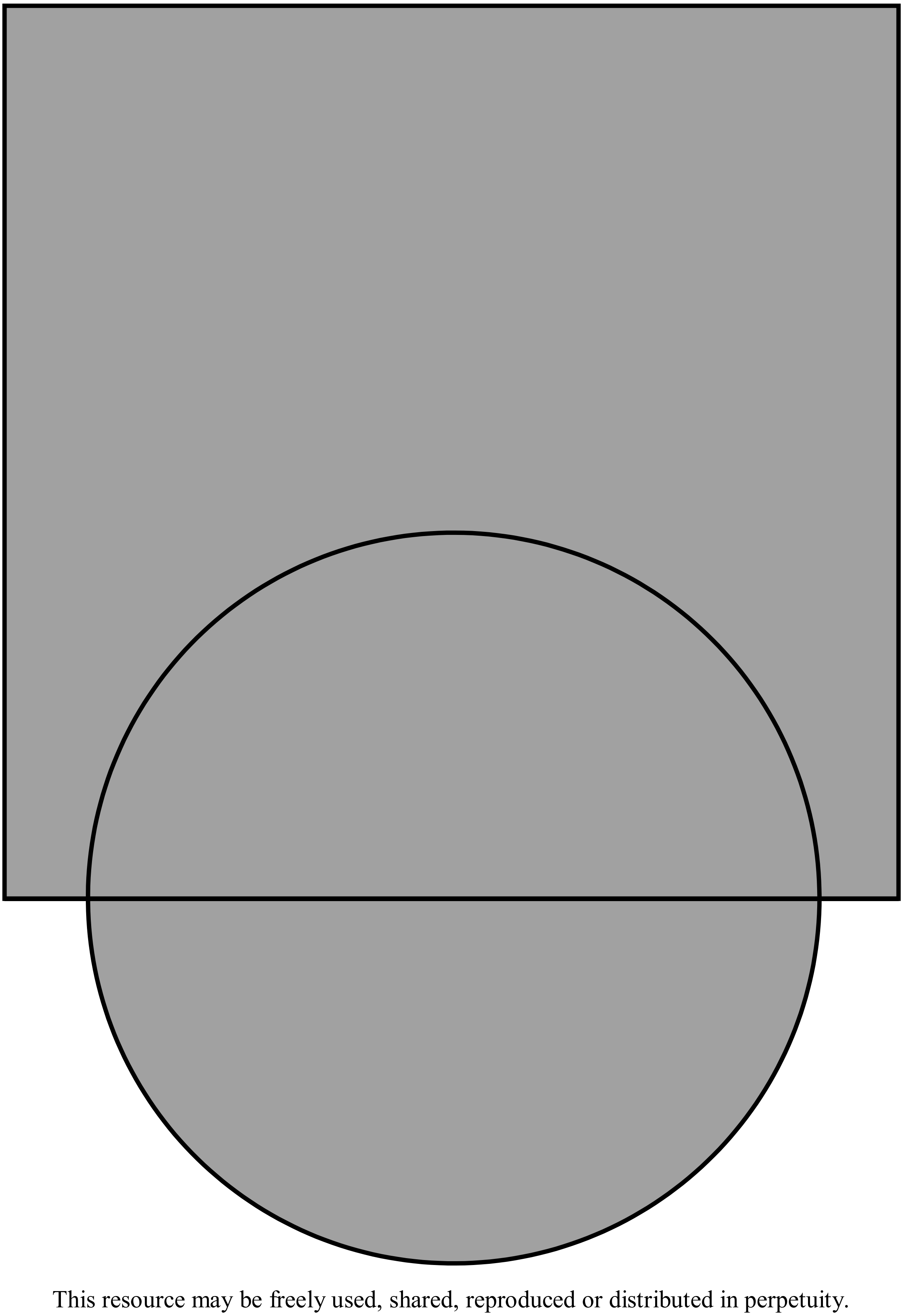
Challenge

Test your hypothesis with this problem.

- Imagine there are one hundred [100] counters placed so there are 67 in the square and 59 in the circle. How many in the squound?
- Can you check your answer another way?

Try to write your rule using the symbols on the recording sheet.

Squound Board

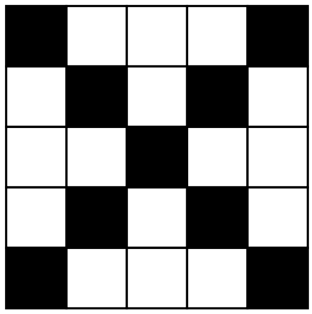


TIME FOR TILING

You Need

- Two [2] sets of about twenty [20] tiles in contrasting colours

The Story



Sue's garden has a square courtyard.
She decides to tile it before she adds pot plants.
She plans her work first with small tiles.

Your Task

1. Sue plans a 5 x 5 diagonal pattern with contrasting tiles like this one.
   What happens if the courtyard is 7 x 7?
   - How many dark tiles will Sue need?
   - How many light tiles will Sue need?
2. If the courtyard is 9 x 9 how many dark and light tiles will Sue need?
3. If the courtyard is 11 x 11 how many dark and light tiles will Sue need?
4. If Sue told you any size square with an odd side length, can you tell her how to work out the number of dark and light tiles for this pattern?

Challenge

Design a way to make a diagonal tile pattern for an even square courtyard.
If someone told you any size of even square courtyard, explain how to work out the number of dark and light tiles.

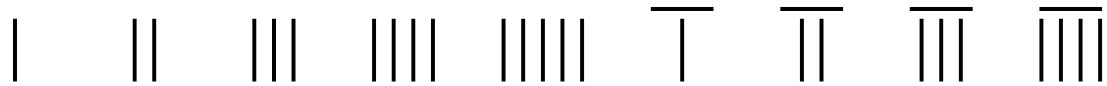
PASCAL'S TRIANGLE IN ASIA

You Need

- About forty [40] sticks and a recording sheet

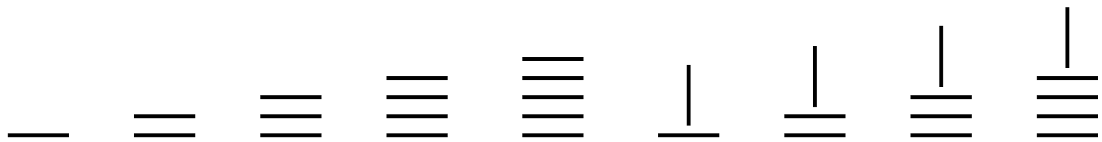
The Story

Ancient Chinese Rod Numerals used marks like this



in the *ones* column, *hundreds* column and *ten thousands* column.

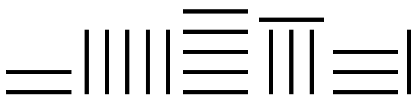
Ancient Chinese Rod Numerals used marks like this



in the *tens* column, *thousands* column and *hundred thousands* column.

Your Task

1. Make each of the following ancient numerals.

   a)  b)  c) 

   Copy each one into your journal and write it in our figures and words.
2. Make some ancient Chinese numerals of your own and ask your partner to work them out.

Challenge

In 1781 in Japan, a writer named Murai published a book called *Arithmetic for the Young*. One picture in the book looked like the recording sheet picture. Decode this picture and rewrite it in the blank circles. Continue any patterns you find.

LAND OF ET

You Need

- Thirty [30] counters in two [2] colours - about fifteen [15] of each

The Story

In the land of ET they have an alphabet with only two letters - **B** and **Y**.

All their words are made of just these two letters, so they have words like:

BBY and **BYBY** and **BBBYYBBB**

Some of their words got really, really long, like **BBYBBYBYYYBYBY** so King E. Fishent and Queen B. Shorter made rules to control the language:

Rules

- **BBB** next to each other is removed (or included)
- **YY** next to each other is removed (or included)
- **BYB** next to each other is replaced by **Y**
- **Y** can be replaced by **BYB**

Examples:

BBYBYBBY becomes **BYYBBY** becomes **BBBY** becomes **Y**

BYBY becomes **YY** becomes the 'Nothing' word

Including **YY** with **BBY** = **YYBBY** = **YYBBBYB** = **YYYB = ...**

Your Task

1. Explore what happens to these words:

   i) **BYYBYYBBY** ii) **BYYBYYBBBYBY** iii) **BBYBY**

2. Create and shorten five [5] ET words of your own.

Challenge

Counting the Nothing word, how many words did the King and Queen now have in the Language of ET?

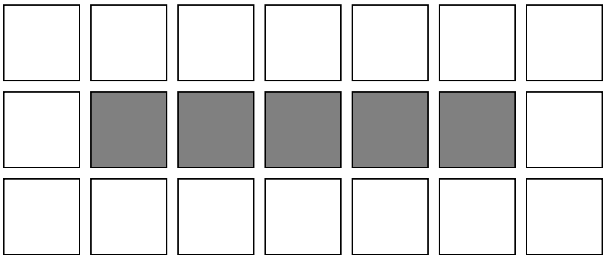
GARDEN BEDS

You Need

- About five [5] tiles to use as 'plants'
- About sixteen [16] tiles in a different colour to use as border tiles

The Story

A gardener places his plants like this:



The plants are in one [1] continuous line.

There could be any number in the line.

The border tiles always surround the plants.

Your Task

1. Work out the number of border tiles needed if the gardener had:
   ... one [1] plant ... two [2] plants ... five [5] plants ... ten [10] plants
2. Explain how to work out the number of border tiles needed for any number of plants, for example, one hundred [100] plants in a line.

Challenge

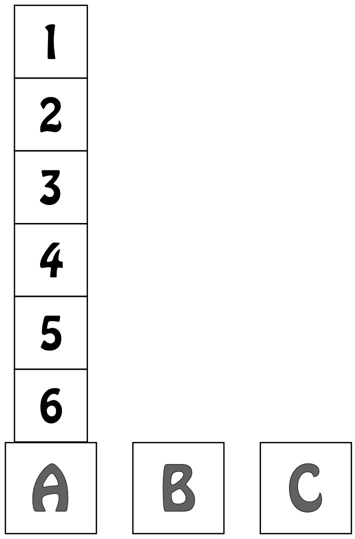
Find two more ways to explain how to work out the number of border tiles if you know the number of plants.

A STACKING PROBLEM

You Need

- Six [6] blocks numbered 1 to 6

Challenge

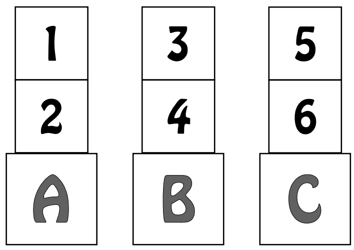


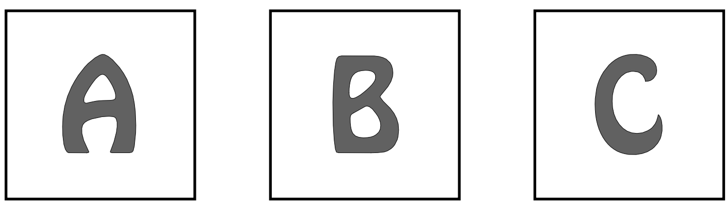
Start with the blocks stacked in order on Square A below.

Move them to the final position using the rules.

Rules

- Move only one block at a time.
- Never put a higher number on a lower one.





CHESS QUEENS

You Need

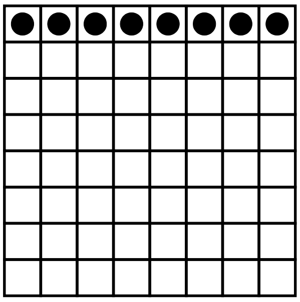
- Eight [8] markers and a playing board

The Story

A chess queen can move:

- any number of squares
- along any row, column or diagonal

provided there are no other pieces in the way. So if eight queens are arranged like this:



then every square can be reached by at least one [1] queen.

Your Task

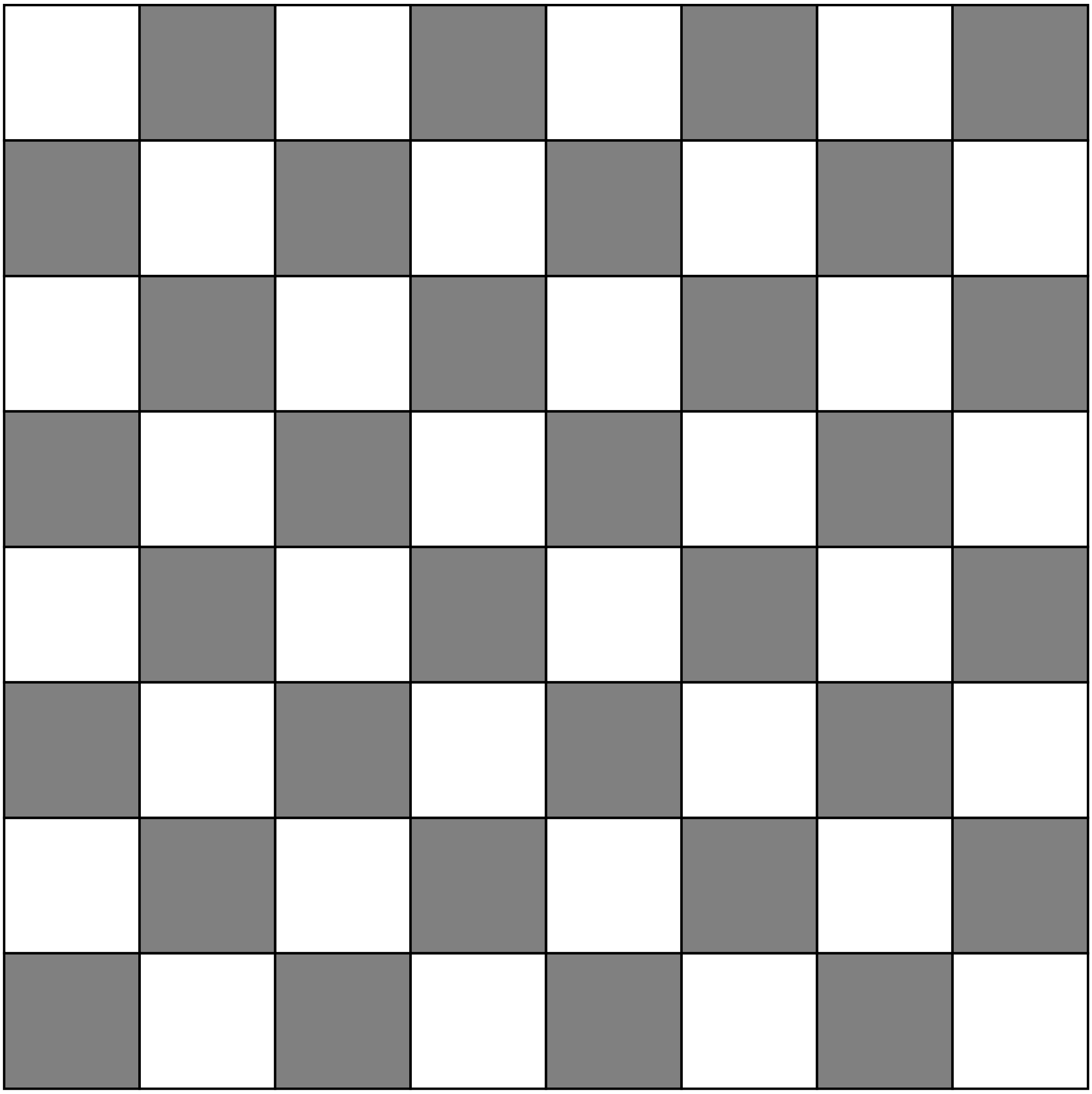
1. Place seven [7] queens so every square can be reached.
2. Place six [6] queens so every square can be reached.

Challenge

Place five [5] queens so every square can be reached.

Can five queens be placed so that one (and only one) square *cannot* be reached by any of the queens?

CHESS QUEENS BOARD



KNIGHT SWAP

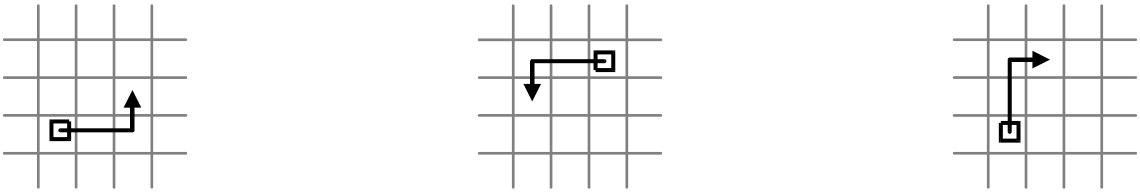
You Need

- Two [2] black and two [2] white 'knights'

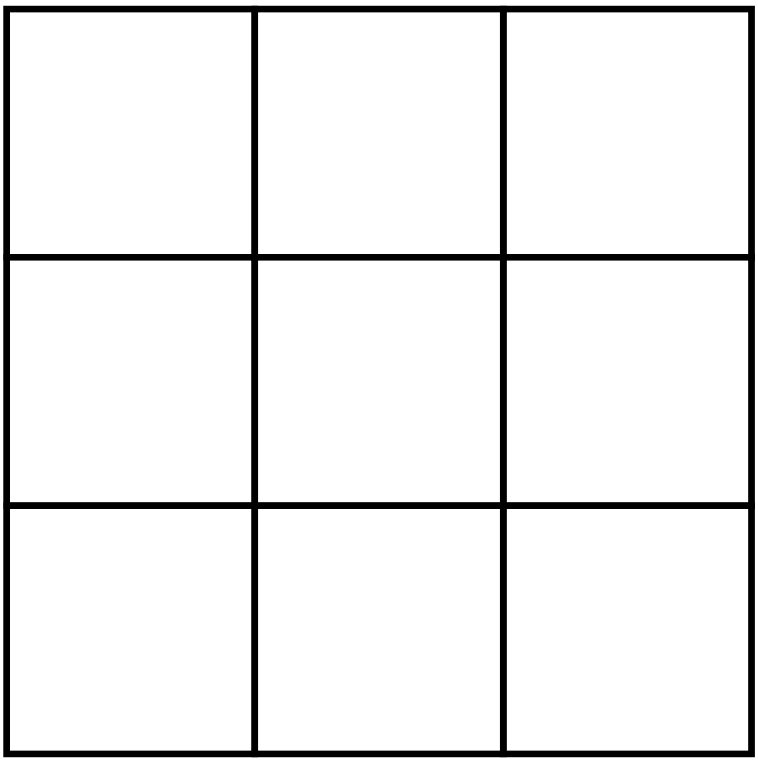
Challenge

The black and white knights begin as shown. The challenge is to make them swap places. Knights move in a (2, 1) L shape, for example:

B		B
W		W



- It can be done in sixteen [16] moves, with each piece moving four [4] times.



PAINTED RODS

You Need

- A set of rods in sizes one [1] to six [6]

The Story

Scott has to paint rods like these for a mathematics equipment company. All faces of a rod have to be painted, including the ends. He starts to think about how many squares of area he is painting on each rod.

Your Task

1. The Size 1 rod is a single cube. How many squares does he paint?
2. Work out the number of squares painted on each of the other rods.
3. Record the information from Questions 1 & 2 in your journal.
   (A mathematician might make a table to record this information.)
4. How many squares are painted for a ... Size 10 rod? ... Size 100 rod.?

Challenge

- If I tell you any size rod can you tell me how to calculate the number of painted squares?
- What happens if I don't understand your explanation?
- Find at least one other way to explain it to me.

KNIGHT PROTECTORS

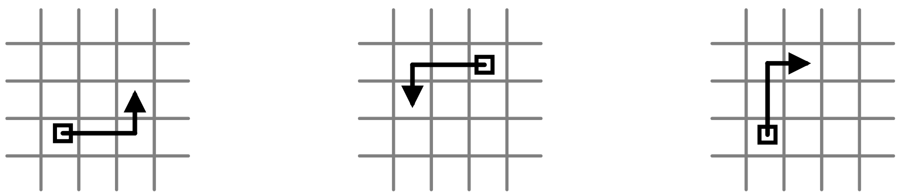
You Need

- Twelve [12] 'knights' and one [1] board
- Marker pen and wiping cloth

The Story

Knights move in a (2, 1) or (1, 2) L shape.

Here are some examples:



- Each knight can protect several other squares.
- For example the knight (K) in this picture protects all the squares marked X.

	X		X	
X				X
		K		
X				X
	X		X	

Challenge

Arrange the twelve knights so that all the squares of the board are either occupied or protected.

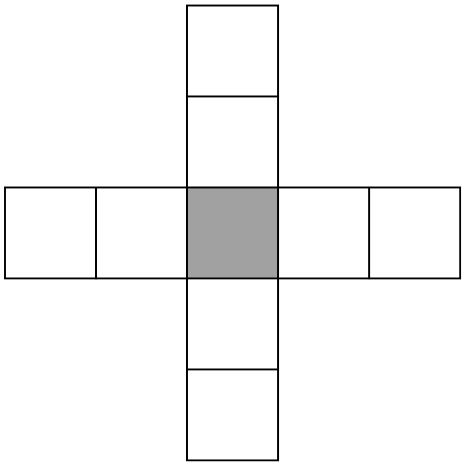
KNIGHT PROTECTORS BOARD

4 ARM SHAPES

You Need

- Seventeen [17] tiles - sixteen [1] in one colour and one [1] in another colour

The Story



A council gardener has to build a path with four arms in a park. It is shaped like a cross. He starts to think about the number of tiles he will need in big and small parks.

Your Task

1. If he builds a path with an arm length of 1. How many tiles does he need?
2. Work out the number of tiles needed for arm lengths of 2, 3, 4 and 5.
3. Record the information from Questions 1 & 2 in your journal. (A mathematician might make a table to record this information.)
4. How many tiles are needed for an arm length of 10? ... 100?

Challenge

- If I tell you any arm length can you tell me how to calculate the number of tiles?
- What happens if I don't understand your explanation?
- Find at least one other way to explain it to me.

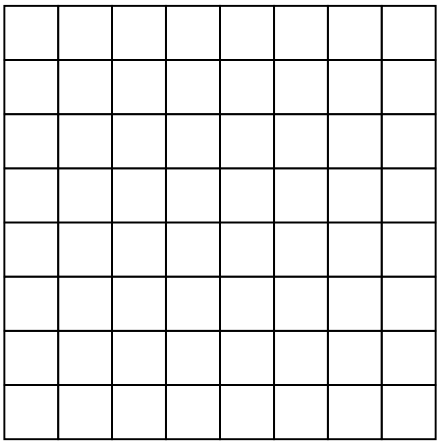
64 = 65

You Need

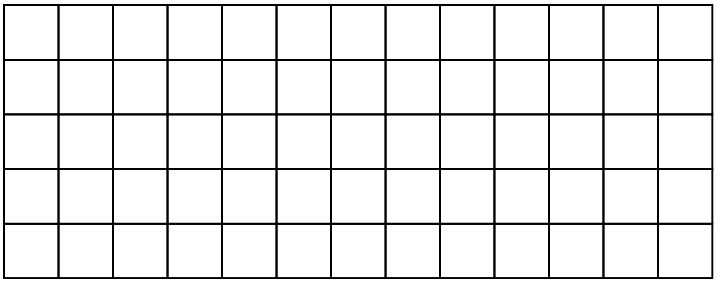
- Four [4] cut out pieces

This is a famous dissection puzzle. It shows the danger of trying to prove something because 'it looks that way'. Sometimes the eye can be tricked.

Your Task



1. Arrange the pieces into an 8 x 8 square. Calculate the area of the square.
2. Rearrange the pieces into a 5 x 13 rectangle.



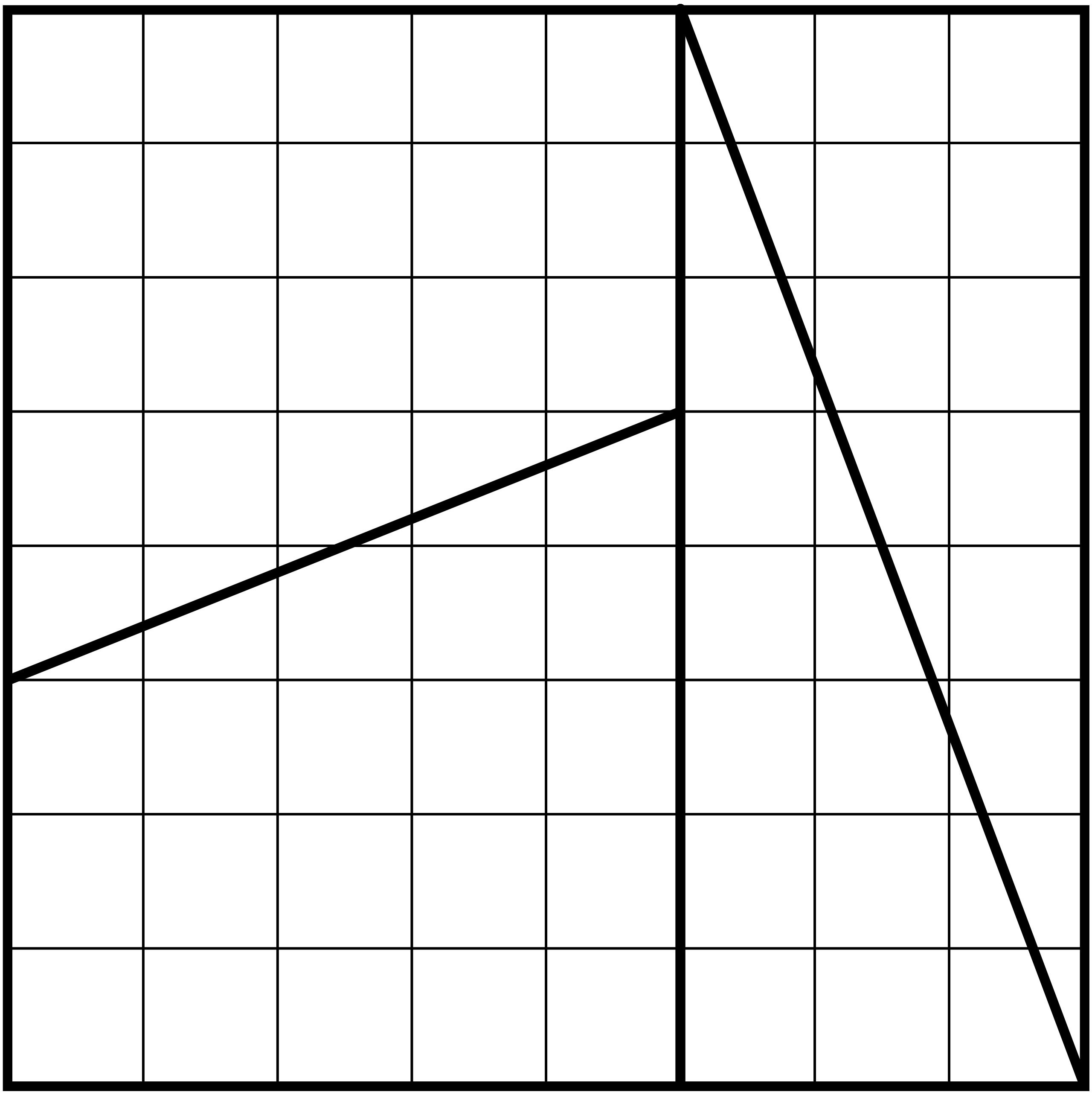
Calculate the area of the rectangle.

3. Try to explain how the same four pieces appear to make two [2] different areas.

Challenge

5, 8 & 13 belong to a special set of numbers.
Find out all you can about them.

64 = 65



Laminate and cut out the four pieces

Task 155

SOMA CUBE 2

You Need

- Seven [7] pieces that make a Soma Cube

The Story

Soma Cube pieces are all the ways of joining three [3] or four [4] cubes so that you *don't* make a straight line or square. The puzzle is to put the seven pieces together to make a cube. The puzzle was invented by the Danish mathematician Piet Hein in 1927.

Your Task

1. Make the cube.
   (Hint: Use the 'most difficult' pieces first.)
2. Carefully take the cube apart so you learn where all the pieces fit. (This helps to develop your visual memory.)

Challenge

Time each other putting the cube together. The challenge is to be able to do it in twenty [20] seconds or less.

50 seconds	40 seconds	30 seconds	20 seconds	15 seconds
ordinary	not bad	good	excellent	fantastic

Can you do it in the same time next week?

You Need

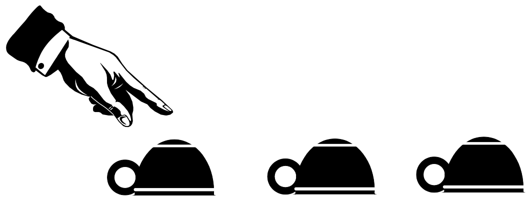
- Three [3] opaque cups and one [1] block (which is the prize)

The Story

This game show used to be on American television. It is famous because it created a big argument among mathematicians about which is the best decision to make.

Rules

- There are three boxes and inside one there is a prize.
- The compère knows where the prize is.
- The contestant points to the box they think might have the prize.



- The compère opens one of the other two (knowing that it *doesn't* have the prize) and says:
  It's not in this one. Would you like to change your mind?

Challenge

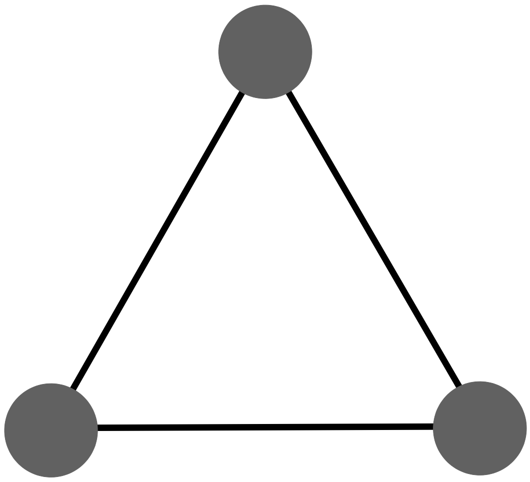
Investigate whether the contestant should change their mind.

EQUILATERAL TRIANGLES

You Need

- Eighteen [18] equal rods (nine [9] each) and blu-tac
  (Make sure the blu-tac is wrapped up when you finish the task.)

Equilateral triangles have three [3] equal sides.
They can be made by joining rods together with blu-tac.



Your Task

1. Make two [2] equilateral triangles with six [6] rods.
2. Make two equilateral triangles with five [5] rods.

Challenge

Make four [4] equilateral triangles with six rods.

Make five equilateral triangles with nine rods.

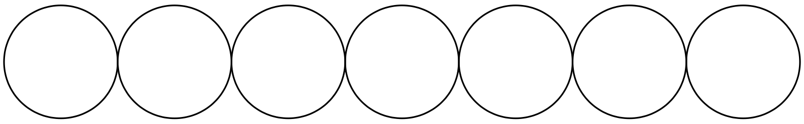
NUMBER DISCS

You Need

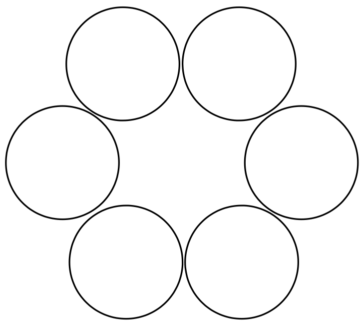
- Seven [7] discs each numbered from 1 to 6 on the edge

Your Task

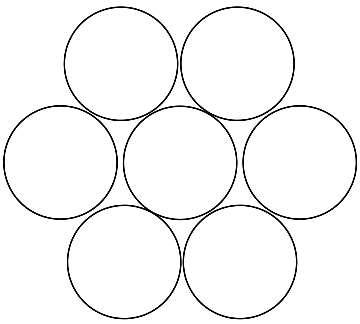
1. Place all the discs in a straight line so that where they touch the numbers are the same.



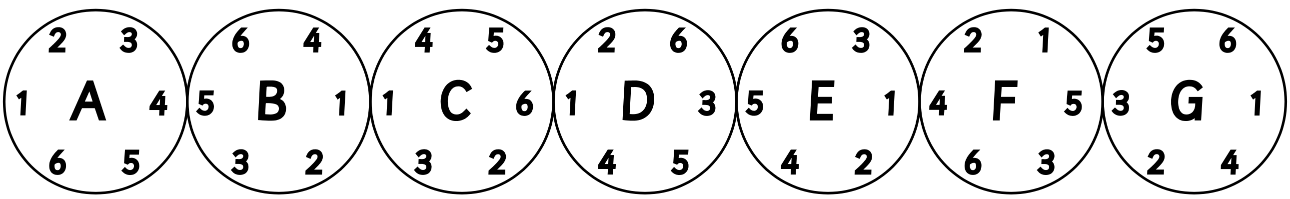
2. Place six [6] of the discs in a circle so that where they touch the numbers are the same.



Challenge



Place all of the discs in a circle with a centre circle so that where they touch the numbers are the same.



You Need

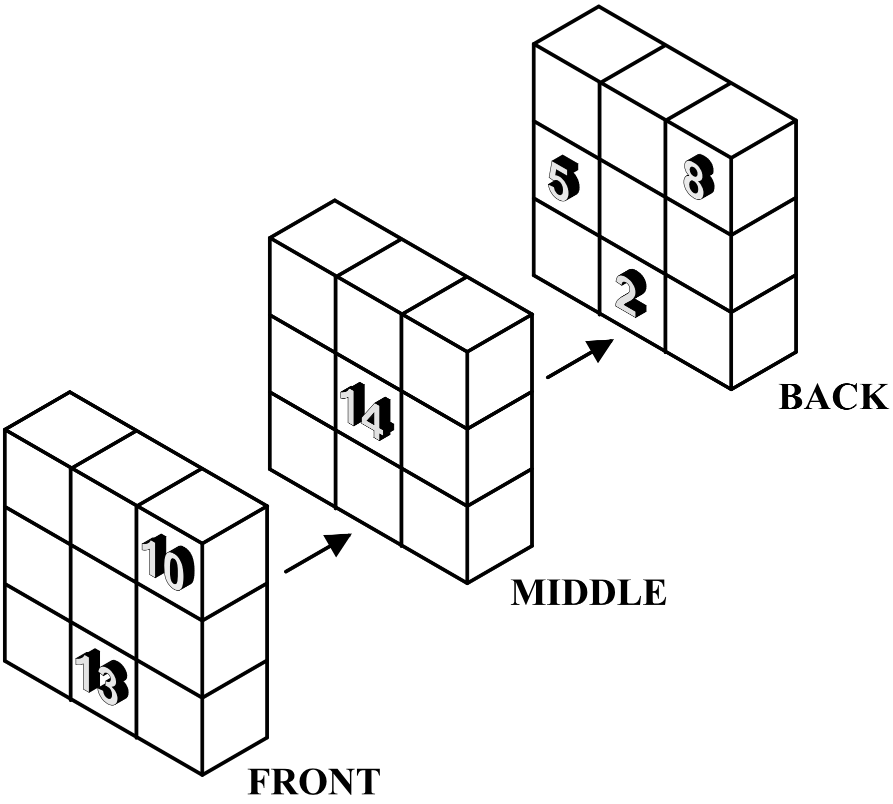
- Twenty-seven [27] cubes numbered from 1 to 27
- About twenty-two [22] blank cubes

Magic cubes are a bit like magic squares, but in three dimensions [3D].

Challenge

Construct a 3 x 3 x 3 cube so that:

- Every horizontal and vertical row or column adds to 42.
- The four major diagonals (top left to bottom right etc.) add to 42.



Start with blanks and the given clue numbers.

One by one replace the blanks with numbered cubes.

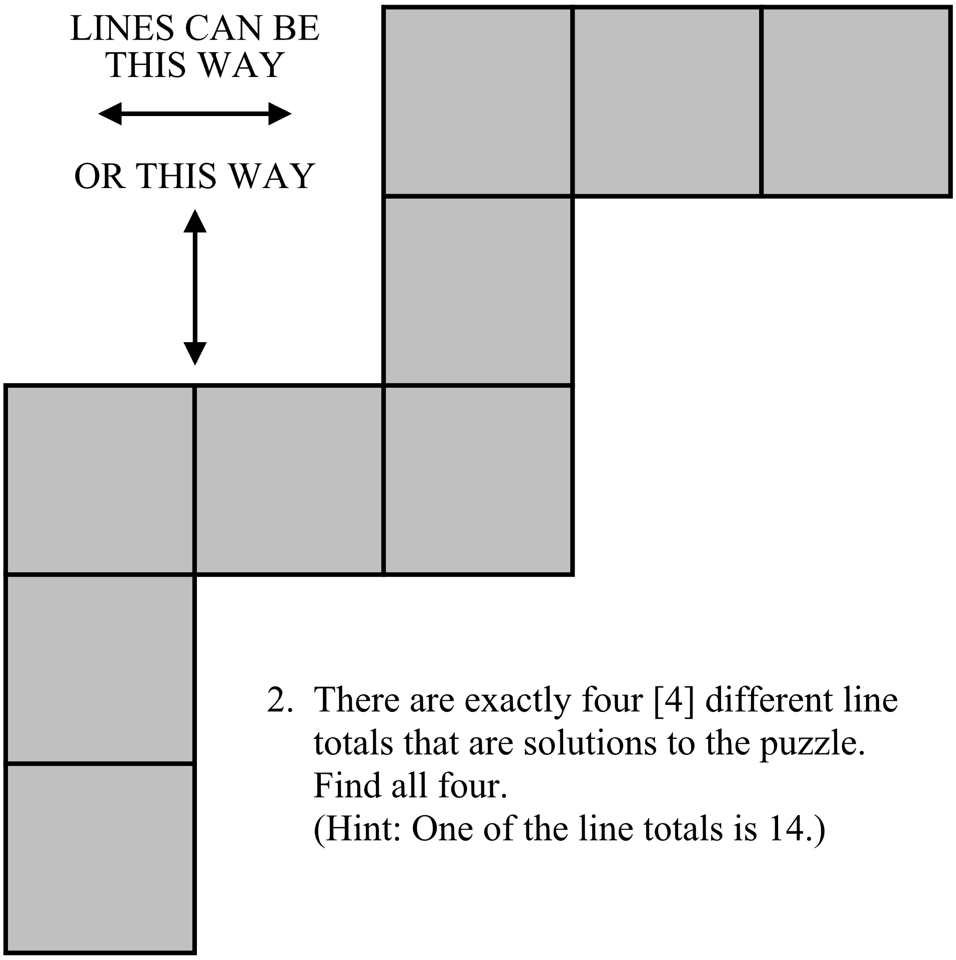
STEPS

You Need

- Nine [9] tiles numbered from 1 to 9

Your Task

1. Place the nine tiles on the steps so that the total of each line is the same.



2. There are exactly four [4] different line totals that are solutions to the puzzle. Find all four. (Hint: One of the line totals is 14.)

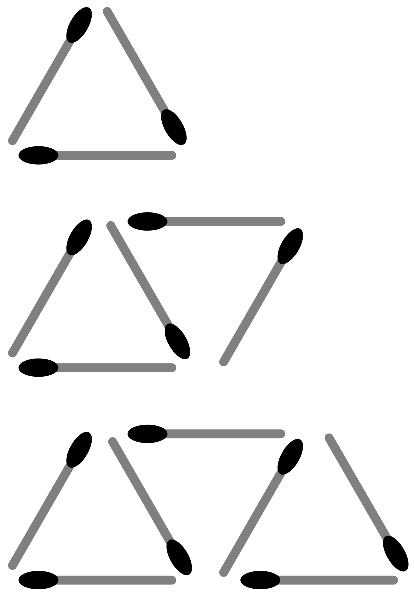
MATCH TRIANGLES

You Need

- Eleven [11] sticks and a recording sheet

The Story

An engineering company makes chains of triangles like these to strengthen buildings. The chains can have any number of triangles.



Your Task

1. Use the sticks to make these three [3] chains.
   How many sticks are needed for each one?
2. Work out the number of sticks needed to make four [4] triangles and five [5] triangles.
3. Record the answers to Questions 1 and 2 in your journal.
   (A mathematician might make a table to record this information.)
4. How many sticks are needed to make ten [10] triangles? Check by drawing.

Challenge

How many sticks are needed to make one hundred [100] triangles?
If I tell you any number of triangles, explain how to calculate the number of sticks.

- What happens if I don't understand your explanation?
- Find at least one other way to explain it to me.

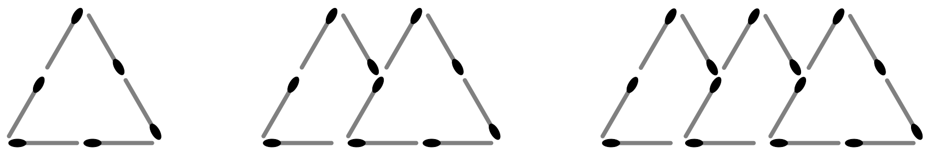
UNSEEN TRIANGLES

You Need

- Twenty-two [22] sticks and a recording sheet

The Story

A child has been making mountains like this with some sticks.



Your Task

1. Use the sticks to make these three [3] mountain chains.
   How many sticks are needed for each one?
2. Work out the number of sticks needed to make four [4] mountains and five [5] mountains.
3. Record the answers to Questions 1 and 2 in your journal.
   (A mathematician might make a table to record this information.)
4. How many sticks are needed to make ten [10] mountains?
   Check by drawing.

Challenge

How many sticks are needed to make one hundred [100] mountains?

If I tell you any number of mountains, explain how to calculate the number of sticks.

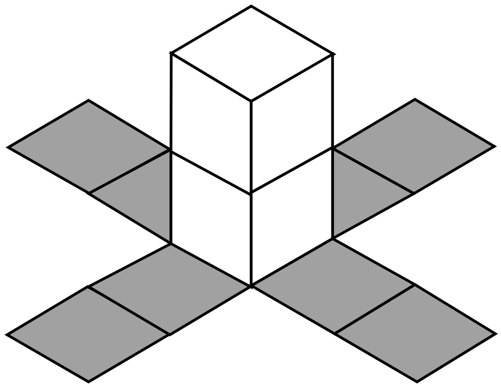
- What happens if I don't understand your explanation?
- Find at least one other way to explain it to me.

MAKING MONUMENTS

You Need

- Five [5] 2cm cubes and twenty [20] 2cm tiles and a recording sheet
  (An alternative size may be used, but it must be same for cubes and tiles.)

The Story



In the parks of Slovenka they build monuments from cubes. Then they make four [4] paths that are the same length as the height of the monument. This is a Size 2 monument and paths.

- The monument and the paths are tiled with the same size tiles as one face of the cube.

Your Task

1. Make the Size 1 monument and paths. How many tiles would be needed?
2. Make other size monuments and paths up to Size 5 and work out how many tiles would be needed in each case.
3. Record the answers to Questions 1 and 2 in your journal.
   (A mathematician might make a table to record this information.)
4. How many tiles are needed to make a Size 10 monument and paths?

Challenge

How many tiles are needed to make a Size 100 monument and paths?

If I tell you any size monument explain how to calculate the number of tiles.

- What happens if I don't understand your explanation?
- Find at least one other way to explain it to me.

JUMPING KANGAROOS

You Need

- Ten [10] 'kangaroos' (five [5] each of two colours)

The Story

Two groups of kangaroos meet on a narrow mountain trail.

Three [3] are going one way and three [3] are going the other way.

Their challenge is to swap sides using the rules below.

- Only one [1] kangaroo can move at a time.
- A kangaroo can:

  ... jump over one [1] *on-coming* kangaroo into an empty space

  ...or hop into an empty space next to itself.

Your Task

1. Find the *smallest number of moves* for the kangaroos to swap sides?
2. Find the *smallest number of moves* if there are two [2] kangaroos each side? ...or 1? ...or 4? ...or 5?
3. Copy this table. Enter your results for 1, 2, 3, 4, 5 kangaroos each side.

Number each side	1	2	3	4	5	6	7	8	9	10
Number of moves										

Look for a pattern that will help you complete the table up to 10.

Challenge

Predict the smallest number of moves for *any number of kangaroos* on each side.

PIZZA TOPPINGS

You Need

- Twenty-four [24] 'pizza bases'
- Forty [40] counters, ten [10] each of yellow, green, white and red. These are the pizza toppings.

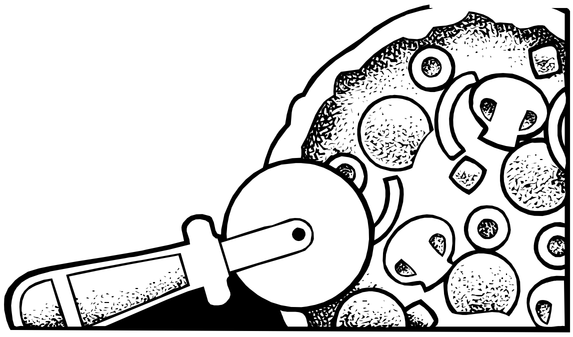
Terra Rossa Pizza shop offers up to four [4] toppings on its pizza bases:

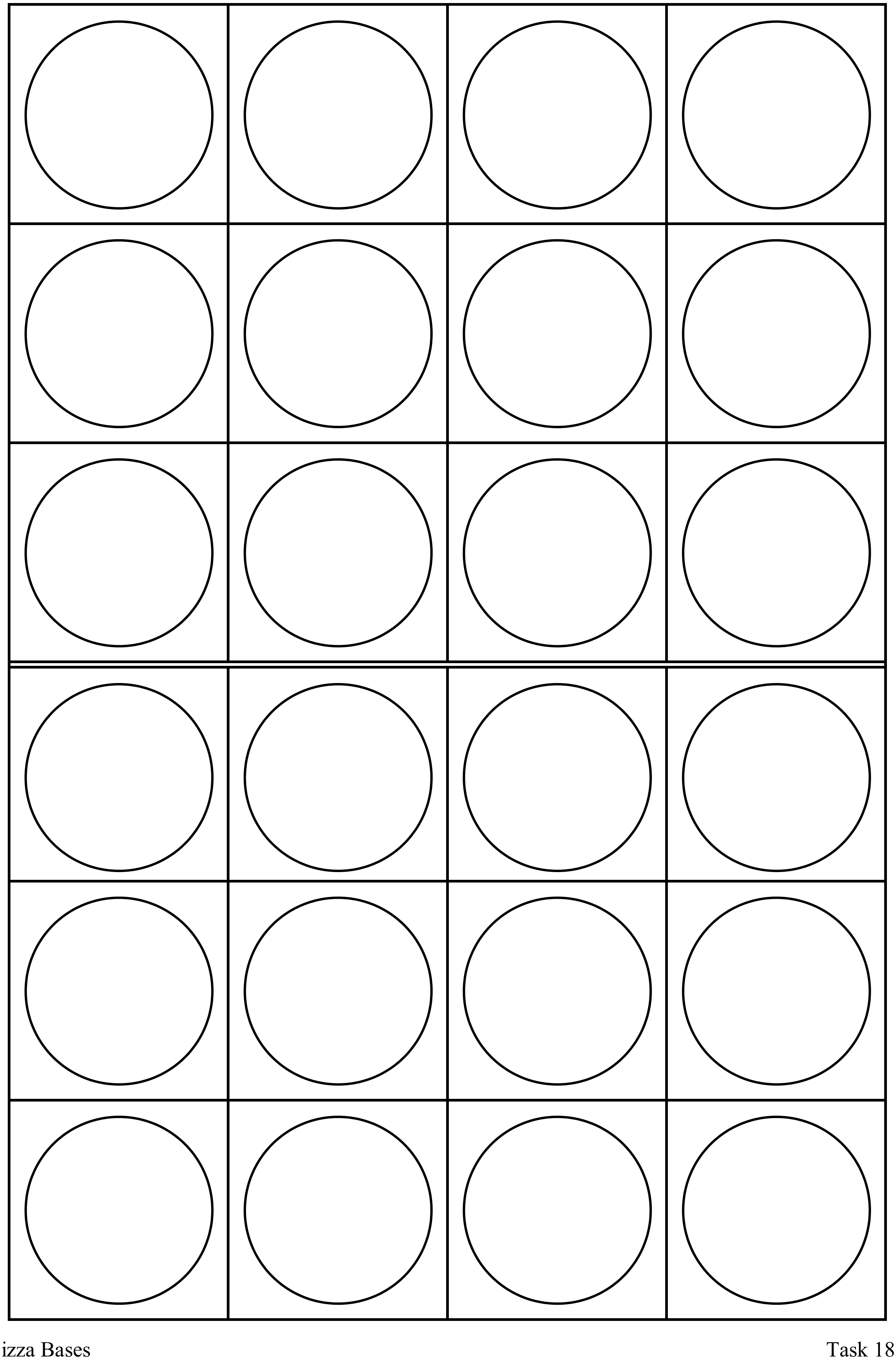
- pineapple (yellow)
- capsicum (green)
- mushroom (white)
- salami (red)

Challenge

How many different pizzas can be made?

How do you know when you have found all of them?





REVERSE

You Need

- Five [5] markers numbered 1 to 5

Challenge

Arrange the five markers like this:

_	1	2	3	4	5

Move by the rules to rearrange the markers like this:

_	5	4	3	2	1

Rules

- Move only one [1] piece at a time.
- Move only one position in either direction.
- Jump over only one piece in either direction.

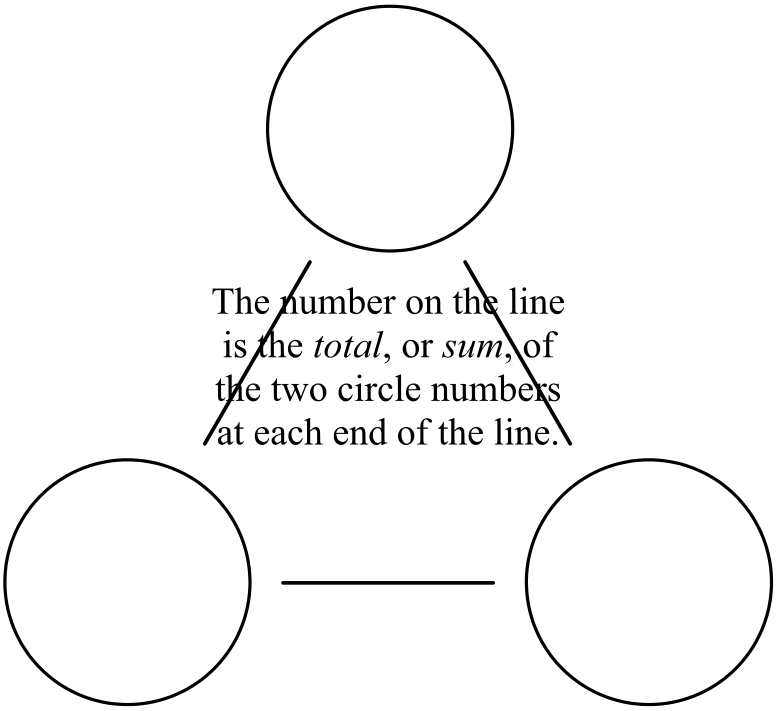
Hint: A mathematician might use the strategy of breaking the problem into smaller parts.

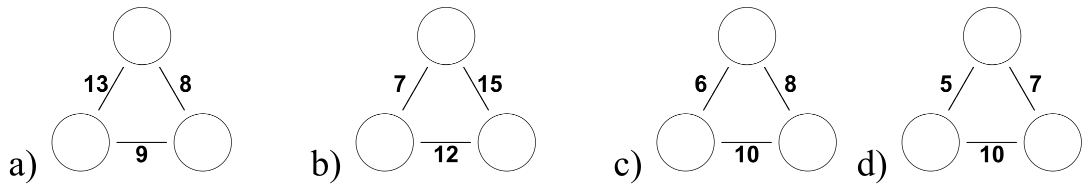
You Need

- Ten [10] discs numbered 1 to 10

Your Task

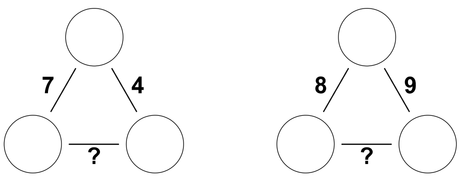
1. Find discs to go in the corners so the line numbers are correct for the problems below:





Challenge

Find the missing line totals.

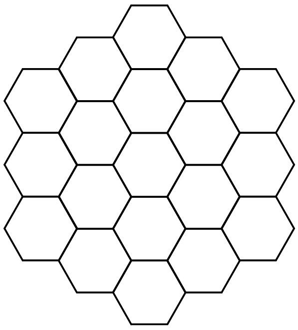


MAGIC HEXAGON

You Need

- Nineteen [19] counters numbered from 1 to 19
- One [1] playing board

Cover the hints with paper until after you try the task.



The Story

This puzzle has been discovered independently by several people since 1887. It became famous in 1963 through Martin Gardner's regular mathematical games and puzzles section in Scientific American.

Challenge

Place all the counters so every straight line adds to the same number.

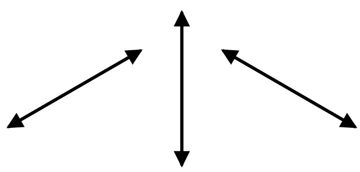
Mathematicians don't expect to solve a problem instantly.

Clifford W. Adams worked on this problem from 1910 until 1957.

So after you try the puzzle, uncover the hints one at a time for more help.

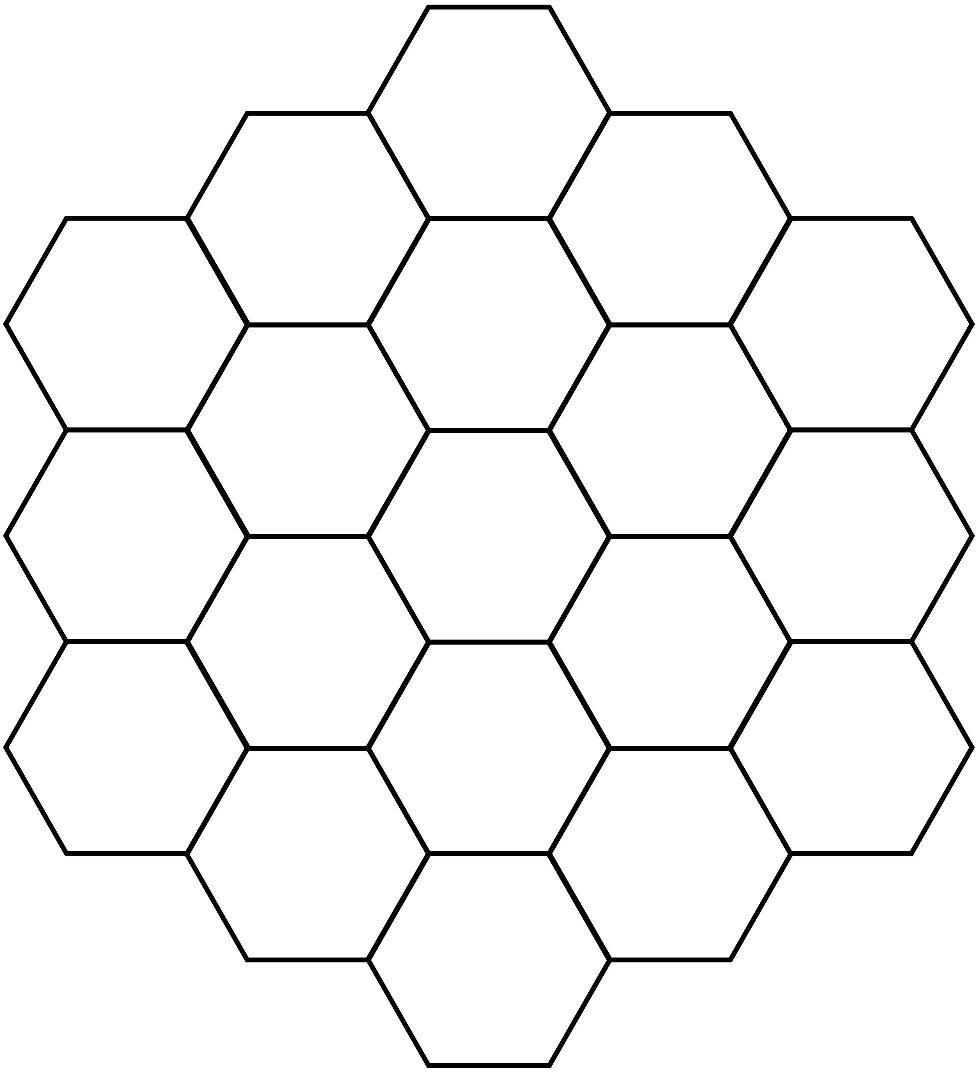
Hints

1. Find the total of all the numbers from 1 to 19.
2. There are five [5] vertical lines and each one must have the same Magic Total. The sum of these five Magic Totals must be the same as the answer in Hint 1.
3. There are three [3] different directions with five lines in each direction. So, fifteen [15] lines must have the same total.



4. Smaller numbers tend to be near the centre and larger numbers tend to be on the outside.

Magic Hexagon Board



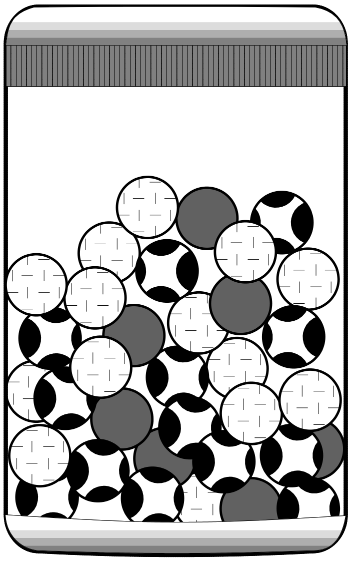
CHOOSING BEADS

You Need

- One [1] container with thirty-one [31] beads - fifteen [15] in one colour, twelve [12] in another colour and four [4] in a third colour

Your Task

1. In this experiment you record the number of trials until you have three [3] beads of the same colour. Close your eyes and choose beads at random one at a time. Stop when you reach three of the same colour.
2. Repeat this experiment five [5] times and record the number of trials.
3. What is the smallest number of beads you need to choose to be certain that you have three of the same colour?



Challenge

- What happens if the container has four [4] colours, ... or five [5] colours, ...or another number of colours?
- What happens if the experiment is about getting four of the same colour, ...or five of the same colour, ...or another number of the same colour?

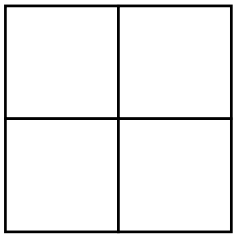
KEITH'S KUBES

You Need

- Two [2] sets of six [6] linking cubes.
  In each set there are four [4] of one colour and two [2] of another.

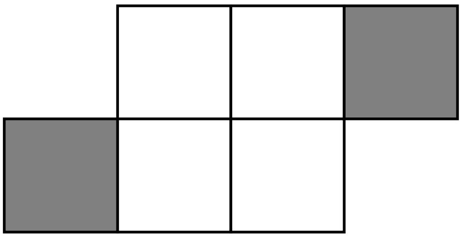
Your Task

1. Use four cubes of the same colour to make ...



2. Find all the different ways of joining on the other cubes so that the 'looking down' view (plan view) shows six cubes. Draw each one you make.

   This is an example



3. Find all the different ways of joining on the other two cubes if you are also allowed to join underneath or on top of the 4 cube block.
   Design a way to record these objects so someone else can make them.

Challenge

You will need more linking cubes from your classroom supply.

- Use the cubes to make *all* the six cube objects from Question 2.
- Use six of them to make a plan view that is a 6 x 6 square if:

  a) you *are allowed* to repeat an object.

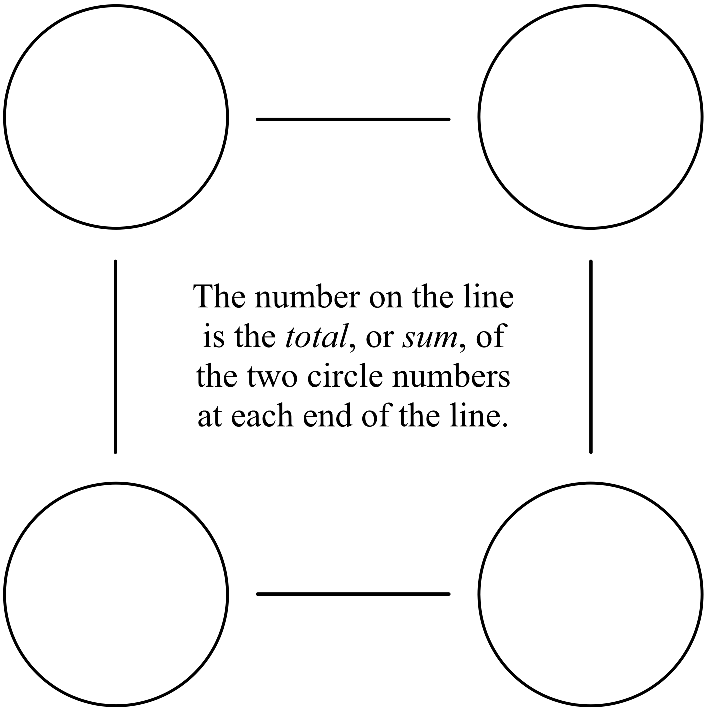
  b) you *are not allowed* to repeat an object.

ARITHMAGONS 2

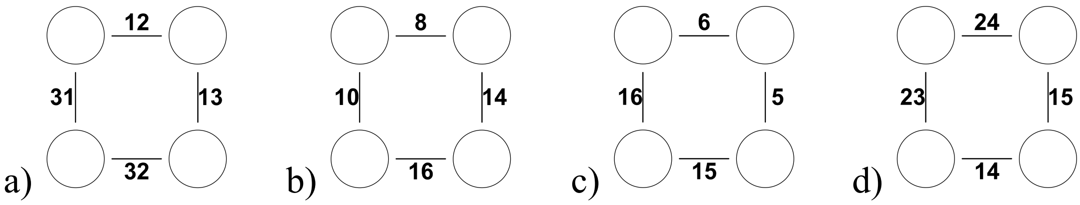
You Need

- Twenty-one [21] discs numbered 0 to 20

Your Task

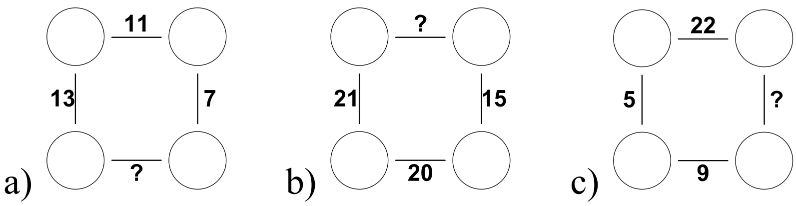


1. Find discs to go in the corners so the line numbers are correct for these problems:



Challenge

Find the missing line totals.



STOP AT 4

You Need

- One [1] pack of cards.

In this card trick, Aces are worth 1.

Sort out all the A, 2, 3, 4 cards to make a Mini Pack.

Rules

- Place the Mini Pack on the table *face up*.
- Move the top card to a new place, *face up*. This is the Starter Card.
- Count on from the number on the Starter Card and **stop at 4**.

  If the starter card is 1, say 1 and count 2, 3, 4 as you pile on 3 more cards.

  If the starter card is 2, say 2 and count 3, 4 as you pile on 2 more cards.

  If the starter card is 3, say 3 and count 4 as you pile on 1 more card.

  If the starter card is 4, say 4 and count NO more cards.
- Place the new pile *face down* and leave it for now.

Your Task

1. Make the next top card into a Starter Card. Repeat the rules.
   Keep on doing this until no new piles can be made.
   Leave the left over cards face up.
2. Choose any three [3] of your piles and move them to one side.
   Put all the others face up in one big pile with the left overs.
3. Turn over *any two [2] top cards* from the three piles. Add their values, then add 1 more and count out this many cards from the left overs.
4. Count the number of left over cards still in the pile.
   Look at the value of the top card of your third pile. What do you notice?

Challenge

Try the trick a few more times and try to discover why it works.

WHAT'S IN THE BAG?

You Need

- Forty [40] objects in four [4] colours
- One [1] bag

Your Task

1. Player A secretly puts 10 objects into the bag using mixed colours.
2. Player B takes out four pieces...
   - records the number of each colour
   - and puts the objects back in the bag.

   These four are called a Sample of what's in the bag.
3. Do this twice more so there are three [3] samples from the bag.

Example	R	Y	G	B
Sample 1:	0	2	1	1
Sample 2:	0	3	1	0
Sample 3:	0	2	0	2

4. From your data try to work out what's in the bag.
5. Swap roles and start again so Player A has to work out what's in the bag.

Challenge

Discuss and record the best system you can think of for predicting what's in the bag when you have three samples.

- Test your system by using twenty [20] objects in the bag.

GREEDY PIG

You Need

- One [1] playing board and one [1] cube dice
- Two [2] marking pens and a wiping cloth

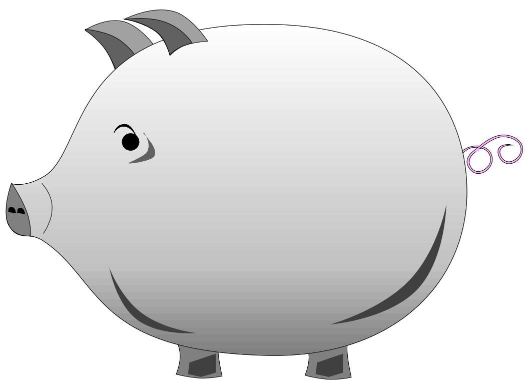
This is a game for two players. Each game has five [5] rounds and the winner has the larger total at the end of the game. Beware of 2! It's the killer number!

Rules

- For each round, roll the dice and record the scores.
- Keep rolling and scoring in that round until each player has either quit or been 'killed'.
- Both players get the first two rolls 'free'.
  You can't be 'killed' on these rolls.
- After the first two rolls you have to decide each time whether to stay in for one more roll, or quit and keep the total of your scores so far.
- If you stay in, you score the number on the next dice roll. **BUT, if that number is 2, the killer number, you score zero [0] for that round**!
- One player might decide to quit early, but the other player can continue rolling until they decide to quit and take a score, or until they roll 2 and score zero for being a 'greedy pig'.
- Total your scores each round.
- Play five rounds each to make the full game, then calculate your grand total. The winner has the larger grand total.

Challenge

Investigate when you should quit to get the best possible total.



Greedy Pig Board

Player A

Game		Total
1		
2		
3		
4		
5		

Grand Total _________

Greedy Pig Board

Player B

Game		Total
1		
2		
3		
4		
5		

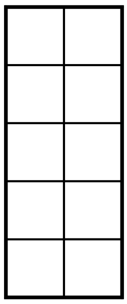
Grand Total _________

RECTANGLE FRACTIONS

You Need

- One [1] rectangle and twenty-five [25] blocks the same colour

Your Task



Fraction questions can be solved using the rows, columns and cells of a rectangle. The first part of this task uses the rectangle shown here.

- Put paper over your rectangle board so you only see this whole rectangle.

1. How could you show **one half + two fifths** with your blocks?

   Anita said: *"That's the same as claiming one complete column and two complete rows by putting blocks on the squares."*

   Think about claiming COMPLETE rows and columns with blocks.

2. Use the rectangle above to work out:

   (a) **three tenths + one half**   (b) **two fifths - three tenths**

   (c) **three fifths + five tenths**   (d) you choose one

Challenge

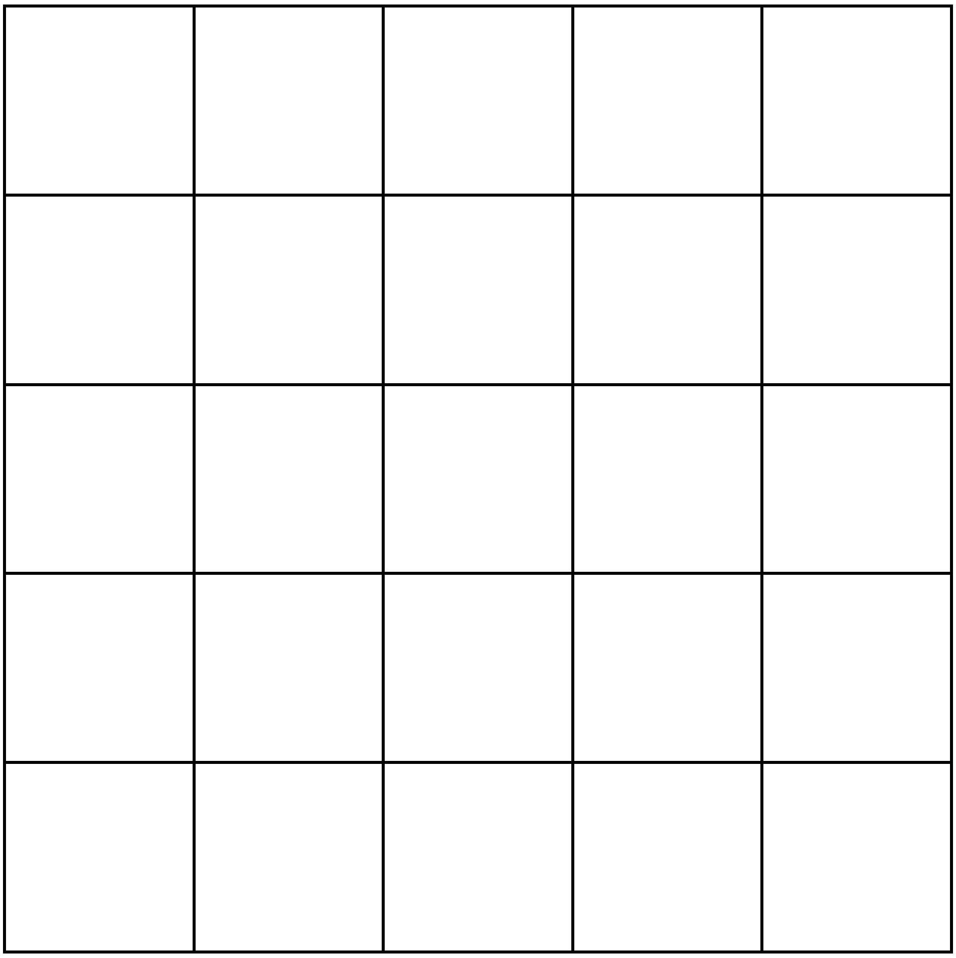
Choose a rectangle that helps you work out **one quarter + two fifths**.

Draw and write in your journal to explain.

Make rectangles of your own.

Create your own fraction questions from your rectangle.

Rectangle Fractions



DECIMALS WITH A TAPE

You Need

- Two [2] 150cm tapes, one each
- One [1] calculator (not supplied)

You have probably seen questions like these in a text book:

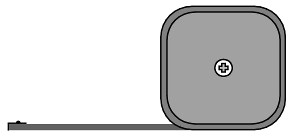
a. 0·15 + 0·23 b. 0·86 - 0·31 c. 3 x 0·45 d. 0·72 ÷ 0·03

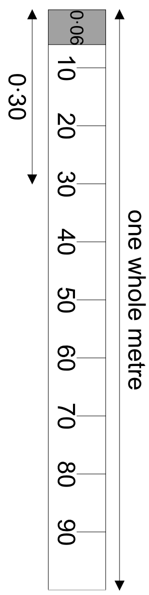
Your Task

1. *Estimate* the answers to each question and record your estimate.
2. Use a calculator to check your estimate.

The Story

Mathematicians have to be able to check their work another way. This task invites you to check your calculator work another way. In the old days they. didn't have calculators, but they did have tape measures





Challenge

Check each of the questions using the tape measures.

Hints

- The whole in this problem is one metre of tape.
- One metre = 100cm.
- If 1m = 1·00, then 5cm = 0·05
  because it is zero [0] wholes and 5cm out of 100cm.
- Ian said: *0·30 ÷ 0·06 means how many lots of 6cm fit into 30cm.*

Explain your checking method with words and pictures.

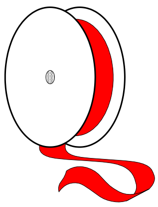
Make up some decimal questions of your own and work them out with the tapes. Check your answers with a calculator.

FRACTION ESTIMATION

You Need

- Two [2] lengths of tape in two colours
  - one [1] about 2m and one about 3m
- Four [4] pegs (2 in each of 2 colours)

Your Task



1. Stretch one tape out straight on the floor.
2. Each person has to estimate where two fifths [$^{2}/_{5}$] along the tape from the left end would be. Clip your peg on where you think it is.
3. Find a way to fold the tape to see who is closer.

---

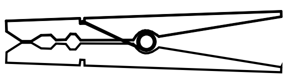
4. Repeat Questions 1 - 3 with the other tape.

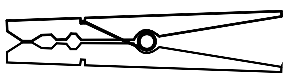
Challenge

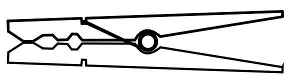
Repeat Questions 1 - 4 for these fractions:

- One quarter [$^{1}/_{4}$]
- One third [$^{1}/_{3}$]
- Two sevenths [$^{2}/_{7}$]

Make up some challenges of your own.







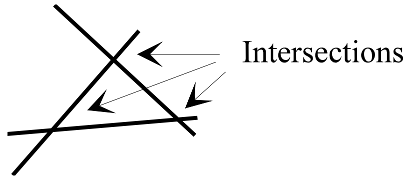
INTERSECTIONS

You Need

- About thirty [30] sticks

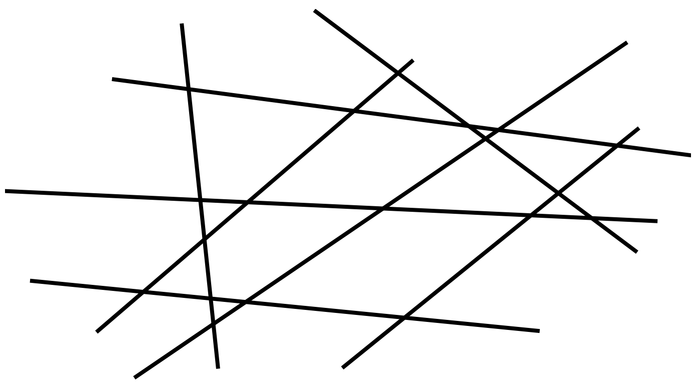
Your Task

1. Three [3] sticks make intersections like this...



   - Cross over three sticks to make one [1] intersection.
   - Cross over three sticks to make two [2] intersections.
   - What is the maximum number of intersections that can be made by crossing over three sticks?
2. What is the maximum number of intersections that can be made by crossing over two sticks?
3. What is the maximum number of intersections that can be made by crossing over four [4] sticks? ...five [5] sticks?

Challenge



What is the maximum number of intersections that can be made by crossing over one hundred [100] sticks?

- In your journal, explain how you worked it out.

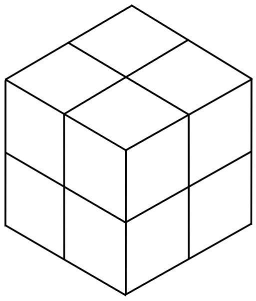
CUBE NUMBERS

You Need

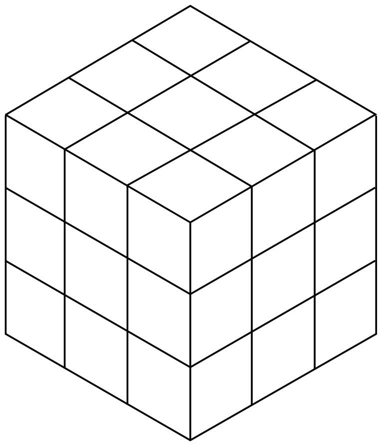
- Twenty-seven [27] cubes:
  ...one [1] Colour A, seven [7] Colour B, nineteen [19] Colour C

Your Task

1. Build a 2 x 2 x 2 cube with Colour A and Colour B. Slice layers away from it to show how it could have been built up from the 1 x 1 x 1 cube.



2. Build a 3 x 3 x 3 cube with all the colours. Slice layers away from it to show how it could have been built up from the 2 x 2 x 2 cube.



3. How many extra cubes would you need to build up the 4 x 4 x 4 cube from the 3 x 3x 3 cube?
4. How many extra cubes would you need to build up the 5 x 5 x 5 cube from the 4 x 4 x 4 cube?

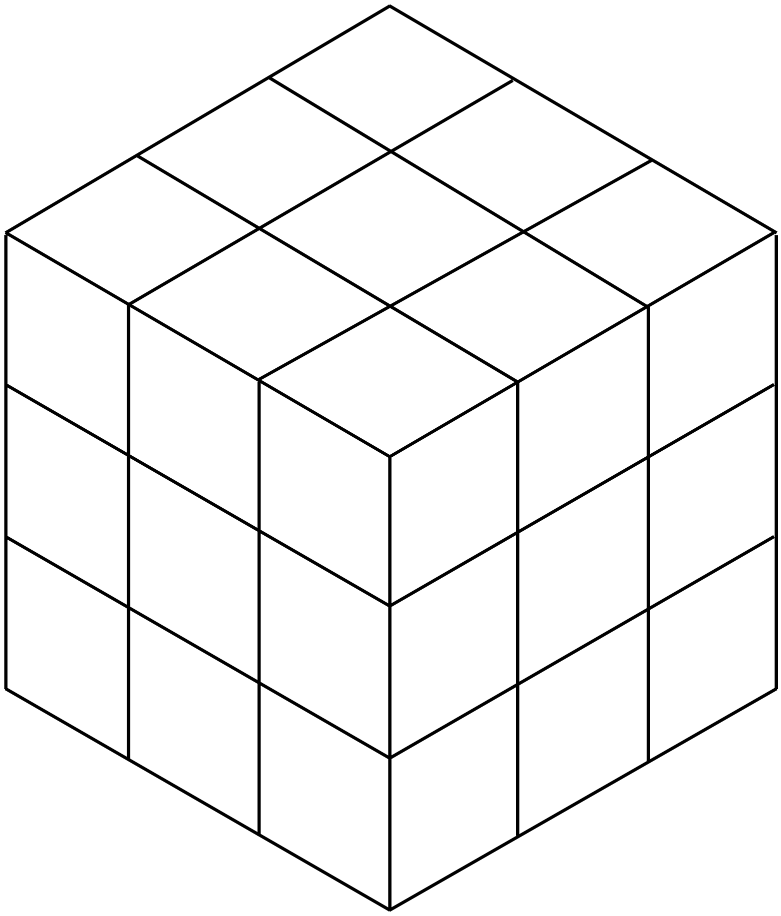
Challenge

If I tell you any size starting cube, explain how to work out the number of extra cubes to make the next size.

You Need

- Nine [9] each of three [3] colours of cube (red, yellow and black look great)

PATTERN CUBE



Challenge

Build a large cube three [3] cubes long, three cubes wide and three cubes high so that each line along, across and up has one cube of each colour.

DIVISION BOXES

You Need

- Ten [10] tiles numbered 0 to 9
- One [1] calculator (not supplied)

The Story

Using his tiles, Arnie made the 3 digit number 546 like this:

5	4	6

Reading from the left, he noticed that:

- the first digit can be divided by 1 … ($5 \div 1 = 5$)
- the first two digits can be divided by 2 … ($54 \div 2 = 27$)
- the first three digits can be divided by 3 … ($546 \div 3 = 182$)

Your Task

1. Make more 3 digit numbers that work like Arnie's.
2. Make a 4 digit number like Arnie's, so that reading from the left:
    - the first digit can be divided by 1
    - the first two digits can be divided by 2
    - the first three digits can be divided by 3
    - the first four digits can be divided by 4

Challenge

It is possible to make 5 digit numbers, 6 digit numbers, … *even 10 digit numbers* which follow Arnie's pattern. How many can you make?

SOFT DRINK CRATES

You Need

- Twenty-five [25] 'soft drink cans'

The Story

Tony was packing soft drink cans into the crate below.

He had packed exactly ten [10] cans into the crate when he noticed:

- every row and column had an *even* number of cans

Your Task

1. Find out how the cans might have been arranged.
   (Some rows or columns may have zero cans.)
2. Try the problem again using eighteen [18] soft drink cans.
3. Choose a different *even* number of cans and try to arrange it so every row and column has an even number.

Challenge

Find an *even* number of cans which *cannot* be packed in even rows and columns.

MONKEYS & BANANAS

You Need

- Thirty [30] 'bananas'

The Story

Three monkeys worked together all day to gather a pile of bananas, then went to bed.

During the night:

- The first monkey took one third of the bananas and hid them in a safe place. But she had to eat one before she could take exactly one third. Then she went back to bed.
- The second monkey woke up later and took one third of what was left and hid them in a safe place. But he had to eat one before he could take exactly one third. Then he went back to bed too.
- The third monkey woke up later and took one third of what was left and hid them in a safe place. But she had to eat one before she could take exactly one third. Then she went back to bed too.

In the morning the monkeys were able to equally share all the bananas left in the pile.

Don't monkey with my bananas!

Your Task

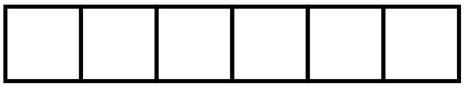
1. How many bananas might have been in the original pile?
2. How many bananas did each monkey receive at breakfast?

CHAINS

You Need

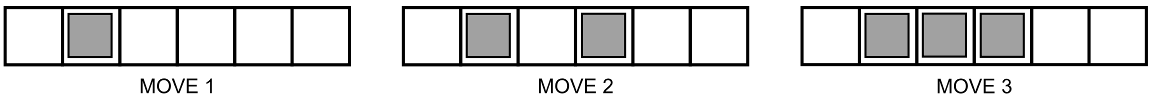
- Six [6] identical objects and the playing strip below

In this investigation you put objects on the cells of a strip to win points.



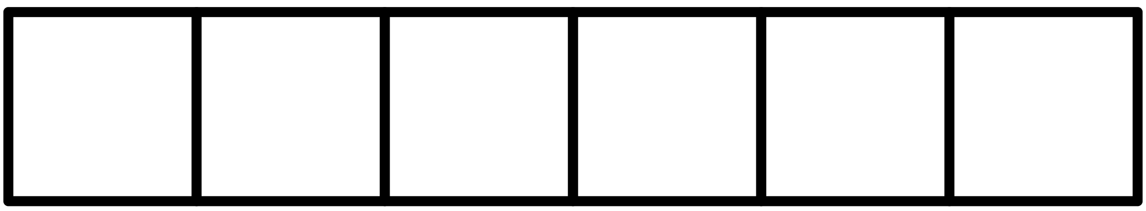
Rules

- The first object you place scores one [1] point.
- When you make a chain of objects side by side you score one point for each object in the chain.
- Placing an unchained object scores one point.
- There are six [6] objects to place, so there are six moves in a game.
- Your score is the sum of the points you win on each of the six moves.
  Example: These three [3] moves score 5 points so far (1 + 1 + 3).



Your Task

1. What strategy would you use to get the highest possible score?
2. What strategy would you use to get the lowest possible score?
3. Are there any scores between the highest and lowest that can't be made?
4. What do you know about the first move in the game?
5. What do you know about the last move in the game?



Challenge

Change the board length and investigate the Chains game again.

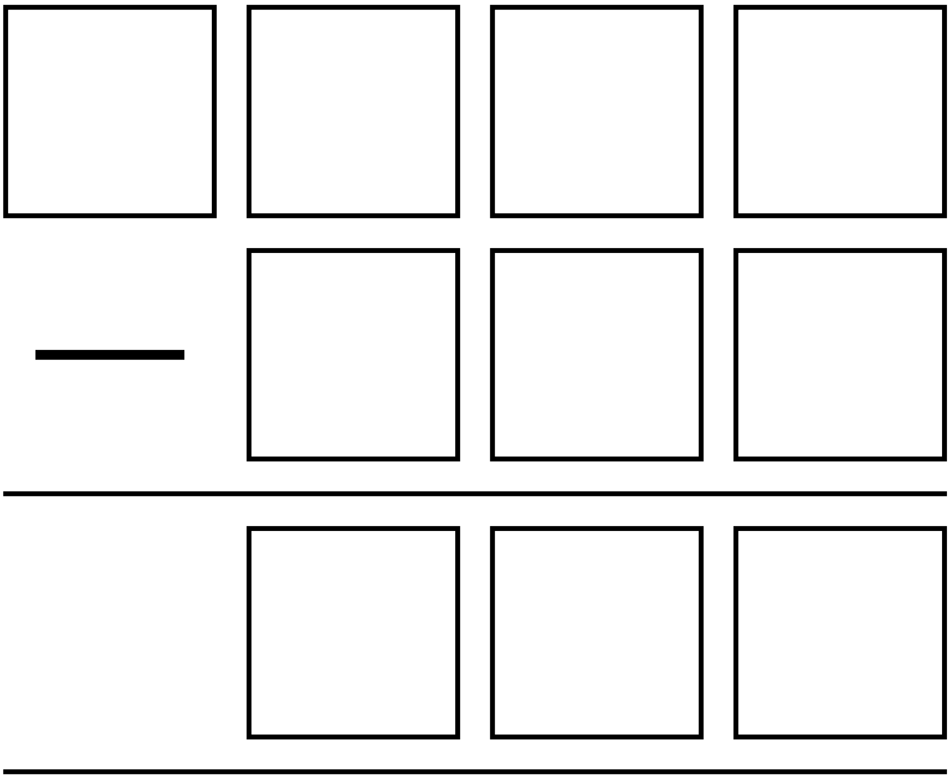
TAKE AWAY TILES

You Need

- Ten [10] tiles numbered 0 to 9

Your Task

1. Place the tiles to make a correct subtraction. Zero cannot be a first digit.



2. Try to find five [5] solutions.

Challenge

How many solutions are there?

How do you know when you have found them all?

SQUARE PAIRS

You Need

- Twenty [20] tiles numbered from 1 to 20

Your Task

1. Arrange the tiles in a list from one [1] to sixteen [16].
   Make eight [8] pairs so that each pair adds to a square number.
   (Note: The sum of each pair does not have to be the same square number.)

1	8		9	16

This pair sums to 9 (3^2)

This pair sums to 25 (5^2)

2. Look inside the list from 1 to 16 for another list that starts at 1 and also makes square pairs.
3. Make the list from 1 to 20
   Find two other lists inside this list that start at 1 and make square pairs.

Challenge

Find as many lists as you can that start at 1 and make square pairs.

- There are only seven [7] lists ending in even numbers that *cannot* square pair. Find as many of these as you can.

GUESSING COLOURS GAME

You Need

- One [1] bag and about thirty [30] discs in five [5] colours (There must be at least three [3] of each colour.)

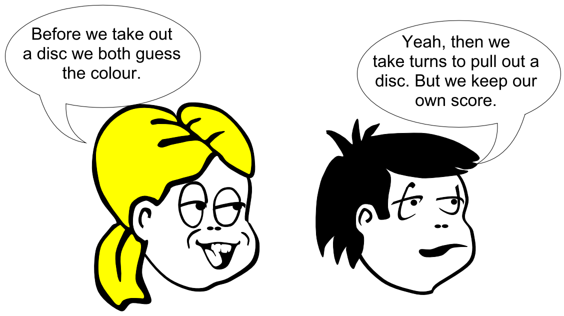
Your Task

1. Choose your own colours so there are 7, 3, 2, 2, 1 in the bag.

   Record what you start with, eg: 7 red, 3 blue, 2 green, 2 yellow, 1 black. Now play this game for two [2] players:

Rules

- You will need a *Guesses* column and a *Points* column.
- Start with 15 points each.
- *Before* a disc comes out, *both players* write their guess for the colour.
- Without looking take a disc from the bag.
- If you guess correctly ADD 2 points to your score.



- If you guess wrongly TAKE AWAY 2 points from your score.
- Write down your guesses and your new points each time until all the discs have come out.
- The winner has the higher positive score.

Challenge

Play the game again starting with three of each colour.

In which game would you expect to score more points?

SMOOTH EDGE TILES

You Need

- Twenty-five [25] square tiles:
  Nine [9] with zero [0] marked edges
  Twelve [12] with one [1] marked edge
  Four [4] with two edges [2] making an L-shape

The Story

Kareema builds beautiful tiled patios. She makes sure every border tile has smooth edges. The marked edges of your tiles are the smooth ones.

Your Task

1. Make a 5 by 4 rectangular patio from the tiles.
   Use smooth edge tiles all around the outside, just like Kareema would.
   How many tiles with zero [0] smooth edges?
   How many tiles with one [1] smooth edge?
   How many tiles with two [2] smooth edges?
2. Find the number of each type of tile if the patio is 6 by 3?
3. Find the number of each type of tile if the patio is 5 by 5?

Challenge

If Kareema tells you any size patio, can you tell her the number of each type of tile? For example: 10 by 8 ... 100 by 50 ... M by N

- Write and draw to explain to someone else how to do this.

ADD THE PACK

You Need

- Twenty-eight [28] playing cards - 7 to King in four suits

In this task count:

- **J**ack as **11**
- **Q**ueen as **12**
- **K**ing as **13**

You will be searching for as many ways as possible to add the pack.

Your Task

1. Think of a really slow way to add the pack.

   Use this way to find the grand total of the pack.

   You may use a calculator if you wish.

2. Catharina worked like a mathematician by grouping some cards.

   - What might she have done?
   - What else might she have done?
   - Try to find several ways of grouping.

3. As Antonio grouped the cards on the table he said:
   20 times 4
   20 times 4
   20 times 4
   plus 10 times 4

   How did he group the cards?

Challenge

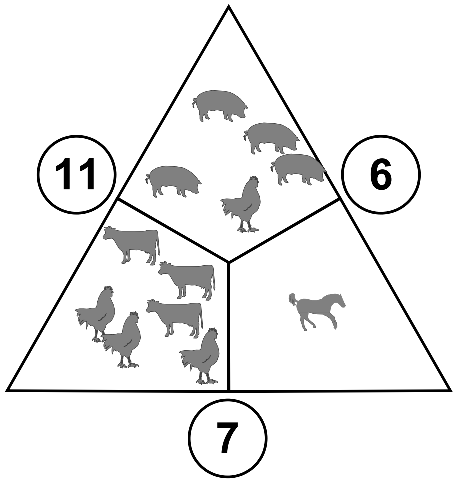
Imagine the full pack of fifty-two [52]cards.

- Find at least three [3] ways to add this pack.
- Do you get the same answer each time?

ANIMAL FARM

You Need

- Twenty-five [25] 'animals'
- One animal farm board, marker and wiping cloth



This picture is an example.

The Story

A farmer has three fields.

The fields are part of a triangle.

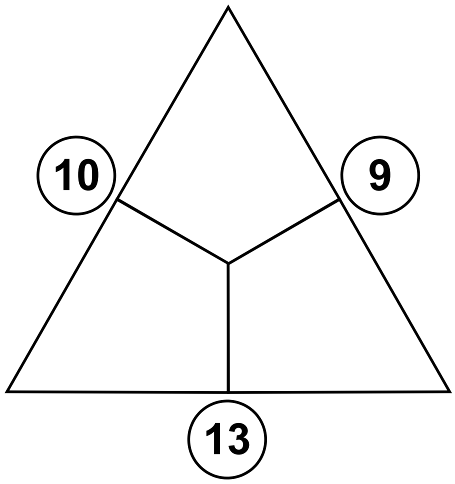
This example shows how the farmer records where the animals are.

It is like a map.

Your Task

1. Put some animals on the board in any way you want to.
   Write the circle numbers for your map.
2. Do the first question again at least three [3] more times

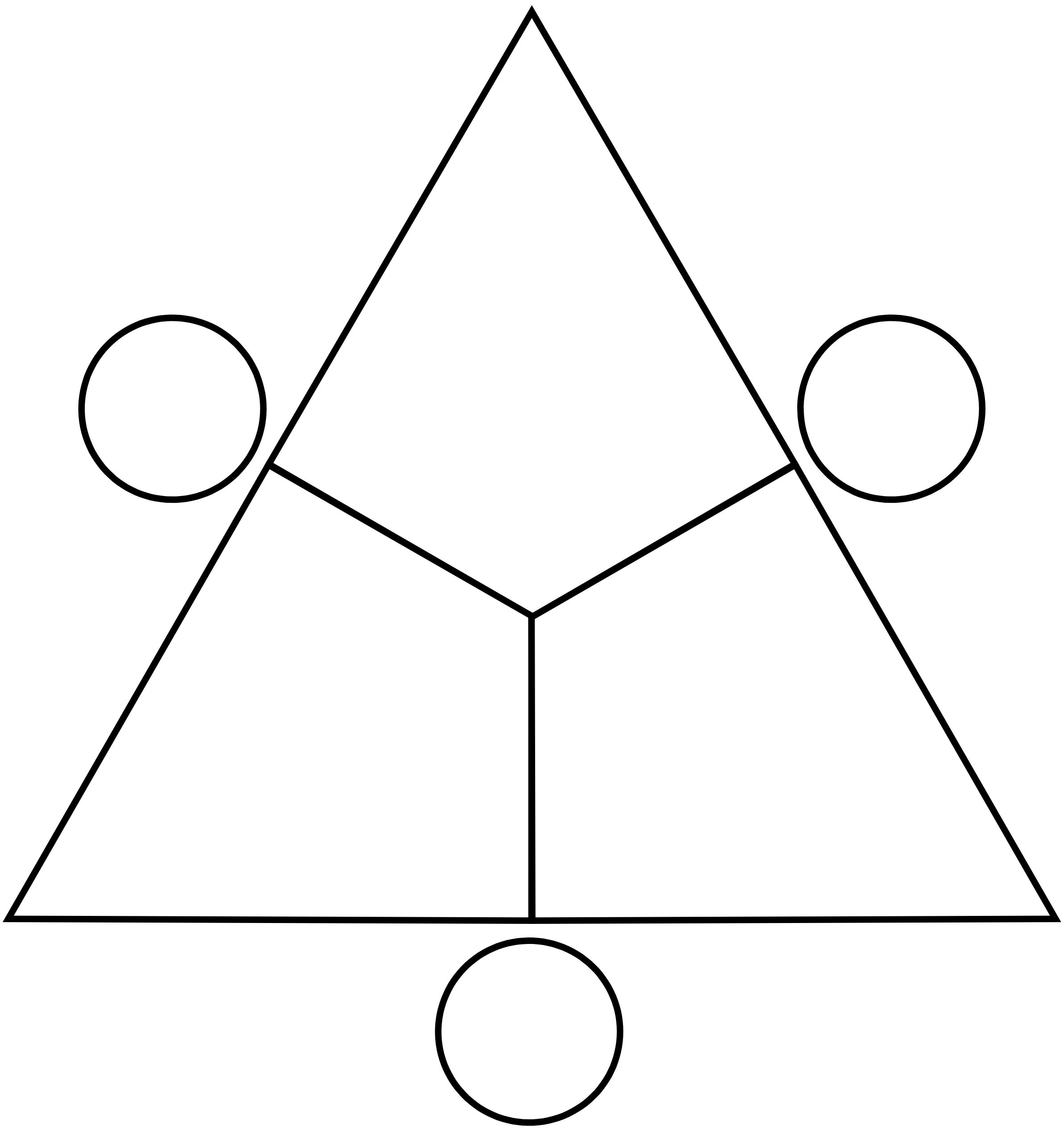
3. The farmer forgot to draw the animals on this map.
   Work backwards to find out the number of animals in each field.
   Is there only one answer?
4. Make up your own animal problems.



Challenge

What could you work out if you found a farmer's map with only two circle numbers?

Animal Farm



FLOWERS IN THE FIELD

You Need

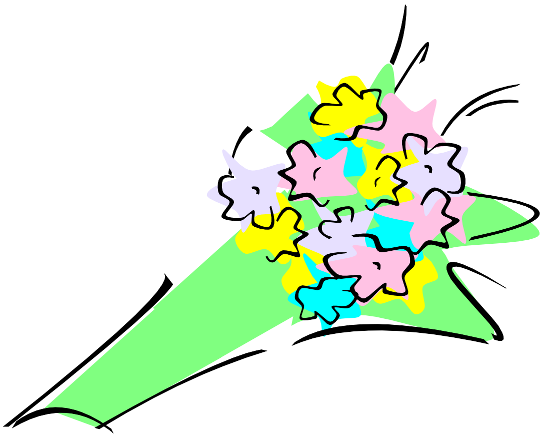
- Ten [10] different coloured 'flowers'

The Story

The children have found some flowers in the field.

They make a bunch for mother.

Your Task



1. They find four [4] different flowers. In how many different ways can they make a bunch of three [3]?
2. Explore the number of ways they can make bunches

   ... of 1

   ... of 2

   ... of 4

   with four different flowers.

3. What happens if there are six [6] different flowers?
   - How many ways can the children make a bunch of four?
4. Explore your own numbers for flowers and size of bunches.

Challenge

If I tell you any number of flowers and any number for the size of the bunches, can you tell me how to work out the number of ways to make bunches?

TABLES FOR 25

You Need

- Six [6] rectangular 'tables'
- Thirty [30] 'students' - fifteen [15] in each of two [2] colours

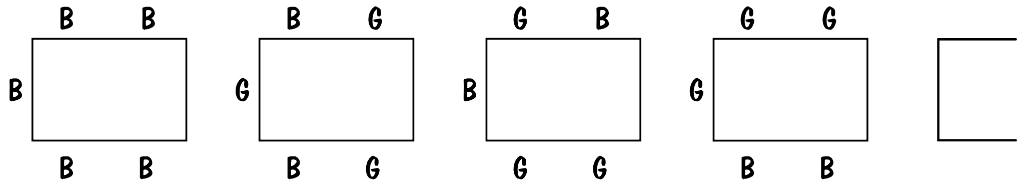
The Story

There are 25 students in Mr. Edwards maths class. Fourteen [14] are boys.

Mr. Edwards says:

"Please sit in groups of five with *at least two boys* in each group."

Here is one way they could sit.



Your Task

1. Make the tables shown and finish the missing one.

   This solution could be recorded as (5, 3, 2, 2, 2). Order doesn't matter.
2. Using Mr. Edwards rule, find a different way to make the table groups.

   Record your solution.
3. Using Mr. Edwards rule:
   - How many ways are there to make the groups?
   - How do you know when you have found them all?
4. Using the same rule, what happens if there are 15 boys in a class of 25?

Challenge

Suppose Mr. Edwards had said *at least one [1] girl in each group.*

How many solutions are there? How do you know you have them all?

LESS THAN FRACTIONS

You Need

- Nine [9] tiles numbered from 1 to 9
- One [1] inequation board

Your Task

1. Use the tiles on Part A of the board to make this inequation true. The fraction must be less than 1.

$$\frac{\square}{\square} < 1$$

2. There are thirty-six [36] possible answers.
   How many can you find? Record them in your journal.

Challenge

Use the tiles on Part B of the board to make this inequation true.

$$\frac{\square}{\square} + \frac{\square}{\square} < 1$$

Discover as many answers as you can and record them.

Less Than Fractions

Part A

$$\frac{\square}{\square} < 1$$

Part B

$$\frac{\square}{\square} + \frac{\square}{\square} < 1$$

SICHERMAN DICE

You Need

- Two [2] standard cube dice
- Two [2] special dice:
  - one [1] numbered 1, 2, 2, 3, 3, 4
  - one [1] numbered 1, 3, 4, 5, 6, 8

Your Task

1. Roll the standard dice and add.

   What are the possible totals?

   How many ways can each total be made?

   Record this information in your journal.

2. Roll the special dice (called Sicherman Dice) and add.

   What are the possible totals?

   How many ways can each total be made?

   Record this information in your journal.

3. What do you notice?

   Sicherman Dice are the only dice with non-zero whole number faces that have this property.

Challenge

If *zero can be used*, find two more dice with this property.