Mathematical investigation (1)

Investigating is a great way to learn to think mathematically, apply logic, spot patterns and improve our perseverance.

Magic Squares

AIM: To investigate properties of 'magic' squares.

You will need: Some paper for jotting and trying out ideas, a pencil

What is a magic square?

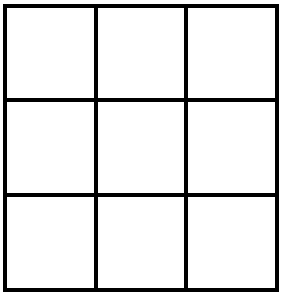
8	1	6
3	5	7
4	9	2

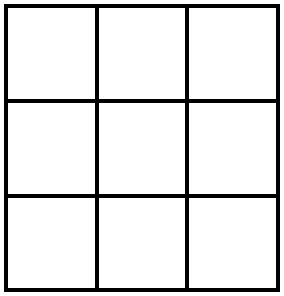
Try **adding** the **three numbers** on each **horizontal,** each **vertical** and each **diagonal** line, e.g. 8 + 1 + 6 across the top horizontal line or 4 + 5 + 6 diagonally from the bottom left to the top right. What do you notice?

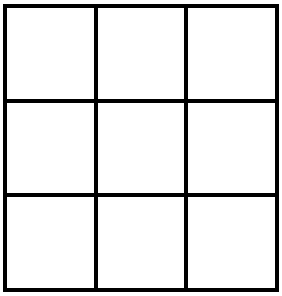
Now try re-arranging the numbers 1-9 in these squares to discover some more 'magic' squares that give the same result. You could start by swapping around the numbers in the corners or at the sides…

You can also try this and some of the other magic square puzzles online:

https://www.transum.org/software/SW/magic_square/magic_square.asp







Recap...

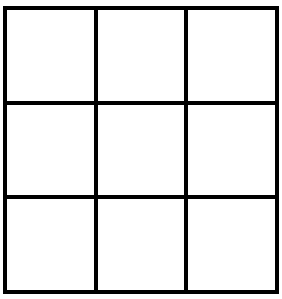
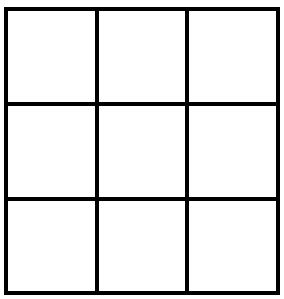
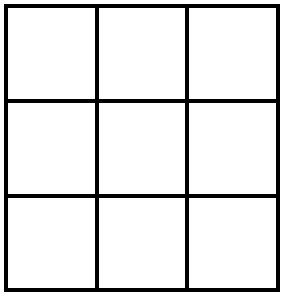
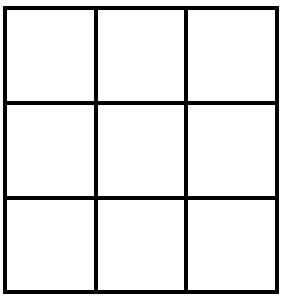
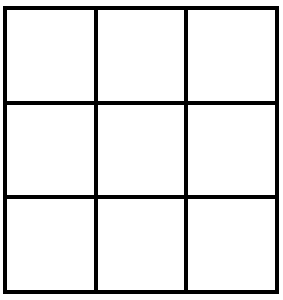
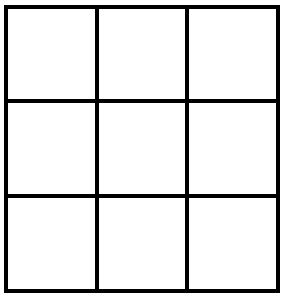
You should have found some other ways of arranging the numbers…

- What do the **3 numbers always add to?**
- What number is always in the **centre?**
- What is the **connection** between the numbers?

Now take the original magic square, and try these puzzles. For each puzzle make a **prediction** before trying it out:

- What happens if you **double each number** in the square?
- What happens if you **add 3 to each number** in the square?
- What happens if you **subtract 1 from each number** in the square?

In each case, what is the relationship between the number in the centre and the total for each line?

Now let's make our own magic square.

This one has **7** in the centre, so can you **predict** what each line should add up to?!

You need to choose values for the square and for the triangle then solve the equations to make this square work!

Choose **different numbers** for the **square** and *triangle* , then find the number in each place… □ = _____ △ = _____

7 - □	7 + □ - △	7 + △
7 + □ + △	7	7 - □ - △
7 - △	7 - □ + △	7 + □

So, the numbers in the Magic Square are special, but why are they called magic? From ancient times, it seems that they were connected with the supernatural and magical world. The earliest record of magic squares is from China in about 2200 BCE and is called ***Lo-Shu***. There's a legend that says that the Emperor Yu saw this magic square on the back of a divine tortoise in the Yellow River!

You can read more about the history of magic squares HERE.

AND BIGGER MAGIC SQUARES

4 by 4 magic square

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

- Try adding each **horizonal, vertical and diagonal line.**
- What do you find? But there's more!
- Try adding the **2 by 2 squares** inside the square, e.g. 1, 15, 12 and 6.
- Now try the **4 squares in the centre.**
- Now the **4 corners...** can you predict the answer?!
- Now the **central numbers on the top and bottom rows (15, 14, 2, 2)...**
- Now the **central numbers at the sides...**

Kaya's older brother says that if you **add 16** to each of the numbers in the 4 by 4 magic square, the **magic number will be 50.**

Use these blank squares to check this… Was he right?

What numbers could you use to make a **4 by 4 magic square** that ***does*** have the **magic number 50**?