

# Magic Squares

**Overview:** Magic squares have been traced through history as known to Chinese mathematicians, Arab mathematicians, Indian and Egyptian cultures. Magic squares have fascinated people for centuries, and historians have found them engraved in stone or metal and worn as necklaces. Early cultures believed that wearing magic squares would ensure they had long life and kept them from getting sick.

Benjamin Franklin was well-known for creating and enjoying magic squares, and it was all the rage during his time. Here's the deal: We're going to arrange numbers in a way so that all the rows, columns, and even the diagonals add up to a single number (called a Magic Sum). The first Magic Square was published in Europe way back in 1514.

## Materials

- Pencil
- Paper

**Activity:** Here's the first magic square, which was published in Europe in 1514. The square has the number 1514 embedded within it (can you find it?).

In the square, when you the sum the numbers in the boxes of any diagonal, row, or column, you always get the same answer: 34. For this particular square, you can add the corners and you'll also get 34.

34 is the "magic sum" of this magic square. Every magic square has its own magic sum. Some squares are 15, while others are much larger.

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

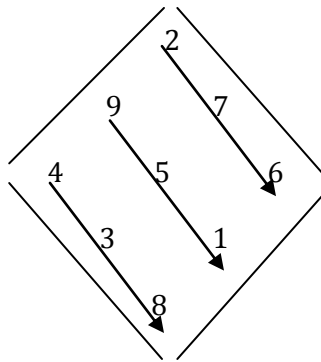
Let's build a magic square from scratch. Start by drawing a box of 9 squares, and write the numbers as shown:

1	2	3
4	5	6
7	8	9

Now swap the values at the corners as shown (the 9 and 1 trade places, as do the 3 and 7):

9	2	7
4	5	6
3	8	1

Now imagine that the grid is made out of rubber bands that can stretch and move. Pinch the 2 with one hand, the 8 with the other, and pull them apart to reform the grid into a diamond shape, with the 2 at the top and the 8 at the bottom. Do you see how I made the numbers in the image below doing this?



Now write the numbers along the arrows into a new grid like this:

2	7	6
9	5	1
4	3	8

This is your new magic square. What is the magic sum?

The sum of the elements on any diagonal, row or column is 15. Now erase 4 to 6 of the values (depending on the skill of your audience) in your box and give it to someone to solve. You've created your own magic square puzzle!

We can also have a look at the upside-down magic square, which gives a magic sum of 264:

96	11	89	68
88	69	91	16
61	86	18	99
19	96	66	81

It's called an upside-down square because when you rotate it a half turn, the result is still a magic square (with the right computer font). The amazing thing is that it still adds up to 264!

18	99	86	61
66	81	98	19
91	16	69	88
89	68	11	96

### Exercise

Find the value of the letters; A, B,C and D in the following upside-down magic square

18	A		61
D	81	98	
91	B		88
C	68		96

1. A
2. B
3. C
4. D
5. What is the sum of elements of any diagonal in the first magical square published in 1514?
6. Find the element at the middle of a nine-element magic square.
7. Draw a nine-element magic square.

Find the values of b and c in the following magic square.

16		2	
c	10	11	8
	6	7	
		d	b

8. b
9. c
10. d

## Answers to Exercises: Magic Squares

1. 99
2. 16
3. 66
4. 89
5. 34
6. 5
7. See magic square below:

2	7	6
9	5	1
4	3	8

8. 1
9. 5
10. 14