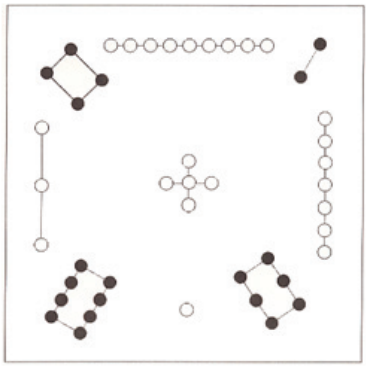
Math Magic!

Activity 3 - Fascinating Magic Squares

Magic Squares are believed to have originated in China thousands of years ago. The oldest known magic square, called Lo-Shu, appeared on the back of a divine turtle in a Chinese river over 4,000 years ago. Magic squares have fascinated scientists, astrologers and mathematicians for centuries. In Medieval times people believed that magic squares possessed mystical powers and had the ability to ward off the deadly plague. Magic squares contain a variety of mathematical patterns, both visual and numerical, some of which you will discover in this weekend project.

Below is a picture of the original Lo-Shu magic square. In the diagram, black circles represent even numbers and white circles represent odd numbers. (The even numbers in the Chinese culture represented the Yin or the female principle of the Universe, while the odd numbers represented the Yang or the male principle of the Universe).



Converting the Chinese symbols, used in the Lo-Shu, into our modern number system, we get the following magic square:

4	9	2
3	5	7
8	1	6

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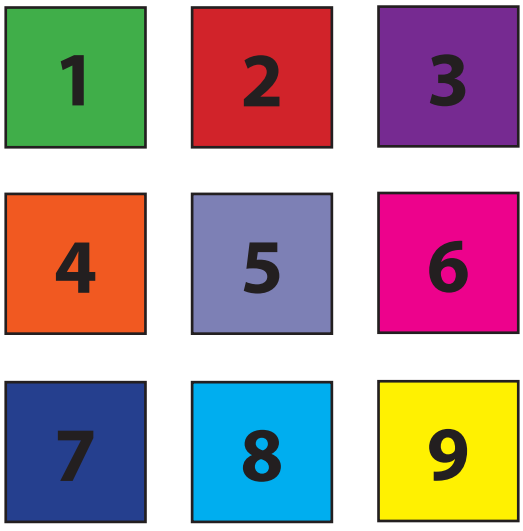
But what makes a magic square so special? What are its unique properties?

Magic Squares Have Three Main Properties

1. The order of a magic square is defined by the number of rows or columns. Because it's a square, the number of rows = the number of columns. The order of the magic square shown on the first page is three.
2. The numbers in each **row**, **column** and **digagonal** of any magic square always add up to the same sum. This sum is called the *magic constant*.
3. Any two numbers in any row, column or diagonal that are equidistant from from the centre of the square are complements of each other. Two numers in a magic square are complementary if they add up to the complement sum, which is calculated by adding that smallest and largest numbers in the square. For example, in the magic square on the first page, complements are 1 and 9, 2 and 8, 3 and 7, 6 and 4. In this case the complement sum equals 10.

Activity Instructions:

Below you will find square tiles with digits from 1 to 9. You can print out this template or you can make your own. Just draw nine large different coloured squares of the same size and number each square from 1 to 9. Whether you print out the template or draw the squares, cut out the individual squares and lay them in front of you.



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Your Task:

- Your task in this activity is to find as many magic squares as you can using the different configurations of the nine squares (numbered from 1 to 9). Experiment with the coloured paper squares placing them in various positions until you find a configuration that works.
- One such magic square is the original Lo-Shu which was given to you on the first page.
- Can you find other magic squares which only contain these nine digits? How many such magic squares can you find? When working on this activity, remember that your magic square has to satisfy the three main properties, stated on page 2 in the red box.
- For each magic square you discover, write down the magic constant.

Further Exercises:

If you have enjoyed the activity above, here are some more magic square challenges.

1. Think of any number. Add this number to every digit in any one of the magic squares which you have discovered in the activity above, or you can use the Lo-Shu magic square. Is the resulting square also a magic square? Try the same exercise choosing a different number and see if you get more magic squares.
2. Think of any number. Then multiply every digit in any of your magic squares by this number. What is the resulting square? Do you get another magic square?
3. Solve the following magic square puzzle: The square with an order of four on the following page has some numbers already entered into the square. Position the remaining numbers in such a way that a magic square is created.

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	12	16	
6		11	
		10	19

The remaining numbers to be placed into the square are:
5, 7, 20, 8, 17, 9, 18, 15, 14 and 13.

What is the *magic constant* of this magic square?

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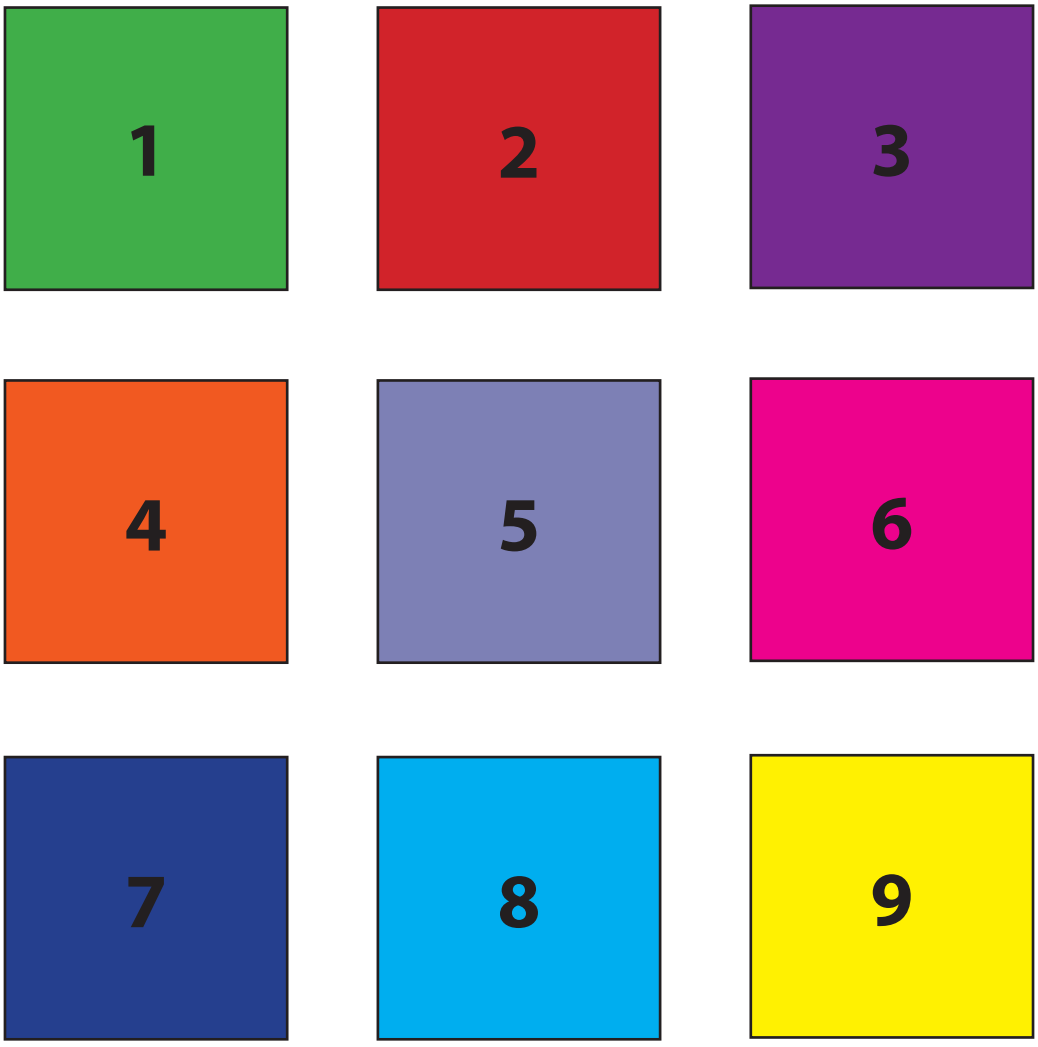

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