MAGIC SQUARES
An Activity for Middle and Upper Grades

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Magic Squares

A *magic square* is a collection of numbers arranged in a square in such a way that the same sum is obtained when the numbers in any row, column, or diagonal are added. This special sum is called the magic sum or magic constant of the square.

We are going to work with 3 X 3 magic squares which have 3 rows and 3 columns. There are other sizes of magic squares. The oldest known magic square is of Chinese origin and is called the Lo-Shu. Its magic constant is 15.

4	9	2	→ 4 + 9 + 2 = 15
3	5	7	→ 3 + 5 + 7 = 15
8	1	6	→ 8 + 1 + 6 = 15

$$2 + 5 + 8 = 15 \qquad 4 + 5 + 6 = 15$$

```
 4   9   2
 3   5   7
+8  +1  +6
15  15  15
```

Find the magic sum for each of the following magic squares.

12	5	10
7	9	11
8	13	6

4	4	4
4	4	4
4	4	4

$\frac{4}{3}$	$\frac{1}{6}$	1
$\frac{1}{2}$	$\frac{5}{6}$	$\frac{7}{6}$
$\frac{2}{3}$	$\frac{3}{2}$	$\frac{1}{3}$

magic sum _____

magic sum _____
(Be careful - the magic sum here isn't 4.)

magic sum _____

23

Fill in the boxes to get a magic square whose magic sum is 39.

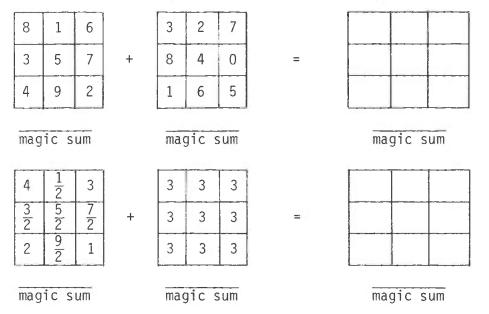| 5		15
	7	

magic sum is 39

Adding Magic Squares

We can add two magic squares of the same size to get another magic square by adding the numbers in the matching boxes. For example:

2	7	6
9	5	1
4	3	8

+

6	11	4
5	7	9
10	3	8

=

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

=

8	18	10
14	12	10
14	6	16

15
magic sum

21
magic sum

36
magic sum

For the following two problems, add the given magic squares to find a new magic square. Then find the magic sums for each magic square.

8	1	6
3	5	7
4	9	2

+

3	2	7
8	4	0
1	6	5

=

magic sum

magic sum

magic sum

4	$\frac{1}{2}$	3
$\frac{3}{2}$	$\frac{5}{2}$	$\frac{7}{2}$
2	$\frac{9}{2}$	1

+

3	3	3
3	3	3
3	3	3

=

magic sum
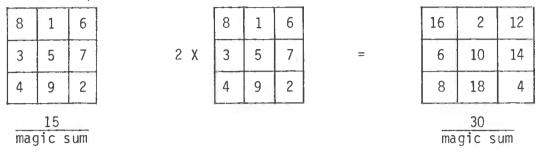
magic sum

magic sum

What do you think? When we add two magic squares, the magic sum of the new magic square can be found by   adding   subtracting   multiplying   dividing

circle one

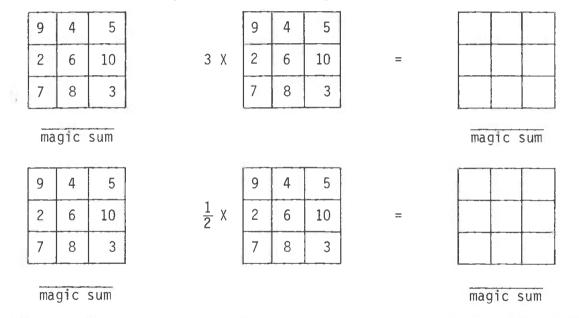the magic sums of the old squares.

24

Multiples of Magic Squares

We can also multiply a magic square by a number to get another magic square. We do this by multiplying the number in each box of the magic square by this number. For example:

8	1	6
3	5	7
4	9	2

2 X

8	1	6
3	5	7
4	9	2

=

16	2	12
6	10	14
8	18	4

$\underline{\quad 15 \quad}$
magic sum

$\underline{\quad 30 \quad}$
magic sum

For the following two problems, find the indicated multiple of the magic square. Then find the magic sum for each magic square.

9	4	5
2	6	10
7	8	3

3 X

9	4	5
2	6	10
7	8	3

=

$\overline{\qquad}$
magic sum

$\overline{\qquad}$
magic sum

9	4	5
2	6	10
7	8	3

$\frac{1}{2}$ X

9	4	5
2	6	10
7	8	3

=

$\overline{\qquad}$
magic sum

$\overline{\qquad}$
magic sum

What do you think? When we multiply a magic square by some number, the magic sum of the new magic square can be found by
<u>adding   subtracting   multiplying   dividing</u>   that given number by the
                circle one   magic sum of the old square.

Doing Your Own Magic with Magic Squares

Let's see if you can create some magic squares. Take the Lo-Shu magic square and multiply it by any number you choose. You should now have a new magic square. Did you find its magic sum? Now, multiply the Lo-Shu magic square by another number. You now have two of your own magic squares. Add these magic squares. You now have another magic square. What is its magic sum? By following these directions, you've found three new magic squares. Now you can create lots of your own magic squares by adding and multiplying.

25