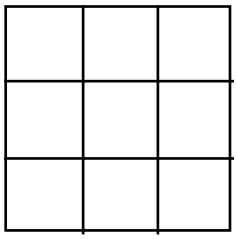
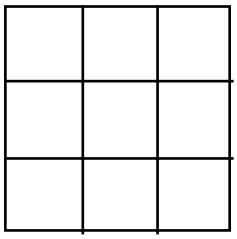
Magic Squares, continued

V. Using one of the magic squares you created using digits (0-8), perform the following operations on **each element** in the magic square. (Fill in the given squares.)

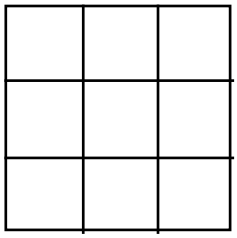
(a) Add 2



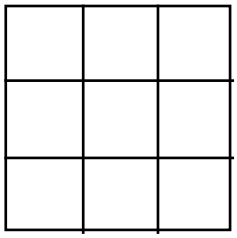
(b) Subtract 4



(c) Multiply by 4



(d) Divide by 2



1. Are the new squares magic??? Check each one. Find the magic numbers.

2. How do the magic numbers differ from the original? Could you predict what the magic number of the square that added 7 to each element would be (without doing it)? Explain how you know your answer is correct.

3. If you were to multiply each element of a magic square by 3, how would you predict what the new magic number would be? Explain how you know that your answer is correct.

VI. Pick 3 of the magic squares from part V above and enter their elements in A, B, and C below. We will be doing some computation with these magic squares. To add two magic squares you add the corresponding elements of each magic square (for example, add the upper right element of A with the upper right element of B). Subtracting is done in a similar way.

A

B

C

a) Find A+B:

Determine if this sum is a magic square. Determine the magic number.

b) Now add C to the sum of A+ B above to obtain (A+B) + C:

Is this new array a magic square?

c) What if you were asked to first add B + C and then add Magic Square A to this sum? Try it.

B+C:

A + (B+ C):

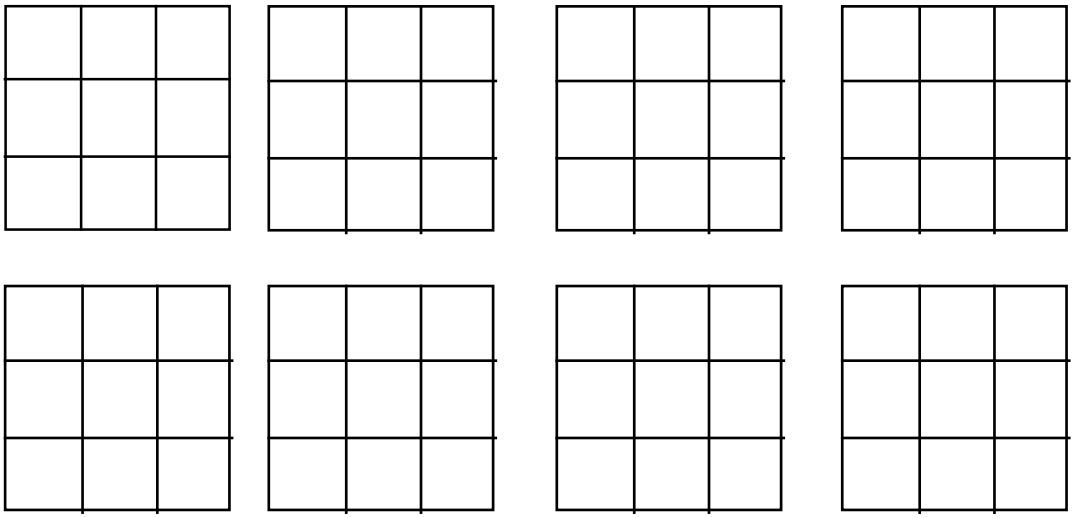
Is this new sum a magic square? What is the magic number?
How is this magic square alike or different from the one in b) above? Can you explain **why**?

VII.

If a student of yours asks you,
"If you add one magic square to another does it always form a magic square? Why?"
How do you respond?

To answer this student's question, you must be able to show that the collection of Magic Squares is closed under this operation (in this case, addition of magic squares). How would you answer this question based on what we've done so far?

Use the blank squares below to illustrate a possible response to your student.



What other questions might you pose back to your students regarding magic squares and their properties?