Magic Squares

Teacher Notes

Introduction

The aim of this activity is to investigate patterns found in Magic Squares.

Students will figure out and use the rules for creating Magic Squares.

Most teachers (and some students) are familiar with Magic Squares–square grids of numbers where each row, column and diagonal add up to the same value. In this activity, students will investigate the properties of Magic Squares and discover some of the relationships between various values. They will then use those properties and relationships to create new Magic Squares.

Resources

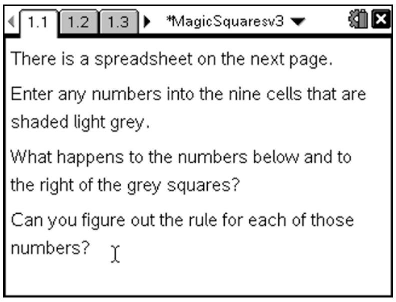
The TI-Nspire document named MagicSquarev3.tns.

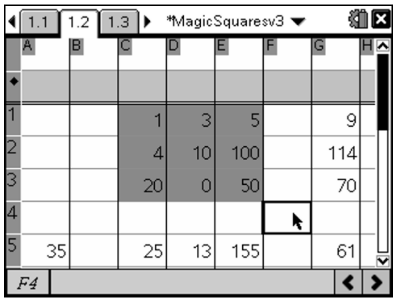
Skills required

Opening a TI-Nspire document and moving from page to page.
Simple editing of text on screen.
Moving around from cell to cell in a spreadsheet and modifying values.

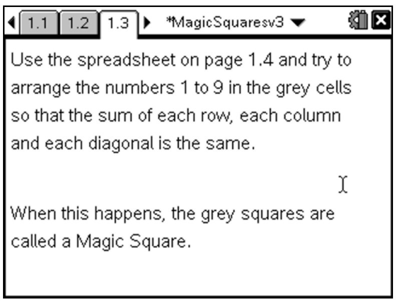
The activity

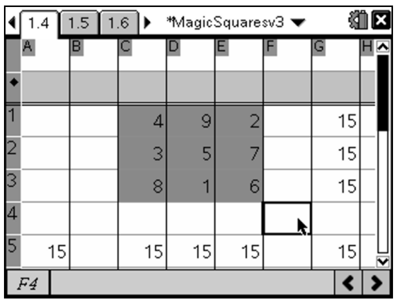
Students first see a blank 3x3 grid and numbers below and to the side of the grid. The students are not yet told that the values in each row, column and diagonal are added together but will investigate what happens to those numbers below and to the side as values are entered into the 3x3 grid.





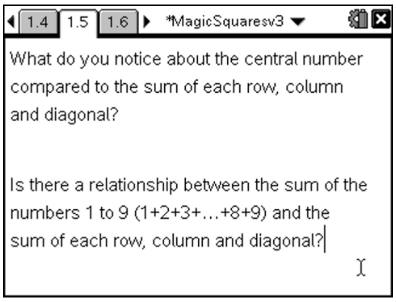
The next part of the activity allows students to use the rules they have discovered to create their own Magic Square using the numbers 1 to 9.
There are of course various possible solutions but all have 5 in the centre.



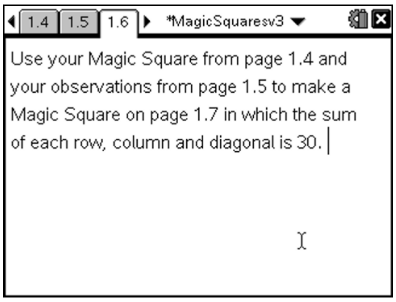


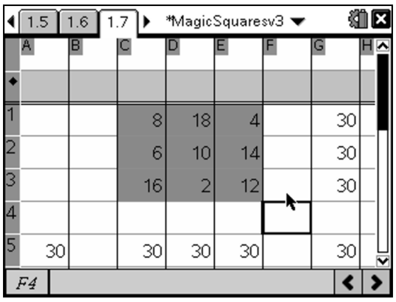
The students are also asked to notice both a relationship between the centre number in the grid and the sum of each row, column and diagonal and between the sum of the numbers used in the grid and the sum of each row, column and diagonal. In the first Magic Square, the centre number will be 5 while the sum of each row, column and diagonal is 15.
The sum of the numbers used (1+2+3+4+5+6+7+8+9) is 45. Therefore the centre number is one-third the sum of row, column and diagonal which is one-third the sum of the numbers used in the grid.

The next activity asks students to use the relationships they discovered in the previous activity to create a Magic Square in which the sum of each row, column and diagonal is 30.

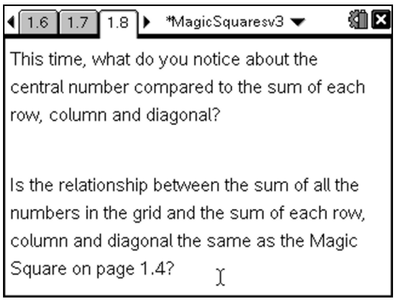


This time, students can use any numbers, not just 1 to 9. There are a number of ways to accomplish this, but the simplest is just to double the numbers used in the first Magic Square. (Since the previous row sum was 15, doubling that value gives 30.)



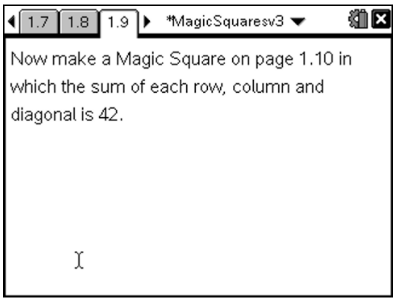


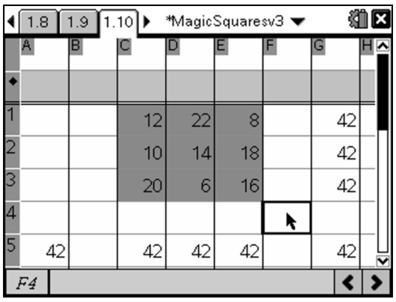
It is worth noting that some students will create a Magic Square in which some numbers are used more than once in the grid or in which all of the numbers are the same. The same relationships hold but the activity is more challenging when each number in the grid is different!



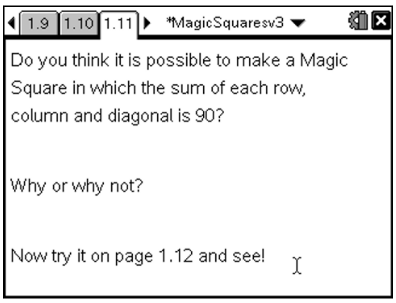
Students are now asked to create a Magic Square in which the sum of each row, column and diagonal is 42. Rather than simply doubling each value as they did last time, this Magic Square is more difficult.

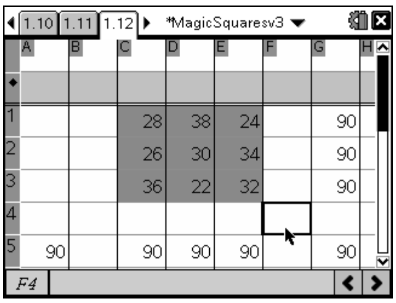
Some students may realise or discover that multiplying each value in the previous Magic Square by 1.4 (since 30 x 1.4 = 42) gives a desired result. Other students may notice that, since 42 is 12 more than 30, they need to increase each value in their Magic Square by 4 (which is 12 shared equally among the 3 values).



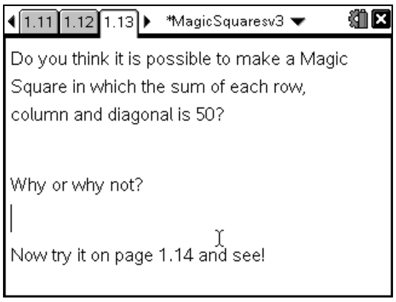


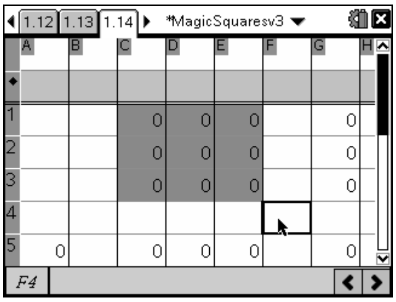
Now students should predict whether a Magic Square in which each row, column and diagonal adds up to 90 is possible. Using the rules and patterns they already discovered, this should be a fairly simple process!





This next task, however, is not as simple. Making a Magic Square in which each row, column and diagonal adds up to 50 is more difficult. Up to this point, each Magic Square has been possible to create without using any decimals or fractions. Each of the target values (15, 30, 42 and 90) were all multiples of 3. Since 50 is not a multiple of 3, the Magic Square must be completed using either fractions or decimals but it is possible!





The final two screens ask the students to use what they have discovered in order to answer several questions.