

The Disko Magic Square

Jeremiah Farrell
Indianapolis, Indiana

Our DISKOS are tokens marked with raised domino pips that can easily be identified by touch alone. We will demonstrate how to use such tokens in several mathematical puzzles and games. We also have in mind some non-trivial magic tricks with DISKOS which can be performed effectively by a blind magician for a blind (or not) subject. The teacher can use ordinary dominoes instead of DISKOS if necessary but not always as elegantly.

We illustrate our ideas with a revised version of the ancient Chinese Lo Shu magic square puzzle thought to date from 2200 B.C. Nine DISKOS are labeled from blank (zero) to eight pips and are to be arranged in a 3x3 array so that each row and column sum to the same total. It is possible to include the two main diagonals in the common total but we do not insist on this – especially with younger children. Figure 1 is one of the 72 solutions to this puzzle which will look different to the eye.

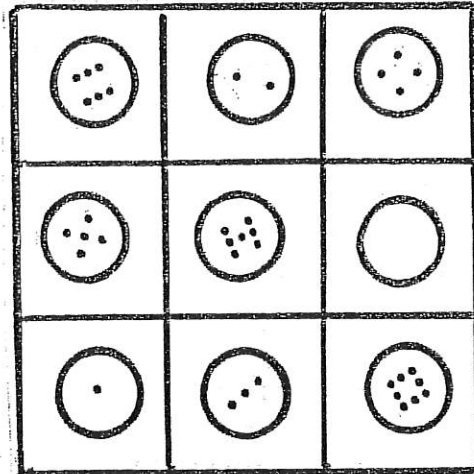


Figure 1

The teacher can decide whether or not to announce in advance to the class that the magic total is 12. Older students certainly should be able to determine this for themselves.

Sooner or later the subject will be able to solve the puzzle and the real magic begins! The blind magician asks the subject to turn the nine DISKOS face down and then, as often as they like, to carefully interchange any two rows or any two columns until the solution is effectively lost. Of course the interchanges do not change the magic constant of 12 for the square and the magician should emphasize this to the subject.

“The constant sum of any row or column remains 12 so if you gave me any two DISKOS in, say, a row, I would be able to easily name the value of the third DISKO in that row,” says the magician.

“Instead,” he adds, “I want you to choose any three DISKOS in the grid but to make it hard on me, make sure they are each from a different row and column – that is, no two in the same row or the same column.” The subject then selects any two of the

three chosen DISKOS and hands them to the magician. The magician immediately and correctly names the third.

As an example, suppose Figure 1 represents the face-down square after the interchanges and suppose the subject selects the 2, 5, and 8. No matter which two of these three are handed to the magician, he can always identify the third.

This magic trick is not easy to see through, even for professional mathematicians, yet it is simple to perform if the magician knows base 3 arithmetic. Figure 2 is a representation of Figure 1 in modified base 3 notation. One could in fact use regular dominoes here in place of making DISKOS.

60	02	31
32	61	00
01	30	62

Figure 2

The right-most unit's digit is, as usual in base 3, 0, 1, or 2. The left-most units however are 0 (0×3), 3 (1×3) or 6 (2×3). These two digit numbers still sum to the same numbers as in Figure 1. Hence the 2-5-8 selection is imagined as 02, 32, and 62 by the magician. It will always be the case that either the left digit or the right digit must be the same number (here right is 2) while the remaining digit cycles through its three possibilities (here the left is 0, 3 or 6). After a little practice even very young magicians can use this information to perform this rather astounding trick.