# Mathematical Magic

### Twenty-Seven Card Trick

This trick is described by Eric Shrader on Cut-the-Knot, www.cut-the-knot.org/arithmetic/rapid/CardTrick.shtml.

"My grandfather taught me this simple trick when I was young:

"Deal out 27 cards face up into a grid of 9 rows and 3 columns. Do this by dealing out 3 cards horizontally in a row, then 3 more cards just below the first 3, then 3 more, etc., until you have 9 rows. (It's best to overlap cards in a column so that the columns aren't so long; just make sure that the values of all cards are visible.) Discard the remaining cards. Only these 27 will be used to play.

"Ask a spectator to mentally pick a card and remember it. Ask him to tell you only which of the 3 columns it is in.

"Collect the 27 cards into a deck. Gather them vertically such that the column containing the spectator's card is second. Pick up cards from the top of the column to the bottom, keeping them in the same order. For example, if the spectator tells you column 1, then first gather column 2 or 3, then column 1, and then the remaining column. When you're done, the top card of the deck should now be the top card of the column you collected first, followed by the rest of that column in order. Then the 10th card of the deck will be the card at the top of the column containing the spectator's card, etc. If you overlapped the cards as suggested, gathering and keeping them in the correct order is easy.

"Now deal the cards again. Deal exactly as described above—horizontally across the rows first.

"Again, ask him to tell you only which column contains the card.

"Pick up the columns vertically—exactly as above—making sure that the column containing the card is picked up second.

"Finally deal them out a third time in exactly the same way, ask which column contains the card, and gather them up in the same manner.

"The spectator's card will now be the 14th one in the deck. To add drama, I usually deal out the cards one at a time face down. I don't make it obvious that I'm counting and I don't look at any of the cards. Instead, I'll hesitate over certain cards, pretending to get a "vibe" from them, and then I'll finally settle on the right one.

"This seemed like pure magic when I first learned it. Only when I got older did I realize that it's actually simple math. Do you see how it works?"

## Eight Card Trick

This is a variant of the previous trick. This time use 8 cards (though it can be modified for more cards) and two columns. The magician asks one spectator to name (aloud) a whole number $N$ from 0 to 7, and a second spectator to select a card. Cards are dealt and collected three times as before, but now, at the very end after the final gathering, the magician is able to count off precisely $N$ cards, revealing the chosen card as the next one. By what method does he stack the columns to force the chosen card to the desired position?