MATHEMAGIC

- A COLOURFUL PREDICTION -

Materials:

- Video of the trick
- 1 deck of cards

How to do the Magic Trick

Goal:

Find the number of black cards in a pile of cards of different colours.

Trick:

1. The magician asks the spectator to choose 10 red cards and 10 black cards. He must shuffle them well. (The other cards are not useful for the rest of the trick.)
2. The magician turns around and asks the spectator to sort the cards in a certain way. The spectator must always take two cards at a time and he must create three piles of cards in the following way:
    - If both cards are red, he places them in the left pile;
    - If both cards are black, he places them in the right pile;
    - If the two cards are a different colour, he places them in the centre pile.

    The spectator repeats this operation until he sorted the 20 cards.
3. The magician, still turned around, asks the spectator to tell him the number of cards in the left pile (pile of red cards).
4. The magician is then able to predict the number of black cards in the centre pile.

    To do that, the magician calculates 10 – (the number of cards in the left pile).

MATHEMATICAL EXPLANATION

Why this trick works

For the trick, it is important to note that we use as many red cards as black cards (10 of each colour).

The magician also knows that the red cards are either in the left pile or the middle pile. The right pile only has black cards.

Therefore, when the magician asks the number of cards in the left pile, he then knows the number of red cards in the middle pile. Indeed, since he knows the total number of red cards (10 cards) and that the cards in the left pile are all red, he knows that the other red cards are in the middle pile. To find this number, the magician simply has to do the following operation:

$$10 - \begin{array}{c}\text{number of cards}\\ \text{in the left pile}\end{array} = \begin{array}{c}\text{number of red cards}\\ \text{in the middle pile}\end{array}$$

But, let's not forget that the magician wants to obtain the number of black cards in the middle pile.

However, in the middle pile, **the number of red cards is the same as the number of black cards**. Indeed, the middle pile was created in a way that when we placed a card of a certain colour, we also placed a card of the opposite colour.

So, the calculation done above also gives us the number or black cards in the middle pile!

In fact, we can even conclude that there are as many cards in the left pile as there are in the right pile!