MATHEMAGIC

- BIRDS OF A FEATHER FLOCK TOGETHER -

AMAZINGMATHS

Materials:

- 1 deck of playing cards

How to do the Magic Trick

Goal:
Assemble all the cards in pairs (a pair consists of 2 cards with the same value).

Preparation:
For this trick, we only use the spades and hearts, from the Ace to the 5 of a deck of cards.

Trick:

1. The magician places the cards on the table in increasing order from the Ace to the 5 of each of the 2 suits (spades and hearts) to form two small piles. He asks the spectator to place one of the piles on top of the other, then place the pile face down.

2. The magician asks the spectator to **cut** the deck of 10 cards several times and give it back to him.

3. The magician places the cards in 2 piles. (Careful, the way he does this is very important). He places each of the first 5 cards one by one to form the first pile and directly puts down the following 5 cards without changing the order to form the second pile.

4. The magician asks the spectator to choose a pile and make a total of 4 “changes of position”. A “change of position” consists of putting the first card of a pile underneath its own pile.

5. The magician removes the first card from each pile and sets them face down. (They will be revealed at the end). The spectator chooses a pile again. He makes 3 “changes of position’’, then the magician removes the first card from each pile. *Whenever the magician removes a pair, he sets them aside, face down.

6. The spectator chooses a pile again. He makes 2 “changes of position’’, then the magician removes the first card from each of the piles.

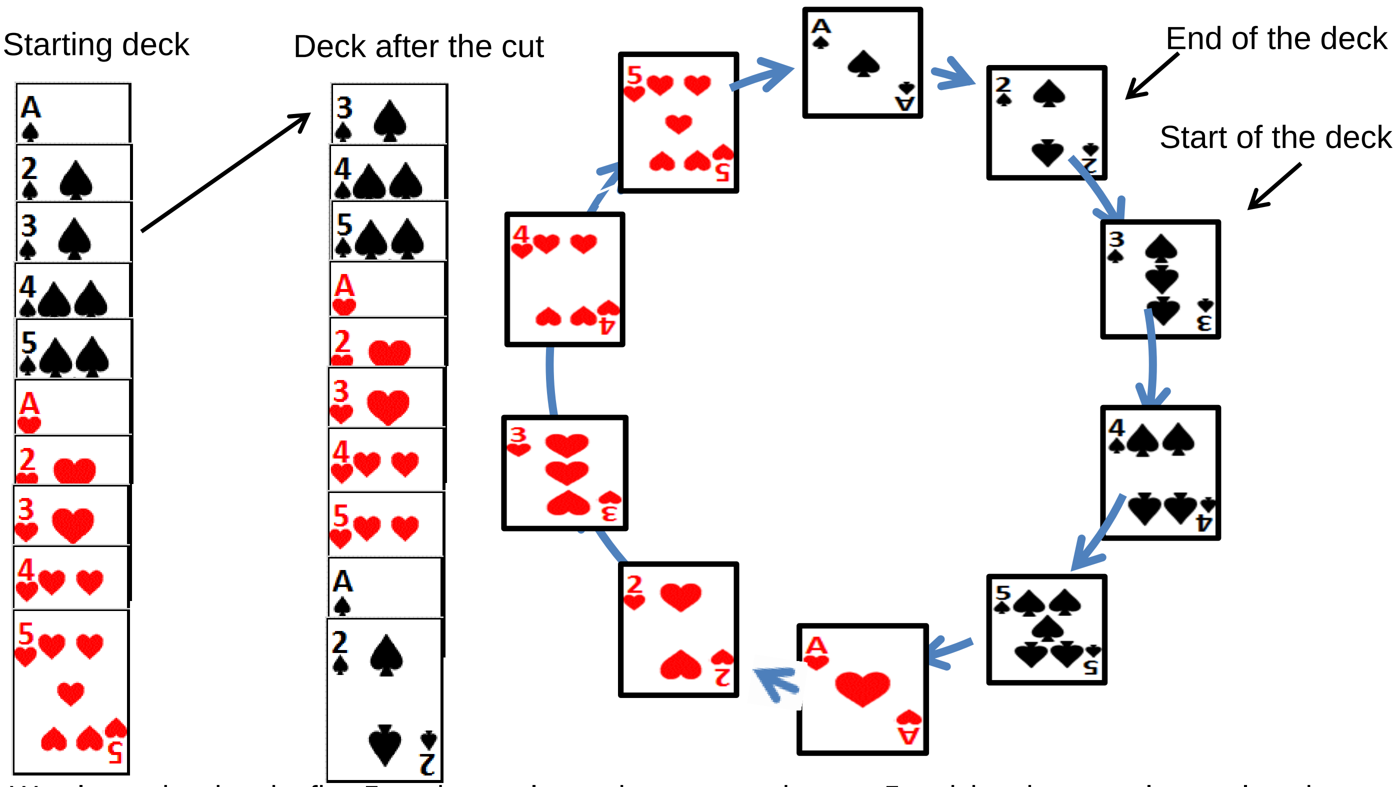
7. The spectator chooses a pile again. He makes 1 “change of position’’ and removes the first card from each pile.

8. The magician turns face up all the paired cards. The pairs of cards are made of cards of the same value!

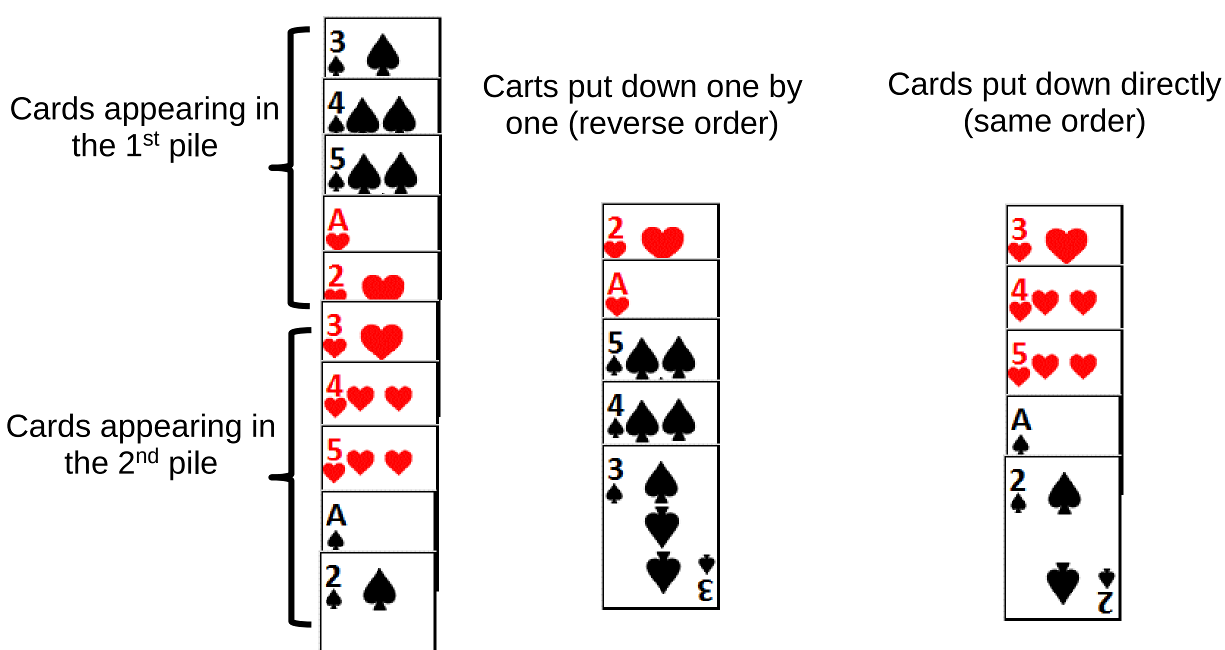
MATHEMATICAL EXPLANATION

Why This Trick Works.

The particularity of the trick is that, despite the fact that the spectator cuts the deck in half a few times to ''mix'' it, the order of the cards is preserved. It is possible to visualize this by representing the pile as a cycle rather than as a stack. For example, if we cut the deck at the second card, the card with a value of 3 ends up at the beginning and the card with a value of 2 ends up at the end:



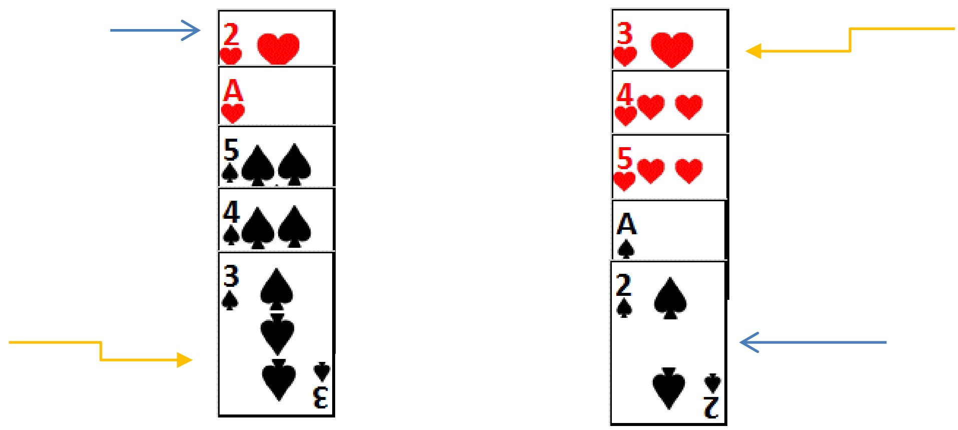
We also notice that the first 5 cards are always the same as the next 5 and that they are always placed in the same order (pile 1: A-2-3-4-5-A-2-3-4-5, pile 2: 3-4-5-A-2-3-4-5-A-2). Thus, when the magician puts down the first 5 cards one by one to form the 1st pile, he reverses the order of the cards. However, when he simply drops the next 5 cards to form the 2nd pile, the order is the same as at the beginning. So, he changes the order of one of the two piles and ends up with two ''mirror'' piles (the value of the first card is the same as the value of the last and so on).



MATHEMATICAL EXPLANATION

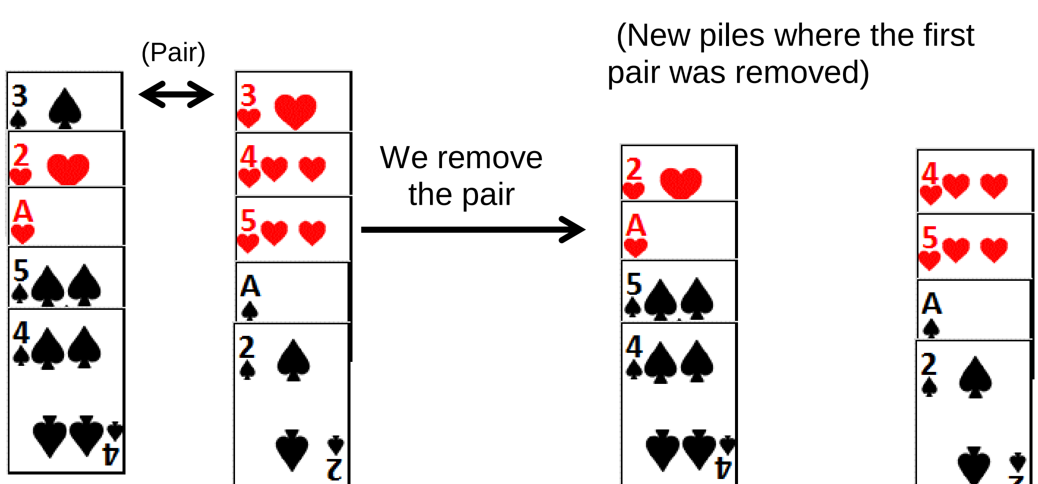
Why This Trick Works (continued)

The fact that the 2 piles mirror each other gives us a very important clue: the value of the card at the top of a pile is the same as the value of the card at the bottom of the other pile.



Since there are 4 cards on top of the last card in a pile, the magician asks the spectator to make 4 ‘’changes of position’’. To do so, he moves the 4 cards that were on top of the pile and places them underneath it. So, the last card becomes the 1st card of the pile. We formed a pair with the cards that are in the first position of the 2 piles!

The choice of the pile in which we make ‘’changes of position’’ does not change the fact that we get pairs, but only changes the value of the pair! In our example, if we make the 4 ‘’changes of position’’ in the 1st pile, we get:



The changes of position allow to maintain the cards’ order. Thus, the cards of each pile are always mirrored to each other after removing the first pair. However, this time there is one less card in each pile. That is why the magician must make a ‘’change of position’’ of less than 3. The logic is the same with the piles of 3 cards and 2 cards.

The pairs who have been removed throughout the trick are then shown to the spectator one by one. The spectator sees that the cards of the same value have paired up!