# Learn: Birthday Binary Trick

## What You'll Need:

- ❑ Five index cards or pieces of paper cut to that size

## Procedure:

**Step 1**

On the index cards or the pieces of paper, write these numbers on the cards:

CARD 1

| | | | |
|---|---|---|---|
| 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 |

CARD 2

| | | | |
|---|---|---|---|
| 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 |
| 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 |

CARD 3

| | | | |
|---|---|---|---|
| 4 | 5 | 6 | 7 |
| 12 | 13 | 14 | 15 |
| 20 | 21 | 22 | 23 |
| 28 | 29 | 30 | 31 |

CARD 4

| | | | |
|---|---|---|---|
| 2 | 3 | 6 | 7 |
| 10 | 11 | 14 | 15 |
| 18 | 19 | 22 | 23 |
| 26 | 27 | 30 | 31 |

CARD 5

| | | | |
|---|---|---|---|
| 1 | 3 | 5 | 7 |
| 9 | 11 | 13 | 15 |
| 17 | 19 | 21 | 23 |
| 25 | 27 | 29 | 31 |

**Step 2**

Give cards 2-5 to your friend. Ask them to give you back all cards that have the number of the MONTH of their birthday (April = 4, they would give you back card 3; December = 12, they would give you back cards 2 and 3)

**Step 3**

Add up the TOP LEFT number on each card returned to you. (If they only return card 3, the number is 4; if they return cards 2 and 3, 8+4 = 12). You now know the month of their birthday!

**Step 4**

Give all 5 cards to your friend. Ask them to give you back all cards that have the number of the DAY of their birthday ($15^{th}$ means they give you back cards 2, 3, 4, and 5).

**Step 5**

Add up the TOP LEFT number on each card returned to you. You now know the day of their birthday! Tell them the month and day of their birthday and amaze all your friends!

## The Science Behind It:

This is all about something called Binary Numbers. Our regular counting system is called Base 10. It uses the “ones” place to count everything from 0 to 9, then when you run out of single digits you use the “tens” place with a 1 and reset the “ones” place with a 0. Binary numbers uses the same idea, but you only get to use a 0 or 1.

This means that you have the “ones” place, but then you have the “twos” place and the “fours” place, the “eights” place, the “sixteens” place, and so on. Here’s a table to help you translate:

| BINARY | TRANSLATION | BASE 10 | | BINARY | TRANSLATION | BASE 10 |
|---:|---:|---:|---|---:|---:|---:|
| 0 | 0 | 0 | | 10000 | 16+0+0+0+0 | 16 |
| 1 | 1 | 1 | | 10001 | 16+0+0+0+1 | 17 |
| 10 | 2+0 | 2 | | 10010 | 16+0+0+2+0 | 18 |
| 11 | 2+1 | 3 | | 10011 | 16+0+0+2+1 | 19 |
| 100 | 4+0+0 | 4 | | 10100 | 16+0+4+0+0 | 20 |
| 101 | 4+0+1 | 5 | | 10101 | 16+0+4+0+1 | 21 |
| 110 | 4+2+0 | 6 | | 10110 | 16+0+4+2+0 | 22 |
| 111 | 4+2+1 | 7 | | 10111 | 16+0+4+2+1 | 23 |
| 1000 | 8+0+0+0 | 8 | | 11000 | 16+8+0+0+0 | 24 |
| 1001 | 8+0+0+1 | 9 | | 11001 | 16+8+0+0+1 | 25 |
| 1010 | 8+0+2+0 | 10 | | 11010 | 16+8+0+2+0 | 26 |
| 1011 | 8+0+2+1 | 11 | | 11011 | 16+8+0+2+1 | 27 |
| 1100 | 8+4+0+0 | 12 | | 11100 | 16+8+4+0+0 | 28 |
| 1101 | 8+4+0+1 | 13 | | 11101 | 16+8+4+0+1 | 29 |
| 1110 | 8+4+2+0 | 14 | | 11110 | 16+8+4+2+0 | 30 |
| 1111 | 8+4+2+1 | 15 | | 11111 | 16+8+4+2+1 | 31 |

This kind of counting is really important to computers. Base 10 works great for people, since most of us have 10 fingers. But computers don’t have fingers, they can only tell if something is turned off (0) or turned on (1). If you’ve ever heard of “8 bit graphics” you’ve heard of binary! Our experiment uses 5 bits. 8 bit graphics would add the places for 32, 64, and 138, for a total of 256 options of colors.