The Number Jumbler

-What happens

The Number Jumbler machine works by making all numbers from 81 to 9, that are divisible by nine, have the same picture. This makes the machine “magically” find your number every time, as for any number you start with, it will be a multiple of 9 in the end.

-How it happens

To explain simply how it happens, we must introduce some key terminology first.

Digital Root = Another way of saying the product of the total sum of a number's digits. For example, the digital root of 21 is 3, (2+1=3), and we can express that as dr(21) = 3

Modulo = A term used for finding the remainder of a number, divided by another number. For instance,11 modulo 2 equals 1 as 11 divided by 2 will return a remainder of

1.

A key rule with modulo is that, when a is any number bigger than 0,

$$an \bmod n \equiv 0$$

since a multiple of n will always be divisible by n, giving a remainder of 0.

Now we know that, we can now express that the digital root of any number greater than 9, will equal its remainder over 9, as:

$$n \bmod 9 \equiv dr(n)$$

And we can test this by an example, so letting n be 25 for instance:

$$25 \bmod 9 = 7\ (2+5)$$

9 goes into 25 twice, so 25 - 18 (9X2) = 7,

Which means 7 = 7, and it should work for any number we put in.

Now we have proved $n \bmod 9 \equiv dr(n)$, we can rearrange it as

$$(n - dr(n)) \bmod 9 \equiv 0.$$

To get x mod 9 to equal 0, x must be a multiple of nine.

Therefore, n – dr(n) will always equal a multiple of nine,

and thus, no matter which two digit number we pick, we will always get a multiple of nine, and since the machine put all multiples of nine, lower than 90, as the same picture, we will always get the same picture as the machine “magically guesses”.

Example

For example, lets pick 37, and use the above equation to test out the formula, $(n - dr(n)) \bmod 9 \equiv 0$.

$$(37 - (3+7)) \bmod 9 = 0$$

$$37 - 10 \bmod 9 = 0$$

$$27 \bmod 9 = 0$$

27 is 9×3 so 9 will go into it, with no

remainders, so 27 mod 9 = 0 is true.