LIGHTS! CAMERA! MATH!
TEACHER'S NOTES

Prepare to be amazed, dazzled & bewildered by Cahoots NI's mind-blowing production Lights! Camera! Math! - a spectacular show where Maths, Theatre and Digital Technology collide to create a fun and interactive performance proving that understanding maths can be fun!

Meet Danny Carmo-it's not so long ago that he thought school and, in particular, math wasn't for him. He was more interested in dreaming about a future on the stage and perhaps the big screen- all he ever wanted to be was a famous magician! But when he knuckled down to learn all the tricks of the trade he realised that Math was not only essential…it was the SECRET to a whole load of magic!

These notes can be used alongside the Danny Carmo's Mathematical Mysteries handbook, which every pupil attending Lights! Camera! Math! will receive. Inside you will find lots of mathematical tips, tricks and activities to enhance your experience when using the book back at the classroom after the show.

Lights! Camera! Math! has toured across Ireland to great success with teachers noticing the benefits of the book's lasting legacy:

"I have used the book in various ways. Sometimes I perform a trick, we talk about why it might work and then look at the Maths connected with it. We then try variations. At other times I get individuals to prepare, perform and explain a trick…Skills such as calculating, Mental Maths, communicating, estimating, looking for patterns etc. are all addressed in this book and in such a way as to keep the pupils interest and to give them an incentive to complete a challenge. Thank you for a great resource."

We hope you enjoy the show and continue to enjoy solving mathematical mysteries!

X Marks the Spot

In this trick, a volunteer is asked to think of a number between 5 and 25 and then take that number of steps in an counterclockwise direction along a path of coins. The volunteer then takes the same number of steps in a clockwise direction. The performer turns over the last coin the volunteer lands on to reveal that it is marked with an X; the other coins are turned over to show they are not marked. The trick provides a novel illustration of the difference between clockwise, counterclockwise and simple arithmetic.

This is a very simple trick mathematically. It is simply a matter of counting the same number twice, once in each direction but, at the end, instead of going back down the tail to end up at the start (which wouldn't be much of a trick!) the count is completed by continuing around the circle.

The Human Calculator

This trick again requires the help of an audience volunteer and involves the performer correctly predicting the sum of five 5-digit numbers. The key to this trick is a purely mathematical phenomenon and no sleight of hand is needed.

Pupils will find this illusion draws on an ability to add large numbers together carefully and helps demonstrate that even apparently random numbers are governed by mathematical theory when considered together. To be able to perform this trick, children will need fast and accurate mental arithmetic to generate the magician's numbers. Pupils could also be asked to explain how this works mathematically.

The Sword Box Illusion

This is a trick that relies solely on the numbers to achieve its magical effect. Four pupils each choose a number from a selection of 16 laid out in a grid or matrix. Numbers positioned in the same row and column as the chosen number are eliminated. Ultimately, four numbers are left on the grid and these will always add up to 34. This trick helps build confidence in working with number grids and recognizing the differences between rows and columns.

Pupils could try this with a grid of the numbers 2 to 17 instead of 1 to 16. They will find that the total at the end is 38. Children could also be asked what they think the result would be if the grid ran from 3 to 18. They should try to figure this out without going through the procedure. There are two mathematical formulas that the students can try out here. The first being; the smallest and largest number in the grid can be doubled and then added together: $(3 \times 2) + (18 \times 2) = 42$ or the second formula, add the smallest and largest numbers and then double the sum: $(3 + 18) \times 2 = 42$.

In All Probability

This game introduces the children to the complex world of probability.
Probability can be expressed using fractions, percentages or decimals and is calculated by considering the number of ways something can happen versus the total number of outcomes. Even though it seems that the odds are in the students' favor every time, the odds are actually two and a half to one against them. This means that if you play this game over and over, you will win most of the time. The children should be encouraged to explore why this is the case. The basic principle is that it is the cumulative probability of turning over 3 picture cards that is important.

Check out this helpful website for more on probability:
www.mathsisfun.com/definitions/probability

The Magic Square

A Magic Square is simply an arrangement of numbers in a square grid so
that the sum of numbers in every row, column and diagonal is the same. Experimenting with these grids helps pupils to understand the difference between rows, columns and diagonals. It also encourages children to experiment with different combinations of numbers.

In the book, it mentions that there are 8 possible variations of the illustrated square. Pupils could be asked to find as many of these as possible and may also wish to explore different ranges of numbers and bigger grids.

The Hologram Illusion

This trick requires the help of a volunteer who has to think of a number between 0 and 9 and then arrange a selection of numbers to make a sum. Using digital root theory, the numbers are added together to produce a total that is the same as the number chosen by the volunteer at the beginning of the trick. The Hologram Illusion highlights the difference between rows and columns, as well as the importance of being able to add numbers quickly and correctly without writing them down.

Check this out for more on digital root theory:
www.nrich.maths.org/5524

The Fraction Engine

The story of the 17 camels shows the importance of understanding fractions and how they combine together.

The eldest son was to get 1/2 of the camels.
The middle son was to get 1/3 of the camels.
The youngest son was to get 1/9 of the camels.

To add these fractions together, the concept of the Lowest Common Denominator (LCD) has to be understood. In this case, the LCD is 18 so 1/2 + 1/3 + 1/9 becomes 9/18 + 6/18 + 2/18 = 17/18.

The Magic Store

This trick is all about adding sums of money together and reacting to the different choices made at each stage of the trick. The children should be encouraged to make up a set of menu cards as in the book and to perform the trick for each other. They should also explore the various paths through the cards to understand why the result is always $21 or $22.

The Magic of Time

This trick may be used to introduce children to some elementary algebra. At the end of the trick, the number we end up with is always a multiple of 9. Let's say that the number of objects removed is represented by the 2-digit number xy. This may be re-written as $10x + y$. The calculation in the trick may therefore be written as $(10x + y) – (x + y) = 9x$ so the answer is always a multiple of 9.

The Magic of 1089

In this trick, the spectator is asked to think of a 3-digit number and to carry out a number of manipulations and basic operations to end up with a final number. This result has been predicted. This is an automatic mathematical trick with the result always being 1089.

The mathematical basis of this trick depends on the idea of place value. So a number e.g. <u>642</u> may be written as 600 + 40 + 2.
Reversing the digits gives <u>246</u> or 200 + 40 + 6.

Subtracting the smaller number from the larger number gives 642-246 = 396, a multiple of 99.
Whatever number is chosen, the result is always a multiple of 99.

The possible values are 99*, 198, 297, 396, 495, 594, 693, 792 and 891.
(* If the result is 99, it should be written as 099.)

The middle digit of all these numbers is always 9 and the first and last digits of each add up to 9. Adding such a number and its reverse gives a number with a 9 in the hundreds place (i.e.900), 9+9 in the tens place (i.e.180) and 9 in the units place (i.e. 9).

900 + 180 + 9 = 1089.