



## Welcome

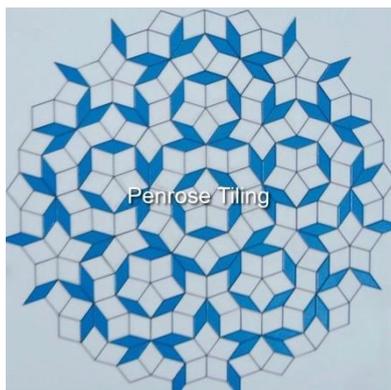
Welcome to the seventh issue of our Newsletter.

The Coronavirus has had a major impact on the activities of MathsWorldUK and as a result we have developed new plans to maintain our momentum towards creating the UK's first Mathematics Discovery Centre. We want to devote this issue to explaining these plans to our readers and followers. In addition, as usual, we will try to bring you up to date with some outside news which we hope will be of interest.

## Touring Exhibition and Pop-up Centre

In the last issue of the Newsletter we reported that our touring exhibition Explore Maths had been set up in the Winchester Science Centre. We were delighted with the look and feel of the exhibition and we were pleased by the warm reception it received by the staff at Winchester Science Centre, even those who had been sceptical about mathematics. Winchester Science Centre had to close to the public, due to Coronavirus restrictions, on the very day our exhibition was due to open. Science Discovery Centres have stayed closed a lot longer than anticipated and when they are open, they will focus on their core business.

For this reason, we are working to establish a pop-up mathematics discovery centre in the centre of Leeds, which we are calling MathsCity. Together with Leeds City Council and the Leeds Business Improvement District we are seeking a suitable rent-free property in a popular shopping area. Initial contacts are promising, and we will settle on a venue in January and do the necessary modifications so that MathsCity will be ready for an informal opening by late Spring 2021, with a formal opening to the public later in the year.



MathsCity will start by housing the original touring exhibition, which has a problem-solving theme, as well as a *Shape and Space Zone*. One of the many benefits of this organic way of growing our mission is that we can develop the content for the future centre and test it robustly with the public. In this way the best content will be ready for the future National Mathematics Discovery Centre. We will be changing the content of MathsCity at 6-9 monthly intervals. The next two sets of contents are planned to be a *Codes and Code-breaking Zone* and a *Zone on the Mathematics of Pandemics*.

It will be difficult to launch a centre under the shadow of the pandemic, but we will be able to learn the lessons of other science discovery centres to run a Covid-safe environment. Visitors, including school parties, will be asked to pre-book their timed visits, and we will have gaps between visits to allow for cleaning.



## Videos at Home with MathsWorldUK

Our Manager of the Touring Exhibition, Dr James Grime, has spent the summer making a series of short home videos with all the great maths communicators that we know. James is a YouTube star in his own right and made our videos under the difficult conditions of lockdown and working from home. These videos are for parents, children and anyone with a bent for exploring mathematics to while away the time spent under Covid restrictions, lockdown or otherwise. The videos have the general title [Maths at Home with MathsWorldUK](#). They may be a bit rough and ready, but that is part of their charm. We aim to appeal to most age groups, although the three important ones on mathematical modelling related to the Covid virus are aimed at an adult audience. (See those indicated in bold type below, which are also summarized for our readers' benefit.)

There is a prominent link to these videos on the home page of the [MathsWorldUK website](#).



Bobby Seagull and James Grime – *Möbius Strips*

Each video is around 15 minutes and consists of a short introduction between James and his guest, a presentation by the guest, and an activity for the viewer. To date we have an audience of several thousand viewers. We would urge our readers to engage with them and recommend these videos to their friends (especially those with children) and other interested parties.

At the time of going to press there are sixteen videos:

- Rob Eastaway and *Diffy Squares*
- Zoe Griffiths and *Maths Magic*
- Thomas Wooley and *The Pie Game*
- Bobby Seagull and *Möbius Strips*
- Katie Steckles and *Colouring-in Challenges*
- Alison Kiddle and *Making Patterns with Lego*
- Katie Chicot and *'Perplex'*
- James Tanton and *Freaky Fractions*
- Peter Rowlett and *Advanced Noughts and Crosses*
- Nira Chamberlain and *The Gambler's Ruin Problem*
- Ben Sparks and *Memory Trick*



- Matt Parker and *Fold-and-Cut Festive Decorations*
- Johnny Ball and *Measuring the Earth*
- **Kit Yates and the *Mathematics of Pandemics***
- **Aoife Hunt and *Social Distancing***
- **Professor Sir David Spiegelhalter and *False Positives***

Videos with Hannah Fry and Alex Bellos are scheduled soon.

The quality of the presenters speaks for itself. You can engage in cutting Mobius Strips with Bobby Seagull, or colouring in 'maps' or regions with Katie Steckles, or learn about measuring the Earth through looking at the historical contributions of some ancient Greek mathematicians with Johnny Ball, or you can enjoy curious ideas like 'Diffy Squares' with Rob Eastaway. You can learn some card trick magic with Zoe Griffiths and experience many more such delights. You can share in the enthusiasm of Nira Chamberlain, the President of the Institute of Mathematics and its Applications, as he discusses the Gambler's Ruin Problem. And there are many other treats to explore through these videos, including the video by our CEO, Katie Chicot.



Johnny Ball - *Measuring the Earth*



Nira Chamberlain - *The Gambler's Ruin Problem*



Rob Eastaway - *Diffy Squares*



Katie Chicot - *'Perplex'*

The three videos on the Coronavirus pandemic are especially interesting and topical. Our own Kit Yates, who is a mathematical biologist and Senior Lecturer in Mathematics at the University of Bath, explains the basic mathematics behind modelling the spread of a deadly virus like the Coronavirus or the Zika virus, and how by looking at members of the population who are **S**usceptible to the virus, those who are **I**nfectious and those who have **R**ecovered, we can develop a basic mathematical model known as the SIR model. We can then use this model to make predictions about how the numbers in each category compare to actual samples taken from the real world to decide whether the SIR model is a good one or not. Kit also talks about the by now well-known Reproduction Number,  $R$ , which is the average number of additional individuals that are infected by one infected person, and explains why when  $R > 1$ , the number of



infections grows exponentially, leading to a pandemic, and when  $R < 1$  the number of new cases decreases exponentially and eventually dies out.

Kit is the author of the book *The Maths of Life and Death*, which actually contains no mathematics! Professor Ian Stewart (author of *Does God Play Dice?* and many other popular books on mathematics) has said of this book “Used wisely, mathematics can save your life. Used unwisely, it can ruin it. A lucid and enthralling account of why maths matters in everyone’s life. A real eye-opener.”



Kit Yates and James Grime – *Mathematics of Pandemics*

David Spiegelhalter’s video is a wonderful explanation of the concept of a false positive in a diagnostic testing regime. He explains why even the Health Secretary dealing with the Coronavirus pandemic became confused about how to interpret the significance and meaning of a false positive test result. Starting with the current pandemic, David introduces the terms *prevalence* (the probability of someone having the disease), *sensitivity* (the probability of someone having the disease and testing positive) and *specificity* (the probability of someone not having the disease testing negative) and then uses a probability tree to discuss the relative numbers of true positives of a medical test (when the test correctly indicates that you have the disease when you do) and false positives (when the test indicates you have the disease when in fact you do not). At the end of his exposition David also makes reference to breast screening tests and facial recognition software as used by the police. In each case it is essential to understand how the number of false positives is related to the samples being investigated.



Professor Sir David Spiegelhalter and James Grime - *False Positives*

The Government has repeatedly stressed the idea of social distancing and that the safe distance apart between two people is 2 metres. In her interesting video, Aiofe Hunt uses some familiar mathematics, including the Theorem of Pythagoras, to show that designing spaces to hold numbers of people all safely socially distanced from each other is far from obvious and requires much more space than most people realize.



Aiofe Hunt and James Grime – *Social Distancing*

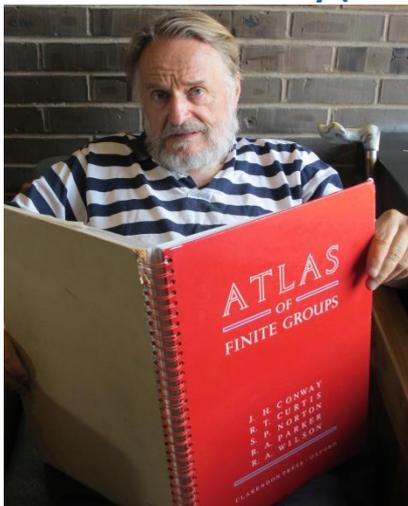
We shall be extending the list of titles throughout the coming winter.

### Funding

We have now matched the funding offered to us by our original donor from the United States. This donor still wishes to remain anonymous, but with his generous donation, and the matched funding we have raised ourselves, these two sources have provided MWUK with £250,000.

Michael Norton, who as Chair of the Trustees of Simon Norton's legacy is our current major benefactor, has now provided us with sufficient funds upfront to research, develop and construct new exhibits for MathsCity in Leeds. Michael's funding together with further funds to be raised will cover the cost of employing a manager for this MathsCity, and the operational budget. We are very grateful for Michael Norton's continuing support, encouragement and involvement with MWUK.

### John Horton Conway (1937 – 2020)



At this point it seems fitting to note the death in April of John Conway after contracting Covid-19. He was one of the most prolific mathematicians of the twentieth century, known for his work in group theory, Combinatorial Game Theory, his 'Game of Life', his outstanding contributions to computational theory and his Monstrous Moonshine conjecture with Simon Norton, connecting group theory with modular forms. This conjecture was later proved by one of his students, Richard Borcherds, who won the Fields Medal for this proof. Conway also co-authored the definitive Atlas of Finite Groups (pictured) with Simon Norton as one of his co-authors. It is to honour Simon Norton that his brother Michael has become such an important sponsor of MathsWorldUK.



## Future Fundraising

We are currently reviewing our fundraising strategy. Within our future plans we will have events for supporters of MathsWorldUK. Pandemic permitting, we hope to have an event next summer in central London. We would welcome your views on what you would want out of such events. What is most important and appealing to you? It might be the interesting venue, the food and entertainment, trying out future exhibits or just the company of fellow MathsWorldUK supporters. To let us know what you think either email [admin@mathsworlduk.com](mailto:admin@mathsworlduk.com) or email any of the MWUK committee that you already know.

## Recent Articles

Two articles about MathsWorldUK have been published recently. These appeared in *Mathematics Teaching* (Issue 273, September 2020), the Journal of the Association of Teachers of Mathematics and in *Mathematics Today* (vol.56 No.4 August 2020), the Journal of the Institute of Mathematics and its Applications. The more our readers can inform others about MWUK the better.

## News of Our Ambassadors



We are pleased to welcome the Fields Medallist, Professor Sir Martin Hairer, FRS, as our latest Ambassador. In his own words “Martin spent most of his childhood in Geneva. He studied Physics and Mathematics at the University of Geneva where he completed his PhD before moving to the UK with the help of a fellowship from the Swiss Science Foundation. Subsequently, he worked at the University of Warwick before moving to Imperial College London where he currently holds a chair in probability and stochastic analysis. He works in the general area of probability theory with a main focus on the analysis of stochastic partial differential equations. He is a Fellow of the Royal Society, the Academy of Sciences Leopoldina, and of the Austrian Academy of Sciences.

Hairer's work has been distinguished with a number of prizes and awards, most notably the Fermat prize in 2013, the Fields Medal in 2014, and a knighthood in 2016.”

We also welcome Professor Sir David Spiegelhalter, FRS, as an Ambassador. David is an old friend of MathsWorldUK and is now a well-known national figure as a member of the government Scientific Advisory Group for Emergencies (SAGE). He is regarded as the voice of sanity when members of the government make statistical claims which do not hold up to scrutiny. David is the Winton Professor of the Understanding of Risk at the University of Cambridge. As discussed above, David has made an outstanding video for us in which he discusses with great clarity the idea and interpretation of False Positives in a medical testing regime and explains why it is easy to make misleading statements regarding false positives.

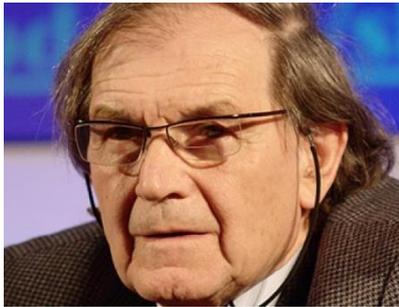


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## Mathematics News

### Professor Sir Roger Penrose shares the 2020 Nobel Prize in Physics for his work on Black Holes

Roger Penrose is emeritus professor of Mathematics at the University of Oxford and an Honorary Fellow of St. John's College, Cambridge.



According to the [Nobel Prize website](#): "Penrose used ingenious mathematical methods in his proof that black holes are a direct consequence of Albert Einstein's general theory of relativity." Einstein himself did not believe that black holes really existed. But in January 1965, ten years after Einstein's death, Penrose proved that black holes really can form and described them in detail. His ground-breaking article continues to be viewed as the most important contribution to the general theory of relativity since Einstein.

The Chair of the Nobel Physics Committee said: "The discoveries of this year's Laureates have broken new ground in the study of compact and supermassive objects. These exotic objects still pose many questions that beg for answers and motivate future research, not only about their inner structure, but also about how to test our theory of gravity under the extreme conditions in the immediate vicinity of a black hole".

Penrose became a graduate student at St John's College, Cambridge in 1952, completing his PhD thesis on tensor methods in algebraic geometry in 1957. Heather Hancock, current Master of St John's, said: "We are delighted to see Sir Roger Penrose receive the Nobel Prize for his outstanding contribution to physics. His ground-breaking proof of the formation of black holes is a landmark contribution to the application of Einstein's general theory of relativity. We offer our warmest congratulations to Roger."

In the 1970s, Penrose collaborated with his younger colleague Stephen Hawking and in 1988, they shared the Wolf Foundation Prize for Physics for the Penrose–Hawking singularity theorems.

Prof Martin Rees, Astronomer Royal and Fellow of Trinity College, Cambridge, said: "Penrose has made amazingly original and inventive insights for many years. I think he and Hawking have done more than anyone since Einstein to deepen our knowledge of gravity. The award came too late to allow Hawking to share the credit with Penrose.

Penrose triggered the renaissance in relativity in the 1960s through his introduction of new mathematical techniques. He introduced the concept of a 'trapped surface'. On the basis of this concept, he and Hawking together showed that the development of a singularity - where the density 'goes infinite' - was inevitable once a threshold of compactness had been crossed. This crucial discovery firmed up the evidence for a big bang and led to a quantitative description of black holes."

Penrose shares the 2020 Physics Nobel with Reinhard Genzel and Andrea Ghez, whose experimental work has provided convincing evidence of a supermassive black hole at the centre of the Milky Way.

(This is an edited version of an article by Heather Hancock, reprinted with permission from the Cambridge Alumni e-Newsletter)



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## John Barrow (1952 -2020)

Professor John Barrow, Cosmologist and Astrophysicist and Professor of Mathematical Sciences in the University of Cambridge died on 26<sup>th</sup> September 2020.



John was a great educator and populariser of mathematics, as well as being an important creative scientist. He was the founding director of the Millennium Mathematics Project which was awarded the Queen's Prize for educational achievement in 2006. John played key roles in establishing the NRICH project and Cambridge Mathematics, which provide wonderful mathematics resources to teachers. He authored many popular books on mathematics and science, including *The Book of Nothing*, *The Artful Universe*, *Pi in the Sky* and *The Infinite Book: A Short Guide to the Boundless Timeless and Endless*. He also wrote *Infinities*, a play exploring the ideas behind Hilbert's infinite hotel, Louis Borges' Library of Babel and a debate between Cantor and Kronecker about the nature of infinity.

Between the years 2003 and 2012 John gave an annual series of public lectures at Gresham College, both as Professor of Astronomy and also as Professor of Geometry. John was a very good friend to MathsWorldUK and freely gave us his time and advice. He will be sadly missed. We send his widow, Elizabeth and his children David, Roger and Louise our deepest condolences.