Albert Hall Nottingham
12th April 2008 7pm

SCIENCE ON STAGE (www.scienceonstage.co.uk)

Science on Stage is a non-profit organisation working to bring together young people and adults in exciting venues with the very best in technical and musical support in order to fulfil our two main purposes of developing performance skills and improving understanding of some of the scientific concepts and principles that shape our modern world.

Science on Stage has taken its educational workshops to many schools in the region and performed full scale productions at Nottingham Playhouse, The Royal Concert Hall and the Albert Hall Nottingham. 'Steel' and 'Twister's Run' have appeared at The Royal Opera House, Linbury Theatre, Covent Garden.

Tonight we present a programme of music, science and dance to include: "In These Stones Horizons Sing" by Karl Jenkins & the new work from 'Science on Stage': "Schrodinger's Cat"

Directed by	Jon Wakefield
Featuring	The Dojo Drummers & Cidinha Furson Bendixen

Performing Groups

Arnold View Primary School, Carlton Digby School, Arnovale Junior School, Willow Farm Primary School, John Clifford Primary School, Coppice Farm Primary School, Ernehale Infant School, Ernehale Junior School, Woodthorpe Infant School, Flying High School of Dance and Drama, In Accord Chamber Choir & Guests, Science on Stage Youth Choir, The Village Singers, Arnold Hill School, Joseph Whitaker School

Sponsors

We are grateful to the following for their kind support:

Awards for All
Arnold Local Area Forum
Newark and Sherwood District Council
Cllr. Jen Cole
Cllr. Peter Barnes
Cllr. John Stocks
Lee Glass
Frank Key
Shoosmiths Private Clients Team
Wilkinson Hardware Stores
Kay Collinson

Please feel free to take, read and digest the booklets and posters in the foyer which have been kindly provided by the Particle Physics and Astronomy Research Council (PPARC)

The Dojo Drummers: Hibiki

A piece written in honour of our teacher's group, Hibiki Daiko, from whom we learnt the spectacular "tsubame-kaeshi" style from Fukui prefecture, where three drummers play four drums, arms crossing over each other in an intricate configuration. An exciting style rarely seen outside this area of Japan.

Introduction

Little Blue (Finale)

This piece is set in the far future when our descendants, or successors, witness the death of our little blue planet as the dying yet swollen sun first scorches then engulfs our place of origin.

Drums; Stuart Carter
Bass guitar; Kevin …….

It is choreographed by Emma Simms and danced by pupils of Joseph Whitaker. Costumes by…..

Homeostasis

This, roughly, means warm blooded. We're warm blooded, so is the Robin, which means we're always at the right temperature to leap into action even when we've just woken up on a freezing cold morning. The woodlouse is cold blooded so he starts slow and gradually gets up to speed. The disadvantage of being warm blooded is that you need to eat ten times as much just to stay warm, if you eat even more you get fat….. and slow, which is the problem the cat faces in this piece.

It is choreographed by……..danced by Ernehale Infants and sung by our younger singers. Costumes by Kay Collinson

Science Demonstrations

Learn a little bit about the two most important gases in the atmosphere, oxygen and carbon dioxide. They could hardly be more different, yet more closely linked.

Oxygen

A song from 'Twister's Run' which shows the two faces of oxygen, the breath of life and the fires of destruction.

It is danced by Arnold Hill School and sung by Emily Harrison, Heather Gretton and Ashanti Payne plus our younger singers

Winter (from Twister's Run)

At the atomic level movement never stops, what we call temperature is simply a measure of how fast atoms and molecules are moving. Because winter is cold, atoms move more slowly and can line up neatly to form ice crystals. They still move, but more like standing in place and shivering. Solo voices are Elliot…., Connor Wilmington-Holmes and Andrew….

Finale (from Twister's Run)

Twister finally grows into a full sized tree and his time scale leaves us behind to pursue our short and frantic lives so he and she, for Twister is both, flies a new set of seeds every year so the story can go on and on.

Both pieces are choreographed by Carrie Bird and danced by 'Flying High' with the solo part sung by Josh Furlong

Interval

Refreshments are served downstairs where you can read more about particle physics

In These Stones Horizons Sing by Karl Jenkins

Organ; David Johnson
Harp; Brian Wilson
Baritone solo; Jeremy Morris
Piano; Pearl Hollis
Percussion; Carolyn Davis
Saxophone; Tony Bell

- Agorawd
- Grey danced by Marie Hopkins and Sophie Broughton
- Eleni Ganed danced by Ernehale Junior School
- In These Stones Horizons Sing

Organ Solo: Toccata from Symphony No.5 by Widor
Choreographed by Emma Simms and danced by Joseph Whitaker School, costumes by…..

Demonstration
Discover what radioactivity is, and what it isn't. Learn how a cat can be both alive and dead at the same time when its fate is linked to that of an atom and find out how just taking a look can spoil everything.

Schrodinger's Cat; music by Jon Wakefield words by David Quick
The tango is danced by Sophie Broughton and Joseph Hajak with drums by Stuart Carter and bass guitar by Kevin…….
The life and death themes are played by the Dojo Drummers (Gekko and Yatai from Dojo Drummers'repertoire) and danced by Cidinha Furson Bendixen.

The final choral piece of the evening is a sung arrangement of Schrodinger's great equation which features all our musicians accompanied by David Johnson on the Binns organ.

Ernehale Infant School
Daniel Woollard, Robert Taylor, Isabelle Pooley, Sam Richardson, Harriet Taylor, Eleanor Shirra, Oliver Dyal-Faulding, James Simpson, Max Hammond, Brandon Bellfield, Harry Newman, Cassie Stevens, Kai Partington, Jacob Cooper, Destiny Ellington, Zoe Turton, Louisa Lemon, Lucy Tipple

Rebecca Morgan, Joseph Ellis, Ceira Ryan, Rhys Turner, Libbie Moss –Hayes, Brandon Ementon, Rees Pickering, Kristian Radze-Hall, Luke Archer, Evan Poole, Morgan Smith, Thomas Pike, Charlotte Sessions, Sam Barber

Teachers: Leigh Simmons, Rachel……, Sue Laplanche, Kay Collinson

Arnovale Junior School

Joanna Maddison, Samantha Stanton, Laura O'Donnell, Rachel Courtney, Joshua Denham-Swift, Rebecca Lewis, Ellie Hare, Phoebe Holden, Ellie Jones, Remy Crosby, Isobelle Baxter, Natalie Bacon, Joseph Waplington, William Harrington, Bryony Gilbert, Niamh Morritt, Rosie Purchase, Elinor Cross, Holly Wilde, Matt Glendening, Stephanie Poon, William Gray, Fern Monkton, Jessica Dyer, Hanna Malik, Grace Burrows, Anna Lambert, Nicola barratt, Mollie Hovell, Lizzie Farrell, Alex Peat, Hope Collishaw, James Harper, Alicia Keward, Lauren Keward, Michael Smith, Alex Cooper, Jasmine Banton, Heather Phillips, Declan Brosnan-Mavin
Parent Helpers: Sarah Monkton, John Glendening, Jane Wilde
Teachers: Gary Barwell, Kath Beale

Woodthorpe Infant School

Finn Cook, Anna Chamberlain, Bethany Layton, Hannah Clarke, Sophia Kopacz, Jack Gilbert, Thomas Hughes, Esme Waddington, Iris Gribby, Charlie Curtis, Mieke Alcock, Ella Ward, Tala Arezovmand, Kenza Malik, Oliver Sherrin, Christian Catch, Emma Noseloy, Luke Duffy, George Gray, Isabelle Francois, Catherine Hudson, Jacob Berlyne, Joseph Robson, Gemma Flint
Headteacher Sharon McKay

Willow Farm Primary School

Mikey Douthwaite, Christian Beeston, Jack Parkin, Brady Clark, Sophie Rudd, Bailey Foster, Ellie Leigh, Lauren Pritchett
Teacher: Michelle Robinson

Flying High Expressive Arts Company

Winter
Isabella Shykles, Katya Cole-Adams, Evie Shykles, Maddie Daley-Smith, Natalie Bacon, Yasmin Castle, Hannah Burton, Katherine Hopewell, Felicity Eamshaw, Elizabeth Eamshaw, Imogen Day, Nicole Thurston, Lottie Massey, Alex Kerrison, Ruby Brooke-Wilkinson, Kezia Vickers, Nadia Vickers, Merenna Scothern, Hannah Drewett, Jade Fisher

Finale
Natasha Bird, Catherine Ackrill, Katie Brooks, Evie Parker, Emily Thurston, Kim Allsopp, Kathryn Drew, Matthew Drew, Kathryn Moore, Sophie Hatton, Eve Slade, Alice Lane
Director: Carrie Bird

Ernehale Junior School

Bethany Archer, Simram Bhogal, Emilee Corbett, Holli Crich, Jemma Davey, Georgia Elba Porter, Kimberley Fallon, Emily Hancock, Chloe Harrison, Zoe Harrison, Lydia Johnson, Katie Hopkins, Katie Jones, Phoebe King, Ella Magiera, Bethany Manners, Niamh McKenna, Emily Morgan, Ishaan Singh, Ella Wright
Teacher: ……..

Coppice Farm Primary School

Garhan Childerhouse, Hannah Truelove, Rebecca Stevens, Eve Brown, Olivia Brown, Claire Longmack, Hollie Taylor, Abigail Hart, Kai Widdison, Hollie Plester, Josie Plester. Teacher: Deena Elliot

Joseph Whitaker School
Megan Kingswood, Charlotte Read, Amy Corbett, Corinne Peat, Emily Plastow, Alicia Caley, Bailey Strong, Kyla Marshall, Steph Robson, Jasmin Daves, Sarah Cafferty, Rebecca Sisson, Charlie Eaton, Nicole Yates, David Unwin, Verity Turner, Hannah Stuart, Marisha Milek, Sarah Dearden, Emily Torr, Sophie Drozdowska, Melanie Mackenzie, Tamara Parkers, Fiona Hill, Sarah Northcliffe, Helen George
Teacher: Kath Else

Carlton Digby School
Mia Cookson, Adam Subden, Freya Gibb, Aileen Glover, Andrew Boot
Teachers: Pam Loydall, Esther Hill, Dave Cassidy

Arnold View Primary School
Harriet Swann, Stephanie Cole, Rachel Lowson, Emily Terrill, Victotia Evans, Tiffany Springthorpe, Hannah Sharpe. Teacher: Sarah Dawson

John Clifford Primary School
Norice O'Brian, Cameron Sinclair-Harris, Cerys Collins, Jess Cook, Zania Benbia, Chelsea Gallimore, Taynika Jarrett, Emily Stone, Rhys Derbyshire, Aisling Forrest, Laura Millington, Georgia Archer
Headteacher: Simon Thompson

Science on Stage Youth Choir
Josh Furlong, Emily Harrison , Ashanti Payne, David Mears, Katie Wragg, Rachel Simpson, Aisha Sadiq, Connor Wilmington-Holmes

In Accord and Guests
Soprano
Sandra Wakefield, Anna Gregory, Denise Mear, Theresa Marchewicz,. Amanda Lees, Miriam Bell, Pip Flewitt, Kate Naish, Debra Sprague,
Alto
Alyson Pinske, Susan Cooper, Mags Wigram, Lucy Matthews, Olwyn Bowpitt, Ros Evans, Marie-Anne O'Reilly, Jackie Skinner, Noelle Walker
Tenor
Don Price, Tim Place, Mark Gittins, Ian Bastow
Bass
Tony Bell, Alan Bell, Andy Bell, Alan Webster

Village Singers
Christine Gisbourne, Madge Slack (Musical Director), Maureen Beeson, Brenda Rowley, Christine Lord, Yvonne McGarrigle, Vera Carter, Maureen Beeson, Margie Asker, Bill Wilson, Brian Wetton

Front of House
Alan Webster, Josh Hulls, Simon Smith and Jake Spowage

Thanks to TEC PA and Lighting

Lighting: Damian Painton

Sound: Rob Kettridge

Groups Taking Part

The Dojo Drummers are a vibrant & dynamic Taiko drum group based at & representing the Mugen Taiko Dojo, the UK's Centre for Taiko Drumming, presenting a performance of powerful rhythms, exciting choreography and high energy.

The Dojo Drummers perform primarily as a six-piece tightly choreographed unit but have a flexible line-up which can be expanded at larger scale events. The group is composed of players who have trained intensively at the Taiko Dojo for several years and include members of the renowned Mugenkyo Taiko Drummers.

Performing at festivals and special events throughout the UK and beyond, the Dojo Drummers have stunned audiences everywhere with their exhilarating rhythms, energetic movement, fiery spirit, and charismatic performance.

"Your performance of Taiko Drumming provided the perfect dramatic and spectacular opening to our event and wholly captivated our audience."
Mr. Shuhei Takahashi, Consul General of Japan

The Flying High Expressive Arts Company works with children and young adults in the Gedling area teaching dance and performance to both recreational and examination classes (GCSE & A' level). Students of 'Flying High' can be found at prestigious higher education institutes like the Liverpool Institute for Performing Arts.

The Village Singers are a North Notts choral group drawn from the villages around Newark. They are now into their eighteenth year led by Musical Director Madge Slack. We are delighted to welcome them to join us in tonight's performance.. The Village singers meet weekly in Caunton Community Centre and regularly give concerts to help local charities

Newark & Sherwood Arts works with community groups and individuals to create an exciting programme of arts projects across the district. The Participatory Arts Development Officer works alongside a large team of professional artists helping groups to plan small and large scale events and longer term projects.
If you would like help and advice with a project, event or idea please contact Wendy Green on 01623 822052

IN ACCORD (www.in-accord.co.uk)
In Accord is a Nottingham-based mixed voice chamber choir with a wide and varied repertoire and delivering a busy programme of concerts throughout the year.

The singers, who number around 30, meet for weekly rehearsals on Monday evenings from 7-45 to 9-45 pm at St Martin's Church, Trevose Gardens, Sherwood, Nottingham. (Contact Jon Wakefield on 9606236)

Schrodinger's science: Quantum Mechanics

Quantum mechanics is a set of rules that have to be followed by things that are really small. By really small we're talking the size of the atom or even less.

It's hard to get your mind around the smallness that is involved in being the size of an atom, but there is a way and it concerns beaches.

Next time you are on the beach take a look at the grains of sand, now try to imagine how many grains of sand there are in all the beaches of the world. It's a lot (around 10^{20}, that's 10 with twenty noughts).

That's also how many atoms are contained within just one of those grains. It's almost as if every grain of sand contains a world of its own within itself. You have to get right down to that sort of scale, to atomic size before the rules of quantum mechanics begin to take affect and smaller still before they completely govern what you can do.

Have a look at just some of the rules you have to live by if you happen to be that small.

1. You are likely to be in two or more places at the same time
2. You can be a million miles away then back in a blink
3. What happens to your partner immediately affects you too even if you *are* a million miles away
4. Things can happen to you and not happen to you at the same time
5. Everything changes when someone looks
6. New parallel universes are created every second.
7. When you move somewhere else you cease to exist for a while, then you arrive
8. Nobody ever knows for sure where you are
9. You're both a wave and a particle
10. You're required by law to be uncertain about what you're doing

Einstein, by the way, didn't approve of this uncertainty and he certainly didn't approve of quantum mechanics, he once famously said 'God doesn't play dice with the universe'. He wasted much of his later life trying to disprove quantum mechanics, the great man was wrong, something he realised with considerable sadness not long before he died.

If atoms did not obey the rules of quantum mechanics they would quickly collapse in on themselves and the universe would end, spectacularly. So whether or not we understand these rules we all have cause to be grateful for them!

Schrodinger

One of the greatest figures in the weird and wonderful world of quantum mechanics was Erwin Schrodinger (1887 to 1961). Schrodinger is famous for two things.

His Nobel Prize

This was for an equation published in 1926 which won him the Nobel prize for Physics in 1933 (shared with Paul Dirac). The equation, for which he is justly famous, enables scientists to solve some tricky problems:

$$i\hbar\ \delta\Psi/\delta t = H\Psi$$

pronounced: *Eye aitch bar dee sigh by dee tee equals aitch sigh*

It comes in many different forms, the one above looks relatively simple but the funny letters all mean something complicated. In order to understand and use the equation you may need to ask a grown-up, like your dad, for help.

His cat

The other thing that made him famous then and even more famous now was his 1935 experimental design to render a cat both alive and dead at the same time.

The experiment is basically a cat in a box with a bit of uranium, a Geiger counter, a hammer and a bottle of poison gas.

To understand the procedure we need to understand a little bit about nuclear radiation. A pulse of radiation is given off when an atom that is unstable and has been teetering on the brink finally has a breakdown. Radioactive material has these dodgy atoms within it. Now because of quantum mechanics we can never know when any particular atom is going to crack up, remember the uncertainty principle (rule 10)? We *can* know however that in a certain amount of radioactive material (say a millionth of a gram of uranium) there is a 50-50 chance of one atom cracking up in the course of, say an hour. If it does, then a pulse of radiation will shoot out, this will be detected by a Geiger counter which lets a hammer fall on the glass bottle of poison gas which means the cat wakes up dead. If the atom stays healthy then no radiation, no hammer, no gas and the cat wakes up alive.

However because the question is decided by an atom that lives by quantum rules (remember rule 4) the answer is both, rather than one or the other, and so because the fate of the cat is linked to the fate of the atom, the cat is also *both* alive and dead at the same time. Schrodinger rather neatly expresses this as "*the living and dead cat is mixed or smeared out in equal parts".* This strange state is called quantum superposition. Another quantum rule (number 5) explains how everything changes when the system is observed so when we sneak a look, the state of quantum superposition breaks down and the cat promptly becomes either alive or dead. Intriguingly she would not be aware of her superposed state, nor of any significance in the

outcome. Many quantum scientists would argue that the act of observation creates two parallel universes, one in which the cat lives and one in which it dies. If no one looks the superposed state will continue.

Schrodinger; the man

Schrodinger was born in 1887 to parents who were both scientists. He was an artillery officer during the first world war which he survived by specialising in fortress artillery in Austria, well away from the Western Front. He married in 1920 and by 1922 was a full professor at Breslau University where he set up house with his wife…. and his mistress. These rather unusual domestic arrangements were to bring him difficulties throughout his life. He opposed the Nazis and so had to leave Germany. [There was a small but crucial seasoning of grace in the history of nuclear power when many of the scientists who could have given Hitler the atomic bomb left Germany before the war either because they were Jewish or because they objected to Nazi anti-Semitism.] After a number of unsuccessful attempts to work at various universities, who were upset when he set up home with both a wife *and* a mistress, he ended up in Dublin in 1940.

In 1944 he proposed a molecule to encode life and set Francis Crick off on a journey which would lead to DNA. He was no stranger to scandal and retired from Dublin in 1955, but not before at least two of his female students had taken copies of his genes as well as his lecture notes! Quantum mechanics has often been associated with mysticism, indeed Schrodinger himself was deeply involved in a form of Hindu philosophy (Vedanta). He died in January 1961 and is buried in Alpbach in Austria where a version of his famous equation is engraved on his tombstone. But sadly, no cat.

Equations for the reaction between magnesium and oxygen

1. $2Mg + O_2 = 2MgO$
2. $Mg + O = MgO$
3. $Mg + {}^1/_2O_2 = MgO$
4. $Mg + O_2 = MgO_2$

They can't all be right….question is which?