SCIENCE

Official Journal of the Irish Science Teachers' Association
Eol-Oidí na hÉireann, Volume 51, Number 3, May 2016

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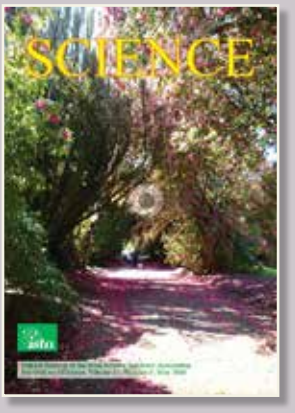
Cover picture: Rhododendron Walk, Kilmacurragh Arboretum



Located in east County Wicklow, Kilmacurragh Botanic Gardens is the centrepiece of an 18th century estate that once covered over 5000 acres (2000 ha). A 52 acre (21 ha) portion of the old demesne officially became part of the National Botanic Gardens of Ireland in 1996. It took a few years to eradicate invasive species such as sycamore, cherry laurel and the common rhododendron (*Rhododendron ponticum*).

There are over 1000 species of rhododendron ranging in size from herbs to trees. They are part of the family *Ericaceae*, which includes heather and blueberries (also known as fraughans or bilberries).

While the common (or pontic) rhododendron is an undesirable invasive alien, the majestic Tree Rhododendron (*Rhododendron arboreum*) grows in only a few places in Ireland. There are several of them on the Rhododendron Walk at Kilmacurragh as shown in the cover picture.

Eol-Oidí na hÉireann
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Chairman's Report

Seán Fogarty

In this my first report I would first like to say what a great honour it is for me to have been elected chairperson of the association. I only hope I can fill the shoes of those who have gone before me. I especially want to pay tribute to Stephanie Leonard, our outgoing chair, for her excellent stewardship of the association over the past two years. I can only hope that I have learnt from the professionalism demonstrated by Stephanie in all her dealings on the association's behalf.

Of course tribute is also due to all on the committee, all of whom work tirelessly for the organisation. I hadn't really realised the length that national committee members go to until I was part of the local organisation committee for the AGM held in Wexford three years ago. The help that the then chairperson, Mary Mullaghy, provided by organising speakers and with advice was just one example; another was the handbook prepared by Declan Kennedy detailing the steps involved in organising the AGM. Declan, as I learnt during my time as vice chair, is always the voice of logic and sensibility on the committee when decisions have to be made. Others on the committee who also work tirelessly include Rory Geoghegan with all his talents as journal editor and producer. He also puts these talents to good use generating the conference brochure. And of course Mary, looking after the web and twitter and the quiz etc., John Lucey and Joe Griffin looking after the finances with Paddy Daly keeping an eye on them, and of course or ultra-efficient secretary Maria Sheehan, whom I will mention again later. I could go on. But it's not only at the national level, but also on every local branch, there are people working away to keep the organisation active, alive and relevant to members. To all of those we owe a big vote of thanks.

As I mentioned earlier I had the pleasure of being involved in the organisation of the Wexford AGM and for my sins I got the job of helping with the Galway and Cork AGM. The weeks preceding these AGMs were hectic, with lists, registrations, printing tickets, name badges etc. etc. But this year nothing, no tickets to print, no name badges – what had happened, had the AGM been cancelled? I asked myself. No the answer was **Maria and the Limerick-Clare branch**, had taken over with such efficiency that I was redundant. Not alone that but the conference

was all arranged and set up nearly a year ahead of time. So congratulations to Maria and all her team for such excellent organisation.

I have been involved in the association for quite a while — in fact since I first started teaching thirty years ago. Back then the branch met at least once a term, on a Monday night in some school lab in the various towns around Co. Wexford. I can still remember many of the demonstrations and tips shared during those meetings. The meetings were usually followed by a cup of tea and a chat in the staff room. In those days there was no Internet, no YouTube, no online sites or blogs to look up or discuss teaching ideas and tips. So branch meetings were hugely important in helping all of us with our professional development.

Then, as now, the AGM has always for me been a motivating event. Whether it is to listen to excellent speakers on a wide range of topics, learn about new approaches to science education, take part in the workshops or browse the stands to see what is out there in the line of equipment books etc., the AGM has always proved a great source of inspiration. My wife, who accompanied me to this year's AGM, was struck by the enthusiasm shown by our members during the event. It is that enthusiasm shown by members that helps us as

teachers to pass on a love and zeal for the subject. But to keep the passion we have to get an opportunity to feed our appetite for science. And that is what the AGM does best and why it is so important in our calendar of events and why it is great to see the event growing in strength and professionalism each year.

It is also great to see the branch meetings going so well. Recently John Daly was down with the Wexford branch with an excellent set of demonstrations to aid the teaching of Junior Cert science. Even in these days of YouTube and web resources teachers still like to come and see the hands-on demonstration and get a chance to ask questions and talk to their colleagues. Declan was also down with us and we hope to get Rory soon. Hopefully the good attendance at such meetings will continue and I would like to see us, at the national committee level, continuing to provide speakers willing to travel to branches with their presentations. This makes it much easier for those of us organising meetings at local level.

Of course the transfer of knowledge is not just from those of us who have been teaching a long time to those new to the job. I myself have changed my approach to teaching following the arrival of a new, younger, teacher to our school. The ideas and approaches she brought with her from her previous school brought a new energy to what had become a rather stagnant department. It is important for all of us to get exposure to new approaches at every stage in our profession by getting a chance to work with others, both young and old. Too often in the teaching profession we are in our own classes working away oblivious to what others are doing and what different approaches we might use, especially if you're the only teacher of that subject. The ISTA has always helped to provide for its members a means for such interaction, and hopefully the opportunity will be there for the more seasoned of us to pick up new ideas as well as pass on some of our experience.

It is amazing how many changes I have seen in my teaching career. While the laws of physics may not have changed – ignoring a new particle or two, a multiverse here or there – but the educational scene has changed. The arrival of the Internet and all that it brought to education is as momentous as the invention of the printing press, and it may even prove to be greater. The shape of knowledge is changing; we have seen the emphasis move from content to the application of knowledge and to key skills and the skill set that employers are looking for. These too have changed.

Different **educational theories** will come and go, be trialled and replaced or improved etc. It is important however that we have our say on such developments and on **new syllabi**, and that we are allowed to add our insight, our experience, and our knowledge to the developments taking place. The ISTA has always been at the forefront representing members' views, as was illustrated by the excellent Hyland Report, which we commissioned in 2014. I intend during my time as chair of our organisation to maintain this important role and strengthen the links we have made with the various bodies involved.

Hopefully the ISTA will be there to help members with all these changes and to provide that help in traditional ways and in new ways. We are already well positioned with our excellent website, twitter account etc. but I would like to see an even greater expansion in the range of online resources that we have so as to even better meet our member's needs.

Finally, I will just say that I am looking forward to the challenges ahead in steering the ISTA through the ever changing waters of science education during my term as chairman.

Sean Fogarty

Chairman ISTA

Image source: News.cnet.com

Nashville Notes
The NSTA Annual Conference (US)

Dr Conor O'Brien

The **National Science Teachers Association** (NSTA) invited the ISTA President to their 2016 annual conference held from March 31st to April 2nd this year in Nashville, Tennessee. And what an experience it turned out to be! The conference programme ran to four volumes and deciphering what's on and when and where proved to be an on-going navigational and time management challenge. By their terms, it was a small conference attracting just under 8,000 teachers, frequently it reportedly often reaches more than 12,000 when run at one of the larger cities. Nashville would be regarded as a small city by US standards with a population of 1,000,000. The main conference centre was located in the city centre in a very new conference complex called Music City Centre, a six floor imposing edifice covering an entire city block. Their rooftop garden covered more than 3 acres (~12,000 m^2) and the main ballroom had a capacity for 8,000 people when fully extended. Three adjacent hotels provided another host of meeting rooms - there were more than 80 events happening simultaneously over a three day period. Added to that was the huge conference exhibition area covering about half of one level of Music City and which featured more than 1,000 stands or booths showcasing commercial educational companies, publishers, government agencies and myriad organisations in the education sector.

Nashville had a particular attraction for me as I had visited the city for two weeks in September 1977 doing a course in Nashville's own Vanderbilt University, required by my then employer Syntex Ireland Limited; their wastewater treatment consultant, Wesley Eckenfelder Jr., a professor at Vanderbilt, ran a course in industrial waste water treatment. In those days I was responsible for commissioning one of Ireland's first large waste water plants.

The big news at the time was Elvis's death in nearby Memphis the previous month. Returning after nearly 40 years meant that there was very little I remembered as the city centre seemed to be almost entirely re-developed. In truth, Nashville is a relatively unappealing city unless you want to pay homage to the Country and Western greats by visiting places such as the Johnny Cash Museum or the George Jones Museum. It seems to attract lots of hen and stag parties and has a busy night life strip – a smaller version of Bourbon Street in New Orleans.

One of the keynote presentations featured the Brandwein Institute Lecture by Prof. J. Drew Lanham entitled '**Love, the word Science Forgot**". He pointed out that science and nature are synonymous; nature may be seen as chemistry, maths, astronomy. I noted some of the points that particularly struck me:

> "Make scientific knowledge part of student's life. Dispense knowledge as a way of thinking. We are the imaginers. We are entrusted with this knowledge for future minds. All people have the capacity to learn - we are always students. We must embrace who we are and work together to complete our task of passing on our connection with nature. Science must lead the way for mankind. You care enough about your profession as teachers to be here at the conference. You came here for a passion. What has been latent in science teaching is love - let YOU shine through, connect head and heart. Teaching is a mission. Find the love in the work you do. Embrace the passion and pass it on."

I also attended "the top 10 safety issues in the science classroom/lab you need to know!". It was interesting to see that the Globally Harmonised System (GHS) of Labelling is indeed global with the US adopting this and the new format of Safety Data Sheets from June 2015.

Highlighting the fact that the USA is such a vast country was a talk on water sampling of the Chester River in Chesapeake Bay, Maryland. This is a huge waterway which is moderately polluted mainly by agricultural run-off. Interestingly a new method featuring a device, which simultaneously scans the land while spreading the exact amount of fertiliser required, is now widely in use and is gradually improving the water quality.

Overall the two days I spent at the NSTA conference were interesting and stimulating. However, I enjoyed the scale and quality of the ISTA conference much more – and didn't have to travel too far!

Conor O'Brien, PhD, MBA, President ISTA

Pictures: Dr Conor O'Brien with Carolyn Hayes, President NSTA and with Bill Badders, Immediate Past President NSTA

Dates for Diary

TEMI National Conference
Tuesday 7th June in the Main Building, UL. Email peter.childs@ul.ie

Science & Mathematics Education Conference
Thu. 16th–Fri. 17th June DCU St. Patrick's Campus. www.dcu.ie/smec

BASF Summer School for Chemistry Teachers
Tue. 28th June & **again** Wed. 29th June in UCC. Details will be circulated to members.

10th Chemistry Demonstration Workshop for Teachers
Mon. 27th June – Fri. 1st July University of Limerick. www.sspc.ie

Primary Science Conference Thu. 9th – Sat. 11th June in Belfast Waterfront www.primaryscienceconference.org

5th Robert Boyle Summer School
Thu. 23rd – Sun. 26th June. Exploring Science & Irish Identity www.robertboyle.ie

ESA Teachers' Summer Workshop 6th – 8th July at ESTEC in the Netherlands, www.esa.int/Education/Teachers_Corner

2nd World Conference on Physics Education:
10th –15th July Sao Paulo, Brazil.

The Festival of Curiosity
21st – 24th July www.facebook.com/TheFestivalOfCuriosity

ISC2016: International Symposium of Chromatography,
28th Aug. to 1st Sep. http://www.isc2016.ie/

Frontiers of Physics
Saturday 24th September DIT Grangegorman Campus www.iopireland.org

ChemEd Conference
Saturday 15th OR 22nd October in DCU (date to be confirmed)

Space Week
3rd – 8th October www.spaceweek.ie

Miniaturized Systems for Chemistry and Life Sciences: Tue. 11th Oct. www.microtas2016.org/program/outreach/outreach_school.html

ICASE World STE Conference
Turkey on 1st – 5th November 2016 www.icase2016.org

Science Week Ireland 13th – 20th November www.science.ie

ISTA Annual Senior Science Quiz Regionals
Thursday 17th November nationwide www.ista.ie

BT Young Scientist & Technology Exhibition
11th – 14th Jan.2017 www.btyoungscientist.ie

ISTA Annual Conference
7th–9th April 2017 in NUI Maynooth. www.ista.ie

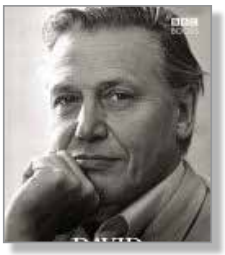
The biennial **Science on Stage Festival**. 29th June – 2nd July 2017 in Debrecen, Hungary www.scienceonstage.ie

ISTA Corporate Members

News & Views

Mary Mullaghy

Sir David Attenborough



On May 8th 2016 David Attenborough celebrated his 90th birthday. A pioneer and legend in science communication, he has helped bring the wonder of nature to millions with his dulcet tones and spectacular documentaries. He has, no doubt, inspired many science educators. We salute him and wish him continued good health.

Award for Mark McCaughrean and his team

Among the many highlights of this year's Annual Conference were the talks by the highly accomplished Mark McCaughrean. So we are delighted to see that he and his team won an award for 'Contribution to popularisation of science' in an International Film Festival of Science Programs for their Rosetta films. http://sci.esa.int/rosetta/53593-outreach-resources

Conference on Miniaturized Systems

The 20th International Conference on Miniaturized Systems for Chemistry and Life Sciences will take place in the **Convention Centre in Dublin** from 9th–13th October 2016.

As part of their outreach programme the organisers are offering a FREE entertaining lecture and Lab-On-A-Chip activities on Tuesday 11th October from 11am–1pm for TY students. To book a place email: **outreach@microtas2016.org**

Data Science Course

DCU has a new course in Data Science. The course co-ordinators welcome an invitation to deliver a presentation to your Higher Level Maths classes. If interested please contact them directly. Details on **www.datascience.dcu.ie**

Hypatia Project

Hypatia is a Horizon 2020 funded project aimed at engaging 13-18 year old teenagers in STEM in a gender inclusive way and addressing the attitudes of STEM education professionals towards more gender-inclusive practices. In order to do this, Hypatia brings together science centres and museums, schools, research institutions and industry with gender experts and teenagers themselves. These groups of stakeholders work together on national and European levels through 14 hubs, co-developing the content and co-organising activities and events. Science Gallery Dublin is the Irish national hub.

Health & Safety Authority

The Health and Safety Authority believes that education is the key to fostering a culture of safety and health which will heighten awareness and keep young people safe and healthy in the home, school, community and workplace.

Check out their website for lots of resources including a **Choose Safety Module**.

SFI publications

SFI publishes a range of reports and brochures throughout the year. These publications may be downloaded as a PDFF from the SFI website by clicking on the title of the publication. **http://www.sfi.ie/news-resources/publications**

ISTA Annual Conference 2017

The Kildare Branch of ISTA will host the Annual Conference on 7th-9th April in NUIM and The Glenroyal Hotel

A comprehensive list of all competitions, news and events is available on our website. www.ista.ie You can also keep up to date on our Facebook and Twitter @IrishSciTeach SFI have asked that we all use #ScienceRising when tweeting this year to mark 1916.

SEC Subject Reports

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Keep up-to-date

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Comments on the March issue of SCIENCE

Adrian Somerfield

Below are comments sent in by Dr Adrian Sommerfield on articles in the March issue of SCIENCE

Dear Rory,

I feel I must compliment you for a very good Science, recently to hand. That is a lovely **picture of M51**, and the little account of its discovery, or at least the recognition of its shape and "island universe" nature, by Lord Rosse was useful. It is a pity Rosse never managed to get the telescope motion steady enough to be able to take long time exposures, especially as Lady Rosse was a pioneering photographer (apart from the source through her dowry of all the cash), so all his pictures are drawings. And in retrospect, a damp and cloudy place like Birr was never a good place to build the telescope!

There were useful insights into "**fracing**" and also evolution in the account of the ASE meetings in Birmingham (my father's university), and there was an interesting "reflection" about that in the **article on Ebola** and how human behaviour and destruction of environment can lead to trouble. I feel I may be having a "thought " coming on, so you have been warned!

Declan Cathcart's piece on "Science" was, I thought, excellent. Especially in its debunking of "scientific method, as if all scientists work to the same patterns. It is important, as he says, that all scientific theories and hypotheses be regarded as temporary, and discarded or modified if evidence shows them to be wrong. Even so, some theories remain useful in their own spheres even if perhaps they are known to be incomplete. Think of light (and the electromagnetic spectrum) and how much of its behaviour, such as refraction, polarisation, interference and diffraction, can be much more easily understood in terms of wave theory even if it is now "known" that it has a particle nature in photons. I would find it very difficult to explain the zone-plate, say, with waves rather than photons, though Feynman has shown how it can be done! The Yagi television aerial referred to by Ian is much more easily understood in terms of standing waves produced by reflection. And then, it is hard to use wave theory to explain the photoelectric effect. There are times, however, when some theories such as Darwinian evolution or the threat of global warming have to be taken seriously and action taken. An important thing for a scientist to be is honest and it is tragic that some have not been. Dishonesty in science will always, ultimately, show up.

Einstein's case which he quoted is interesting; yes, Einstein himself did no experiments, but he used evidence from others, particularly Michelson and Morley, to get to useful theoretical conclusions, which could be experimentally checked by others, such as mass/energy equivalence and the bending of light by gravitation. And the Michelson – Morley experiment itself is interesting in being a null experiment. It failed to detect the motion of the Earth through the "aether", which it set out to do, yet it was not a failure! Luck also comes into it if one keeps an open mind and keen observation; think of Fleming and penicillin. So there is no fixed, neat method of doing science; perhaps science is a process of finding out rather than a "thing" one studies. Speaking of gravity reminds me that Newton's laws of motion and Law of Gravity are accurate enough in most cases (though not in the case of Mercury's orbit) to land a craft on a comet, even if we do not know what gravity is; and it now seems to be connected with waves!

It is amazing to see the developments in instrumentation as shown in various places, but particularly in the **spectrophotometry article**. In my final undergraduate year we were allowed to take a UV spectrum. The spectrometer was the most advanced piece of kit in the Lab (we even used lever balances), and it was a special privilege. It took about an hour to collect the readings "manually" and most of the evening to calculate the curve, reading by reading! Now you see a handheld device about the size of a mobile phone which you can prod into something and read out an infrared or Raman spectrum "just like that". I do sometimes wonder how far such devices should find places in school science. How far do the pupils understand what is happening? Are all electronic instruments infallible. I suppose no pupil uses a d'Arsonval ammeter or voltmeter[1] now!

It is nice to see **Randal** and **Ian** still going strong and to see ingenuity and improvisation still encouraged. I remember the old "minimax" fire extinguishers around my prep school which worked (if they worked!) on the principle Randal described. I would argue with him that all acids and all carbonates produce carbon dioxide. I remember once filling a Kipp's apparatus (or is it Kipps'; anyway I don't imagine it is seen nowadays) with marble chips and adding some old acid I had around and it must have contained a little sulphuric acid. The whole reaction stopped dead!

Richard Fox was interesting about the useful resources available on YouTube, the BBC and elsewhere, especially since experimental work and demos with real chemicals is so restricted by heath-and-safety issues, though I would hate to see actual experimental work cease. For example, in reference to the article, are pupils now allowed to see sodium and potassium, or even lithium actually reacting with water? I am sure they can't see a barometer being made. Can they even use a mercury thermometer? As a "layman" I find I can no longer buy an ordinary clinical thermometer, only an inconvenient electronic gadget, so I suppose ordinary thermometers are outlawed in schools too. Pathetic.

[Talking about **global warming**, I think it unlikely that the Irish will ever take it seriously enough actually to do anything about it. Any effort to improve and strengthen the electricity network is met with protests and delays, ideas for pumped storage systems are opposed on "environmental" grounds (how did we ever get Turlough Hill?), I am sure any attempt actually to install wave-energy collection devices or tidal barrages would be opposed by fishermen (though there is one

1 moving coil meters

at **Strangford Lough**), and the only reasonable attempt at conservation that has been made, that of improving our water and sewerage systems, has been scuppered by a refusal to accept that it must be paid for! But I digress.]

I am not really convinced about all this **mole** business. It seems to be thought of as hugely difficult concept, a mountain which must be scaled before a chemistry student can make progress, like the "P*ons Asinorum*", the theorem about isosceles triangles which was believed to be so difficult that an ass who could not prove it could make no further progress in geometry. You do not have to understand the thermodynamics of the Otto cycle before you can drive a car! What is the fuss? It's only a tool. It was simple in my day when we called it a **gram-molecule** and defined it as the "molecular weight expressed in grams". We accepted that every element had its own atoms and the "average" weight of those atoms was unique to that element. We also accepted that we did not know (or usually did not need to know), the actual weight, but by a series of ingenious processes and thought we knew their **relative weights** and expressed them in terms of hydrogen H = 1 (or later oxygen-16 = 16). So a gram-molecule of H_2 was 2 grams and a gram-molecule of H_2SO_4 was $2 + 32 + (4 \times 16) =$ 98 grams. And **Lodge** was very insistent that it was not 98 but **98 grams**, and you did not argue with Lodge!

It is not on the course now but some of those methods used to be, such as du Long and Petit's rule and the vital Avogadro's hypothesis about gases, but the history of the determination of those atomic weights through the 19th century is very interesting, real science.

So I suppose the problem is that we forget that at school level at least the mole concept is really a means of calculating what quantities (mass in grams or tonnes or ounces) of A we must mix with B to get some masses of D and E. It may be interesting to throw in Avogadro's number as a sort of magic number, but I think it is causing confusion. But I am old-fashioned now!

I have been looking back at the old copies of Science you put on a stick for me (that copying leaves a lot to be desired!) to look up an old article I wrote about Random Walking (1963) which gives a method I used several times to actually **estimate roughly molecular size**. Not that the idea was original of course; it was introduced by a nun from Bristol at one of our AGMs and I worked it up.

I suppose I have written some nonsense so I will stop where I started and compliment you on a very good issue.

Best wishes,

Adrian

(13 March 2016)

Dr Adrian Somerfield, former physics teacher at St Columba's College, Whitechurch, Dublin

Frontiers of Physics 2016

Paul Nugent

IOP | Institute of Physics In Ireland

Annual Conference for ALL Teachers of Physics, including Junior Science Teachers

will take place on

Saturday 24th September 2016

in the

School of Physics,
Dublin Institute of Technology
Grangegorman Campus

This year's Institute of Physics teachers Conference will take place in the new DIT NUIG Grangegorman Campus. It will be a day of lectures, demonstrations, and workshops, resources and networking for all teachers of physics including Junior Science Teachers.

The eminent physicist **Prof. Mike Cruise** FRAS, FinstP, University of Birmingham and lead investigator on LIGO Gravitational Wave detector will deliver the keynote presentation.

There will be other guest presenters and a series of 'Showcase Talks' from DIT School of Physics.

Workshops will include:

- Isaac Physics, University of Cambridge
- Perimeter Institute, Canada
- Physics for mobile devices, Alessio Bernardelli

A discussion will take place on the 2016 Leaving Certificate Physics examination papers and marking schemes, which will form the basis of the Institute of Physics report to the SEC.

More details will be available on **www.iopireland.ie**

Dr Paraic James RIP (1959 –2015)

Paraic James died suddenly on 4th December 2015 aged 56. Paraic was a committed teacher, researcher, and promoter of chemistry. He served as Vice-President and President of the Institute of Chemistry of Ireland and most recently as the Institute's Registrar.

A native of Beltra, Co. Sligo, he was born on 8th March 1959, the second of three sons of Mary and Hughie James. Educated at Ballinlig National School, St. Mary's College Ballisodare, and University College Galway, he graduated with a B.Sc. (First Class Honours) in Chemistry in 1980. His postgraduate research on the chemistry of nitrogen heterocycles was undertaken under the supervision of Professor R. N. Butler in Galway, who is also recently deceased. He was awarded a Ph.D. by the National University of Ireland in 1983 for this research and earned the 1851 Exhibition Scholarship to work at the University of Oxford with Professor Jack Baldwin. This work focussed on the chemistry of penicillin.

In 1986, Paraic was appointed Lecturer in Chemistry at NIHE Dublin (now Dublin City University), being promoted to Senior Lecturer in the year 2000. He served as Head of the School of Chemical Sciences for a number of years during

which his great management and organisational skills became evident. He maintained strong interests in heterocyclic chemistry and Nuclear Magnetic Resonance spectroscopy. This work led to many publications in international peer reviewed academic journals. Paraic supervised 16 graduate students to Ph.D. and M.Sc. degrees.

He made major contributions to the development of the B.Sc. programme in Analytical Science and was instrumental in establishing the B.Sc. programmes in Pure and Applied Chemistry (now simply called Applied Chemistry), Environmental Science with Health, and Chemistry with Language degrees. Paraic lectured across all years of the undergraduate and postgraduate degree programmes, and his approach to teaching was characterised by a deep concern for the welfare of his students. He was always careful to identify those students who were struggling with the course content and to ensure they received the extra supports necessary for them to succeed. Indeed the outpouring of affection from the student body at DCU following the news of his passing was evidence of this.

Paraic's interest in chemical education was not confined to the third level. He was heavily involved with the Science Olympiads. Starting in 1995, Paraic organised the Irish team's participation in the International Chemistry Olympiad (IChO) aimed at second level students. Several of his former Olympians went on to make a career in chemistry and they happily acknowledge the influence Paraic had on their career choice. Paraic was central to the development of two science Olympiads for younger second level students and served as Scientific Coordinator at the first and third European Union Science Olympiads (EUSO) competitions. The International Junior Science Olympiad (IJSO), for students under 16, commenced in 2004 and Paraic served as European Vice-President from 2004 to 2012 and assumed the role as Treasurer more recently. All of this involved a significant commitment in time and energy, liaising with schools, team selection and training, and accompanying the teams to the competitions as a mentor and jury member.

His involvement in the various science Olympiads also allowed him to indulge his passions for international travel and photography. Among his most treasured possessions was his collection of more than twenty volumes of carefully catalogued photographs from all over the world.

Paraic served as Secretary of the Society of the Chemical Industry (Irish Branch) and was a member of the Radiological Protection Board. He served on the Board of Management of Coolmine Community School from 1993 to 2015, acting as chairperson for much of that period. In that role, he was an invaluable support to successive Principals, assisting them in dealing with many difficult issues. He was also a loyal Fine Gael supporter holding a variety of offices in the Dublin West constituency.

Paraic's Funeral Mass took place at Dromard Church, where he had been christened, and he was the first to be laid to rest in the new cemetery adjoining the Church. Paraic was a modest and unassuming person, who did much to promote Chemistry in Ireland. He will be greatly missed by his many friends and colleagues.

The Journal of the Institute of Chemistry of Ireland

Editor: Pat Hobbs

Student alternative concepts in Science

Ted Forde

Abstract: Many students possess alternative scientific concepts. These can prove difficult to unlearn. They can range from flat earth views to confusion between concepts of force and energy.

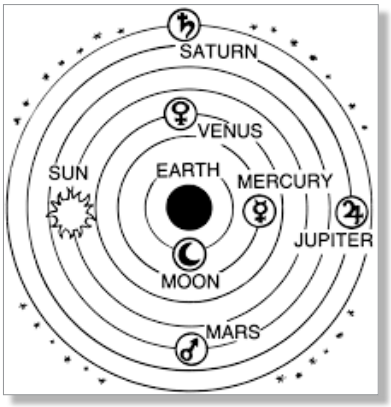
It is a simple matter to show two men standing on different parts of the earth's surface. Either a simple drawing or a globe and two small models will do. One man can be shown standing in Ireland and the other in Australia. Most adults will show the two men having opposite orientations, i.e. both will appear upside down with respect to one another. However, younger children may show the two men as having the same orientation (that is, the man in Ireland will have his feet on the ground while the Australian will be standing on his head).

This and a number of other experiments carried out by Nussbaum and others (1) suggest that many children possess an alternative concept of the earth in space. It involves the notion of a flat earth extending all around them. The reason seems to be that this is how the earth appears to young children as they look around them.

Many other alternative concepts appear throughout science education. For example, there is evidence (2) that 10% of a sample of young UK students regarded the sun, wind and fire as being alive. Piaget (2) found ideas on motion among university physics students that were derived from Aristotle rather than from modern science. **Driver (2) explains that children come to terms with natural phenomena that they experience by building their own conceptual frameworks and that these frameworks are often at loggerheads with those of the scientific community**

There appears to be a natural developmental process at work here. Ideally, as students go through the educational process alternative concepts are replaced by orthodox scientific ideas. However, a problem arises when alternative concepts are retained by learners.

Driver suggests that alternative and scientific concepts can coexist in the mind of a student. **There is evidence (3) that alternative concepts are held by many third level students and even by professional scientists.** In 2005 a study carried out in the USA (4) found that 20% of Americans and 30% of Russians held a view of the earth that predated Copernicus. They held the belief that the earth is orbited by all celestial bodies, including the sun.



David Ausubel (5) suggests that students actively try to create meaning by explaining new concepts in terms of those they already understand. Where a student concept differs from that held by the scientific community it can prove extremely tenacious and resistant to unlearning.

Driver (2) gives an example of an experiment where a student appears to confuse the concepts of weight and energy.

Two students are carrying out an experiment involving Hook's Law. The aim of the experiment is to show that when different masses are added to a suspended spring they are proportional to the displacement of the spring.

Ball bearings are added to a cup suspended from the spring. The experiment proceeds in the manner predicted by Hooke's Law. Then, one student, Tim, asks that the spring be moved higher up the supporting stand. The same masses are used at the new height. Tim wishes to investigate if the same displacements will be observed at the new height. He explains:

> "This is further up and gravity is pulling it down harder-I mean the gravity is still the same but it turns out it is pulling harder the farther away. The higher it gets the more effect gravity will have on it because, like if you just stood over there and dropped a pebble on him, it would just sting him, it wouldn't hurt him. But like if I dropped it from an airplane it would be accelerating faster and faster and when it hit someone on the head it would kill him".

Tim (incorrectly) expects a greater displacement of the spring when it is further from the ground.

The experiment described provided an opportunity to make Tim aware of the conflict between his concept and that of the scientific community. Nussbaum (1) holds that making students aware of their own alternative concepts may lead to their replacement by accepted scientific concepts.

Ted Forde, Ballinteer, Dublin 16
(Retired Chemistry Teacher)

References

(1) Driver, R. (1985) editor, *Children's Ideas in Science*, Milton Keynes: Open University Press.

(2) Driver, R. (1991) *The Pupil as Scientist*, Milton Keynes: Open University Press.

(3) Lewis, E.L. and Linn, M.C. (1994) Heat Energy and Temperature Concepts of Adolescents, Adults and Experts: Implications for Curricular Improvements, *Journal of Research in Science Teaching*, Vol. 31, No.6.

(4) https: // en. Wikipedia. Org/ wiki/ Geocentric model

(5) Ausubel, D.P. (1968) *Educational Psychology: A Cognitive View*, Holt Reinhart.

STEM Teacher Education – Initial and CPD

The 7th **Science and Mathematics Education Conference** (SMEC) will be hosted by the Centre for the Advancement of STEM Teaching & Learning (CASTeL) in DCU St Patrick's College Campus, from 16th–17th June. This international conference provides an opportunity for educators to discuss issues pertaining to STEM teacher education from early childhood to third level.

The main themes of this year's conference include:

- Initial Teacher Education; including professional knowledge of teachers; teaching and learning in initial teacher education; relating theory to practice; and issues related to teacher education programmes, policy and reform
- In-service education; including in-service education and training; curricular reform and new programmes
- Continuous Professional Development for all teachers; including teachers as lifelong learners; methods and innovation in professional development; evaluation of professional development practices; and reflective practice, teachers as researchers, and action research.

They also welcome contributions dealing with other aspects of STEM teaching and learning at primary, secondary and tertiary level. Oral and poster presentations are welcome.

Guest Speakers include:

- Prof. Thomas Guskey, College of Education, University of Kentucky.
- Dr. Sara Hennessy, Reader in Teacher Development and Pedagogical Innovation at the University of Cambridge.
- Dr. Andrea Stylianides, Lecturer in Mathematics Education at the University of Cambridge.
- Dr. John O'Reilly, Lecturer, University of Limerick.

To register, please visit:
http://www.dcu.ie/smec/register.shtml

Musings

Ian McCulloch

My cupboard is bare. When putting something together for this issue I am normally recovering from the Annual Meeting which provides me with lots of material. This year circumstances prevented me attending on Sunday. Those circumstances expanded and I was unable to come down at any stage.

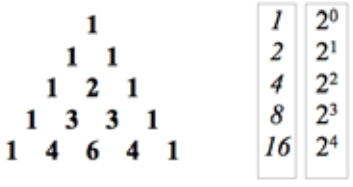
I am forced to resort to the other subject, maths, for which I used to be timetabled so as not to incur the editor's wrath. (Does Rory know what wrath is? In my experience it certainly seems not to be in his nature.)

The topic I have decided to bring to your attention is Pascal's Triangle. Most of you are, I'm sure, familiar with this. Even so, it has some rather arcane properties some of which you may be unaware of.
If you don't know, or haven't already spotted it, each row starts and finishes with a "1". The numbers in between are arrived

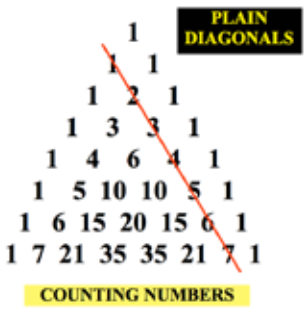
```
                1
              1   1
            1   2   1
          1   3   3   1
        1   4   6   4   1
      1   5  10  10   5   1
    1   6  15  20  15   6   1
  1   7  21  35  35  21   7   1
```

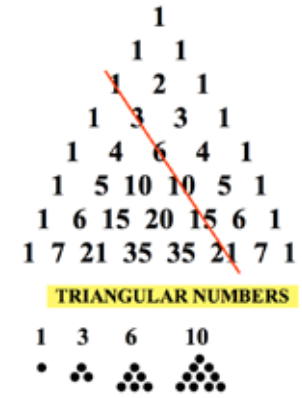
at by adding the two numbers above left and above right of the gap you are trying to fill.

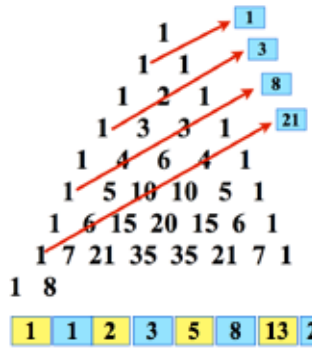
The first observation I will bring to your attention is that the sum of the numbers in each row generates a neat little sequence.



A perusal of the diagonals bears even more fruit.







1 1 2 3 5 8 13 21 34

This is, of course, the famous **Fibonacci sequence** so beloved of rabbit breeders.

And now for something completely different — binomial expansions. Most of you will know, or be able to work out, that

$(1+x)^0 = 1$ (anything to the power of zero is one)

$(1+x)^1 = 1+x$

$(1+x)^2 = 1+2x+x^2$

$(1+x)^3 = 1+3x+3x^2+x^3$

But what about $(1+x)^{10}$?

$(1+x)^{10} = 1 + 10x + 45x^2 + 120x^3 \ldots + x^{10}$

The first two terms are handy enough and then it continues x^2, x^3 etc. up to x^{10}, but what are their coefficients? If you look at the coefficients on the right-hand-side of the four equations above, you will see that they correspond to the first four rows of Pascal's triangle so all we have to do is add a few rows to the first Pascal's triangle above and the 45, 120, etc. are revealed.

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 20 15 6 1
1 7 21 35 35 21 7 1
1 8 28 56 70 56 28 8 1
1 9 36 84 126 126 84 36 9 1
1 10 45 120 210 252 210 120 45 10 1

To continue on this theme, how about $(1+x)^{-1}$, $(1+x)^{-2}$, and so on?

$(1+x)^{-1} = 1 \div (1+x)$

$$
\begin{array}{r|l}
1+x-x^2+x^3 \ldots & \\
\hline
1+x & 1 \\
\underline{} & \\
-x & \\
\underline{-x-x^2} & \\
x^2 & \\
\underline{x^2+x^3} & \\
-x^3 \text{ etc.} &
\end{array}
$$

This is an infinite series and, again, Pascal's triangle comes to the rescue for the coefficients if you don't fancy algebraic long division — the figures on the left (or right) diagonal starting from the top, alternately positive and negative, give you the coefficients.

A similar exercise to the above for $(1+x)^{-2}$ yields $1 - 2x + 3x^2 - 4x^3$, i.e. the diagonal one "step" in from the edge.

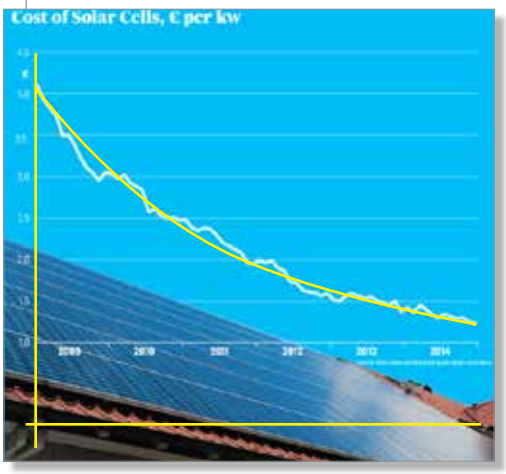
Pascal's triangle is certainly a mathematical marvel that just keeps on giving and giving. It can also provide insights when investigating "sets". You will be relieved that I will not be pursuing this avenue on this occasion and even more relieved when I confess that I will probably never return to this theme ever again.

In an effort to retain my grumpy old man status I do have something else — a graph, whose origin escapes me, that offends me in three ways. The symbol for watts expressed with a lower case 'w'. A misleading *x*-axis and a curve that would have been far more meaningful without its plethora of nooks and crannies. It should have looked something like the lower version on the right.

I have stored away safely Richard Fox's list of "Youtube" classics from the March issue of "SCIENCE" for that time in the future when I succumb to a smart TV. Given that my cathode ray tube has not been gone long that may be later rather than sooner.

Ian McCulloch

Formerly of Sandford Park, Dublin



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National Centre for STEM Education

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50 Years Looking Forward

Registration open

10th Chemical Demonstration Workshop for Teachers

Email: sarah.hayes@ul.ie. +353 61 234915

Sponsored by the Synthesis and Solid State Pharmaceutical Centre (SSPC), the Faculty of Science and Engineering and Dept. of Chemical and Environmental Sciences, University of Limerick, Pharmachemical Ireland, and supported by the Institute of Physics Ireland, the 10th Workshop will be held at the University of Limerick on the June 27th to July 1st, 2016. Due to the course being sponsored and heavily subsidised the cost of this course is only €150, which covers accommodation, meals and course materials.

The University of Limerick's four day residential course (Starting Monday lunchtime and finishing Friday lunchtime, i.e. 4 full days and nights B&B & meals) will help teachers become more confident in doing demonstrations in school at Junior Certificate Science and Leaving Certificate level, and will cover safety aspects and the use of ICT in demonstrations. We will have special guest presenters, offering a wide variety of demonstrations.
Teachers, working in pairs will also be required to research, devise, test and present a 10-20 minute Science Demonstration Show at the end of the course.

You should bring your favourite demo along to show and share with other teachers. There will be opportunities during the course to watch experienced demonstrators live and on video, to access printed and internet resources on demonstrations, and to leave with materials and tested demonstrations for use in schools.

Further information please contact SSPC Education & Outreach Officer Dr Sarah Hayes

www.sspc.ie

Feedback on the ISTA Annual Conference

The 54th ISTA Annual Conference was held in Limerick from 8th to 10th April. It was splendidly organised by the Limerick-Clare Branch of ISTA under the expert guidance of Dr Maria Sheehan.

Below is a small selection of the written comments of members who attended the conference.

"I was inspired by all the speakers!!! I will definitely make a change to some of my bad teaching habits. Already I am implementing Eric's suggestions! Amber Gell was an inspiration!! What a lady! I showed all my classes some NASA videos to get them inspired and tomorrow I am talking about Marks adventures with the comet. Thanks for the speakers, they were brilliant!"

"Best ISTA conference I have ever been to, hands down. I left excited and inspired by stories of international scientific/educational endeavour but most importantly from the stories I heard and friendships I forged with my own science teacher colleagues."

"I was positively exhausted Saturday evening with the eventful day we had — a reflection on the brilliantly organised day. Enjoyed Animal Magic also much to my surprise. Oliver, Emma and Sampson what beautiful creatures! The simplicity of the chemistry show demonstration on Sunday was a pleasure and joy to watch. Hunting Amazon for see through ladle later! Great teaching hooks."

"Many many congratulations to the team who put together this year - great conference and lots of food for thought. There was a lovely buzz around the place - well done!"

"This was a really enjoyable and beneficial conference and very sociable. Eric Mazur and Amber Gell were particularly good. Pecha Kucha and Science on Stage likewise were very good."

"The conference programme was excellent. It was such a high standard. The conference ran smoothly and efficiently and was a credit to all of the hard work of the organising committee."

Above: *Maria Sheehan (with barnowl);*
Below: *Amber Gell; The team of helpers*

Mick Moriarty (Kildare Branch) commented:

Wow, what a conference! The Kildare branch would like to extend our thanks to the Limerick-Clare branch for such a well-run conference and for all the nagging questions that we put to all the committee on the running of the event. The range and quality of speakers, workshops and stands left us spoiled for choice, eager to go to everything and mindful that the boots we are about to fill are big ones indeed.

The Kildare branch, as you are more than likely aware, are hosting the event between 7th - 9th April, 2017 in NUI Maynooth and The Glenroyal Hotel*. Thanks to Majella Dempsey in the Education Department of NUIM, we have been given a tour of both the South and North Campus and we are in the process of selecting rooms, laboratories, theatres and an area to host the many sponsors that frequent the annual conference.*

The real work starts now. We have met sponsors and speakers at this year's conference. We have put together all the emails of ISTA Kildare members (current and retired) to reach out and invite members to join the committee. It is not a closed group and we want to be all inclusive and to bring as much expertise to our big day! The decision is yours.

Buoyed by the knowledge that we have the backing of the ISTA and the immediate experience of the Limerick/Clare branch committee, we look forward to the challenge of putting our shape on the next national conference.

Pecha Kucha

A Pecha Kucha session was held at the recent Annual Conference in Limerick. (Pecha Kucha is a presentation style in which each presenter is given 20 seconds to talk about or explain each of 20 slides. Each presentation therefore lasts for 6 minutes and 40 seconds.) The session focused on Transition Year Science.

The presenters were:

- Richie Moynihan - Physics teacher and member of the Irish Science on Stage team
- Declan Cathcart - Biology teacher and member of the SAILS team
- Brigid Corrigan - Chemistry and Biology teacher, JCT associate and member of the Irish Science on Stage team
- Pat Dundon - Biology and Physics Teacher, PDST science associate and member of the Irish Science on Stage team
- Paul Nugent - Physics teacher, Institute of Physics (IoP) network coordinator and member of the Irish Science on Stage team
- Paudi Scanlon - Physics and Maths teacher with an interest in technology and coding.
- Yvonne Higgins - Biology and Chemistry teacher, BT Science and Technology Exhibition Educator of Excellence 2016

Patrick Dundon organised the session.

What follows is a synopsis of some of the presentations.

Developing thinking skills

presented by **Richie Moynihan**

Richie's presentation introduced simple ideas to get students thinking about analysing data and drawing scientifically valid conclusions. The talk consisted of an opportunity to practise these skills, in the context of Excretion, in Junior Certificate Biology.

We were presented with a brief summary on facilitating the students' ability to represent data using appropriate graphs and to use scientific contexts to explain the shapes of graphs. By drawing links to the Project Maths syllabus, specifically the patterns, coordinate geometry, functions and the statistics sections, we were shown the value of using cross curricular understanding to further students' understanding of the scientific processes and concepts involved in excretion.

Richie also suggested novel ways to generate data for other topics, including using previous Coursework B titles for contextual inspiration.

Creepy crawlies in the TY laboratory

Declan Cathcart gave us a presentation on an example of his work on assessment of inquiry skills. One vehicle he used for this was an investigation into the living conditions of woodlice that he has carried out with his Transition Year students. He brought us through an outline of the **open-inquiry lessons**, from forming hypothesis to experimental design to testing and collecting data.

Formative assessment comprised questioning groups at each step of the process, recording the progress of groups and individuals, and focused in particular on developing a hypothesis and designing an experiment.

He showed us examples of students' experimental setups, ranging from "exceptional" to "yet to meet expectations" according to a rubric he used. Declan found that assessment was more valuable when carried out during the sessions, as compared with reports written during and after the experiments were carried out. He also emphasised the importance of students' being aware of the **assessment criteria** from the outset.

Physics with everyday objects – Simple Ideas for TY Science

presented by **Paul Nugent**

Teachers often have difficulty finding material to teach Transition Year Students. The following uses the simplest of every day equipment and materials yet students can explore key concepts for Leaving Certificate Physics.

The activity promotes fun as well as developing 21st Century Skills such as critical thinking, collaboration, adaptability, initiative, effective oral and written communication skills, ability to access and analyse information, curiosity and imagination.

- The class is randomly put into groups of three.
- Each group decides on a team name and charter which they share with the class
- The group randomly selects an object from the list below. They research and develop as many demonstrations/tricks/ experiments as possible:

Paper / card	String / rope
Balloons	Paper clips
Elastic bands	Plastic bottles
Straws	etc.

- Students keep their ideas secret from other teams and make a short video/ claymation to present to the class. Other teams gain credit by asking questions.
- Students individually write a short reflective piece on what they have learned.

Lots of ideas can be found on **www.scienceonstage.ie**

Are 2 straws better than 1?

‘Something that works well for me that you might try on Monday…’

presented by **Brigid Corrigan**

Purposeful use of technology can embed better teaching, learning and assessment practices in the classroom. The tools of technology are many and are revolutionising education practices, whether teachers accept it or like it. They are here to stay. Embracing technology for how it can enhance teaching, learning and assessment of any subject involves trial and error and recognising that the tools of technology themselves are nothing without the expertise of pedagogy to guide them to a purposeful use. So, what tools are worth trialling? Two online tools that I am recommending are Padlet and Kahoot because they can support teaching, learning and assessment in a novel and fun way. A third suggestion is gathering photo evidence of white board/wipe board work that emerges or develops in the class. Save as a record/evidence of work as well as forwarding it on to students for revision etc.

All can be used to introduce or review topics, explore what students already know, examine content knowledge learned, to flip the classroom, use as formative and summative assessment for learning and much more.

Padlet, Kahoot and photo evidence of classroom work enable students to be become self-directed and independent in their learning by encouraging them to manage their learning, using technology to learn and can provide the opportunity for peer and self-assessment.

Amgen Biotech Experience

presented by **Yvonne Higgins**

Yvonne reviewed a variety of resources available to TY science teachers, that have been found to be successful in engaging students’ interest. She focused particularly on activities from across the spectrum of the science subjects, that require students to work in an investigative manner.

Capturing attention in STEM classrooms

presented by **Pat Dundon**

In this presentation Pat summarised the highlights from two recent webinars that he presented to European STEM teachers on the SCIENTIX portal namely “Quirky ideas to pique and promote student interest in STEM classrooms” and “Using discrepant events and mysteries to enliven the teaching and learning of science”.

He briefly introduced ‘**Think Big’ Questions, Fermi Problems, Discrepant Events, Mysteries and STEM ‘Memes’**. Experience shows that these strategies help to promote the hands-on and minds-on teaching and learning of topics that students otherwise find difficult.

http://www.scientix.eu/web/guest/resources/details?resourceId=10067

Alternative assessment methods

presented by **Paudie Scanlon**

Paudie discussed a range of alternative methods of assessment that remove, or at least reduce, the stress for students and may even be enjoyable. They are all very easy to implement.

Feedback from conference re Pecha Kucha

The feedback on the session was overwhelmingly positive from a very engaged audience. Maybe we could have another Pecha Kucha at next year’s ISTA Conference in Maynooth.

TEMI Conference, Leiden, 15-17 April 2016

Peter E. Childs

TEMI, Teaching Enquiry with Mysteries Incorporated, is an EU-funded FP7 project aimed at encouraging inquiry-based science education. The project was coordinated by Queen Mary College, London and the University of Limerick was one of the 12 European partners. The UL team was led by Dr Peter Childs and the project ran from 2013 to 2106. The project was based around the delivery of CPD workshops to six cohorts of teachers, who each did two workshops separated by 8-10 weeks. In between the workshops teachers were asked to try out 5 TEMI ideas (from a bank of ideas) and to devise two TEMI lessons themselves. The project focuses on the use of mysteries or discrepant events to engage students and introduce inquiry using the 5E model. There is also an emphasis on showmanship and the gradual release of responsibility model, to transfer ownership of inquiry to the students. The Irish workshops involved 53 teachers in 30 schools and 11 pre-service science teachers from UL. In addition, several short 'taster' workshops have been given to Irish science teachers e.g. at the recent ISTA conference in Limerick we gave two workshops to a total of 57 teachers.

A contingent of Irish teachers went to the final TEMI Conference in Leiden, where they took part in workshops and lectures, a science fair, and met teachers from the other partners. The photo shows the Irish group at the science fair. The teachers came back with lots of new ideas and new friends.

The Irish team at the Leiden conference

The latest issue of **Chemistry in Action!** (#107, Spring 2016) is a special issue on the TEMI project and as well as reviewing the achievements of the project, has lots of TEMI ideas for engaging students. This should be in schools by now.

Cover of the special issue

TEMI National Conference

The TEMI project formally finishes at the end of July 2016. The UL team is holding a **TEMI National Conference on Tuesday 7th June 2016 in UL**. This will give an opportunity to bring back TEMI teachers from all six cohorts to meet each other but also to share their work with other science teachers and stakeholders. The conference will include talks on showmanship by Paul McCrory and Tilman Andris and a Science Fair, where the TEMI teachers will display their work.

A limited number of spaces will be available for teachers who have not been part of the project. If you are interested in attending please send an email to:
Peter Childs at **peter.childs@ul.ie**
There is no charge for the conference, which will run from 10 am to 4 pm in the Main Building at UL. Refreshments and lunch will be provided.

At the end of the project the teaching resources created by the Irish team and the TEMI teachers will be made available on Google Drive to all interested science teachers – you will just have to register on the site. Details will be given at the conference and in the next issue of SCIENCE and Chemistry in Action! and on the EPI*STEM website. The UL team is also planning to offer TEMI Workshops to ISTA Branches in the next school year as part of our dissemination process.

Dr *Peter E. Childs*
Emeritus Senior Lecturer in Chemistry
Director, Chemistry Education Research Group
Hon. Editor, Chemistry in Action!
University of Limerick

TEMI workshops

Peter E. Childs

The UL TEMI team is offering to run **workshops for ISTA branches** during the coming school year. This will be a similar but an expanded version of the workshops run at the ISTA conference in Limerick. TEMI stands for Teaching Enquiry with Mysteries Incorporated (www.teachingmysteries.eu) and aims to use mysteries/discrepant events to engage students' attention, lead them to ask questions and channel them into inquiry.

The approach aims **to raise questions** so that students want to find out the answers. The approach is suitable for introducing topics in Junior Science and LC science and we have developed ideas for all the sciences, as well as for Transition Year.

The workshop will be a '**Circus of Mysteries**', where teachers will be introduced to the TEMI idea and the allowed to sample a range of mysteries that can be used to introduce lessons.

There are **free lesson materials** available on the TEMI website as well as a **booklet on 'Teaching the TEMI way**'. The latest issue of Chemistry in Action! (#107) is devoted to the TEMI project. If you are not on the mailing list, email Peter Childs for a copy.

To book a session next year email peter.childs@ul.ie. We would hope to do one a month from September and October is already booked! There is no charge but we assume the local branch will cover expenses. The TEMI project finishes in July but these workshops will be part of our continuing dissemination activity.

Dr Peter E. Childs

UL TEMI Coordinator

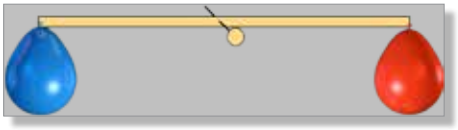
'Weighing' air

Demonstration Experiment (Number 3 of 10)

Randal Henly

The atmosphere exerts pressure because of the weight of the air. The experiment described here is ideal for showing—particularly to first-years—that the air surrounding the Earth has weight, i.e.,the air must have mass.

A very simple way to do this is to find the mass of an empty balloon, inflate it, and find the new mass, which will be greater. However, such a method is quite unimpressive, particularly when the teacher has done the 'weighings' and the pupils have seen nothing.



Apparatus

Long wooden lath—strong enough not to bend (while a metre stick will suffice, a lath about two metres long is better; there is more 'leverage' and greater turning and the result is more impressive), two balloons, arrangement for support (see below), sharp scissors, preferably pointed (e.g., a nail scissors)

The following experiment always holds the attention of pupils. A wooden rod is supported in the centre(*) so that it can rotate. Two inflated balloons are attached to the two ends of the rod. (Some adjustment will probably be needed there to make the rod balance. I usually attach some *Blutac* to the back of the lighter end of the rod to make it heavy enough to balance horizontally.)

Ask the class what will happen when the air from the red balloon is released. Surprisingly, quite a majority predict that either that balloon will go down or that nothing will change. Those that predict the balloon will rise are always in the minority.

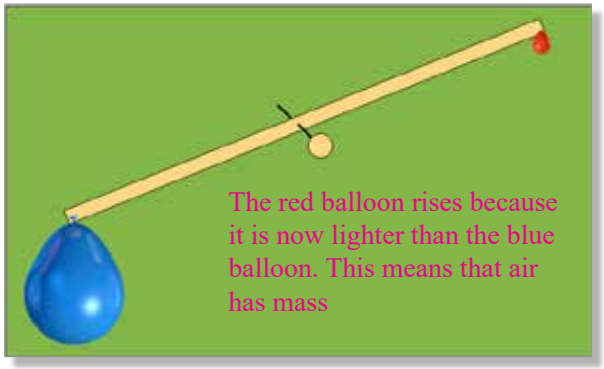
While holding the rod, cut a hole in that balloon and when the air has escaped, release the rod; the deflated balloon rises because this end is now lighter. Do **not** burst the balloon as bits of rubber will separate and be lost, making the experiment invalid. Cut a hole, with a **sharp** scissors, in the **unstretched** rubber near the balloon's opening. **Hold the stick while the balloon is deflating** as otherwise that balloon is driven downwards (Newton's 3rd Law) and this of course would lead to the wrong conclusion. Explaining the reason is introducing an aspect that is unnecessary and will only complicate the issue.

As for all demonstration experiments, a diagram to reinforce the explanation is always recommended—something like the following:

Does Air Have Mass?

The red balloon rises because it is now lighter than the blue balloon. This indicates that air has mass.

Randal Henly



(*) A good way to do this is to drill a hole in the centre of the rod and to push an awl, nail or strong pin through this hole, into a cork which is supported by a clamp attached to a stand.

SciFest: Where Creativity Meets Opportunity

Sheila Porter
SciFest CEO

The SciFest Programme continues to grow at a phenomenal rate, year on year. We are excited to see that 2016 is set to break all previous records with more than 8000 students presenting projects.

The SciFest@School strand of the programme was introduced in 2011. The idea was to make sure that each and every student would be encouraged to 'try' science and experience the excitement of a science fair. Five schools hosted in-house SciFest@School science fairs in 2011. Word spread quickly and this year to date 54 schools have hosted SciFest@School science fairs and a further 3 have indicated their intention of doing so before the end of the year. Participation in the programme not only promotes a love of science in the school but can also to be a great way to involve parents, retired teachers, local industry and past pupils in the exciting changes that are taking place in the teaching and learning of science.

A SciFest@School can be cross curricular and reach out to other departments. In a SciFest@School in Lanesboro Community College in November the first year home economics students put together, and served an excellent lunch of sandwiches, various salad dishes and home-made cakes to the judges. In Coláiste Chraobh Abhann TY art students designed a banner which stretched almost the full length of the exhibition hall. A SciFest@School provides an opportunity for TY students to practise their events management skills and act as mentors for younger students. In CBS Roscommon each year the TY students put on a super interactive science show for their first and second year students and for the pupils from the local primary schools.

In 2016 there are sixteen regional SciFest@College science fairs taking place. Fourteen of these are being hosted by the Institutes of Technology, one by DCU and one by St Mary's College in Derry. Students can enter directly at regional level but having first participated in a SciFest@School is a definite advantage. These students have already been through the judging process, have grown in confidence and are more focussed. It is wonderful to watch a student progress from a SciFest@School to a SciFest@College and finally to the SciFest National Final in Dublin The creativity of the students when given the opportunity is truly mind blowing.

Above: *SciFest@School Coláiste Craobh Abhann*

Left: *Events management team from TY SciFest@School Coláiste Craobh Abhann*

Below: *TY Science show SciFest@School CBS Roscommon*

Left: SciFest@College 2016: A student from Coláiste an Phiarsaigh explains her project to Shelley Adams from the University of Southern California

Below: SciFest 2015 National Final: Spirit of SciFest Award winner, Eve McGlinchey

Louis Madden, a fifth year student from Largy College, Clones, Co Monaghan, the **overall winner of SciFest 2015**, looked at whether genetic testing and DNA research could be carried out simply, cheaply and efficiently. He spent just under €150 on cheap and recycled material and built several pieces of laboratory equipment including a vortex, centrifuge, PCR, transilluminator, gel box with power supply and gel camera. Using this equipment, he isolated and amplified chloroplast DNA. Comparing his results with those of other tests of the same material he demonstrated that genetic testing could be done in a simpler, cheaper and more effective manner. The development of this low cost apparatus could allow a school to carry out DNA profiling in the school laboratory. Louis will represent Ireland at the Intel International Science and Engineering Fair 2016 in May in Phoenix, Arizona.

Other projects at the SciFest 2015 National Final included a wearable device designed by Cillian Gartlan, Patrician High School, to mitigate risks associated with stroke treatment. Cillian won the Boston Scientific Medical Devices Grand Award for his invention. A student from Coláiste Raithín, Bré, Lúc de Barra won the SEAI INESPO award for his project which investigated the potential of pine needles as an alternative biodiesel source. He will represent Ireland in June at INESPO 2016 (International Environment and Sustainability Project Olympiad) in the Netherlands. The Berlin Long Night of Science Award went to Eoin Hayes and Adam Burke from Coláiste Chiaráin in Croom for their project 'The Handy Guide to sign Language'.

Participation in SciFest helps students develop the skills sets essential for the next generation of creative problem solvers and entrepreneurs. Each year the standard of projects exhibited gets better and better. The innovation and the creativity on display even at school level is a testament to the hard-work and dedication put in by the students and their teachers. SciFest proves that when students engage with STEM outside the classroom they bring their learning to a new level and produce amazing results.

SciFest@College 2016 DIT: Best Project Award winner Omar Salem, Sutton Park School, Dublin

LATEST NEWS FROM ISEF, 12th May 2016

ISEF is the biggest science fair in the world. At this year's event **Lauren Murphy**, of Loreto Balbriggan, was awarded a third place award in the Computational Biology and Bioinformatics category and $1000 cash prize. Lauren had won awards in SciFest and Sentinus (NI) in 2015.
At the same event **Louis Madden** won **two special awards** which included participation in the "Web Valley" summer school in Trento, Italy and €1000 cash prize. **Congratulations to both.**

Above: *Lauren Murphy and Louis Madden at the Intel International Science and Engineering Fair (Intel ISEF)which was held in Phoenix, Arizona from 8th to 13th May 2016.*

Discover and Learn at Dublin Zoo

Aileen Tennant

Dublin Zoo is one of the oldest zoos in the world and hosts over 400 individual animals on 28 hectares of land and water. Dublin Zoo is an environment rich in living things, from animal to plant life, both native and non-native. It is a true living classroom that engages people of all abilities, young and old.

Education, conservation and research are the main objectives of Dublin Zoo. The Discovery and Learning department has many years' of experience in designing and delivering education programmes which meet the learning objectives of the secondary school science, CSPE and leaving certificate biology syllabi. Our programming aims to embrace the skills and objectives outlined in pre-school and primary syllabi and offers interactive informal education programmes to engage learners of all ages.

Second level programmes

Our highly qualified teaching staff facilitate students to become more informed of the natural world around them and the role they have to play in conservation issues. Our CSPE module, Zooardship, provides a platform for students to understand the role of zoos in the 21st century and their evolution over the decades. It allows students to explore key concepts such as conservation, sustainability and human development. The groups discuss what we should be doing as stewards of life on Earth and what positive action they can take to help our endangered species.

The ever-popular Ecology sessions for Junior Cycle and Leaving Cert students takes place in beautiful woodland habitats in the Phoenix Park. Students are guided through using the various tools of any ecologist to identify flora and fauna in their environment and complete a specially designed ecology workbook that is tailored carefully to the biology curriculum. Following their morning session outdoors, the zoos various habitats and geographical regions are there to be explored. These sessions are in demand and early booking is a must.

In nature, we know that only the animals with the best adaptations survive. In the Animal Adaptations module students look at a variety of animal adaptations and learn how it meets their needs in the wild. This module offers hands on action with skulls, furs and live organisms (subject to availability) used to enforce the concepts of survival in the wild.

Our Biodiversity Module explores the animals in terms of their position on the IUCN 'Red List' of threatened species. This hands-on class utilises biofacts and provides an introduction to the Zoo's involvement in conservation and breeding programs. Students are also introduced to actions that they can carry out to help with protecting biodiversity locally and globally. This programme can be tailored to suit schools applying for the Green Schools Biodiversity Flag. For more in-depth analysis of conservation issues, why not come along for our Conservation class. Conservation is a big job for Dublin Zoo and zoos globally and this class invites the learner to explore all that we do on a global level to help endangered species.

The Discovery and Learning Department is thrilled to have guest educator and environmental expert, Eanna Ní Lamhna delivering the Genetics module in Dublin Zoo. This highly engaging session brings genetics beyond the textbook and gives examples of genetic variation, mutations and crosses from our animal collections in the zoo. No better location to put the topic into a real life context. This class is suited to transition year groups and students studying leaving certificate biology.

Specialist STEM Events

A big highlight of the programme calendar is Science Week and Engineers Week. This year secondary school students were provided with an opportunity to become habitat designers for our Orangutans. Participants play out the role of one of the key figures in the habitat design process in Dublin Zoo. Students are grouped into teams to take on the responsibilities of our director, Leo Oosterweghel; our Head of Horticulture, Stephen Butler; Grounds Operation Manager, Gerry Creighton to name a few. This collaborative workshop gives students the insight into good zoo design and how zoos ensure the animal care is of the highest standard.

Workshops wrap up with a final habitat design from each group and a presentation from each group which is reviewed by their peers. Prizes go to the best planned and creative designs.

Primary Schools

Dublin Zoo is an accredited Discover Primary Science and Maths centre which bustles with activity throughout the school year. Our programmes are designed to give students from junior infants to 6th class a greater appreciation of wildlife. Schools can choose to go on safari in our African Savanna with our Explore Africa programme or delve into life in the rainforest in our Rainforest Discovery session. Emphasis is on conservation and awareness of endangered species.

Family Farm, the farm in the heart of the city, and the state of the art classroom in The Farmhouse host two highly interactive workshops, Living Earth and Back to Basics with Butter Churning. The garden allows

students to get their hands dirty and learn about native species, while the pond dipping exercise allows students to learn about aquatic wildlife. A wonderful environmental education experience for young learners.

All of the programmes and workshops offered embrace the objectives outlined by the Social, Environmental and Scientific Education (SESE) curriculum and encourage the learn-by-discovery approach.

Primary Teacher Training

Dublin Zoo offers a weeklong summer course in teaching the primary SESE curriculum from Dublin Zoo. This course is run in conjunction with Drumcondra Education Centre and is a hot ticket with places booking out in under a minute. Primary school teachers explore the many opportunities that exist to teach the Science, History and Geography curricula here at Dublin Zoo and gain valuable skills and knowledge to deliver inspiring lessons with their students in their own schools

Aileen Tennant,
Discovery and Learning Manager at Dublin Zoo

For further information on the classes that we offer or to enquire about tailor made programmes please contact ***education@dublinzoo.ie*** *or phone* ***01 474 8932***

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LearnChemistry

Enhancing learning and teaching

Science Educator of the Year 2016

Noel Cunningham interviewed by Mary Mullaghy

This year's **BioPharmaChem Ireland Science Educator of the Year Award** went to the very deserving **Noel Cunningham**. Originally from Limerick, Noel now lives in Kildare and works in Dublin. He is already a recipient of the Institute of Physics Teacher's Award, which he received in 2010. Many of you will know of and use Noel's work, which is listed below but very few people know the man behind the work.

So in a very honest and open interview Noel told me about himself and his route into teaching and how he has become a pioneering science educator in Ireland today.

Can you tell us a little about yourself?

Athea – a small village in West Limerick. I went to National school in Athea and my secondary school was Tarbert Comprehensive in Kerry (Mom is from Athea, Dad is from Moyvane in Kerry so naturally I support Kerry in football). I am married; my wife's name is Lisa and we are incredibly fortunate to have three beautiful girls: Eve (6), Lucy (4 – but she's almost 5!) and Sophie (2). Lisa is a flautist and is a music teacher in the same school as myself. And just to muddy the water further, her maiden name is also Cunningham.

Were you always interested in Science?

I was not a particularly good student. I was naturally curious about how things worked but like most people then the closest we came to Science in National school was a nature table in Spring. I can remember asking my teacher in second class how people in Australia could drink tea if they were upside down; I was trying to be funny but I was told not to ask stupid questions.

Why did you decide to study Physics in College?

There were certainly no physics or science programs on television apart from those about the natural world such as '***Amuigh faoin Spéir***' by the late **Éamon de Buitéar**, and while those who were lucky to get BBC had the opportunity to see and hear the dulcet tones of the wonderful **David Attenborough**, I think the closest we came to watching science was '***Ripley's Believe it or Not***', which I used to love watching. I had a teacher for the 'Inter. Cert' who refused to do any practical work and in Leaving Cert. physics our class was a little difficult to manage, so all experiments consisted of demonstrations. So for me science was a subject we did in school, and I absolutely hated it for the first three years and had no more than a mild interest in it at senior cycle. It turned out that Physics was my best subject so with no idea what I wanted to do in college this seemed like a reasonable fall-back option.

Noel was presented with the Science Educator of the Year Award at the ISTA Annual Conference by Siobhán Murphy, who represented the BioPharmaChem Ireland who have sponsored the award for many years. Also in the photo is Dr Oliver Ryan, founder of the awards.

So things improved in college?

Not exactly. I studied Applied Physics in DCU. For years afterwards I thought I was the 'worst' student in my year because I came out with just a bare pass after four years of study (I would like to take this opportunity to publicly express my gratitude to whoever came up with the concept of 'pass by compensation'). Then somebody pointed out that only about half of the people who started with me in First Year actually made it through in four years. So that makes me just about average. I felt much better after hearing that, and was never so happy to be 'average' in my life.

I'm pretty sure I suffer from some form of ADHD; my attention span has always been abysmal. But this wasn't a condition that existed back 'in my day' so I just had to struggle through. I was not made for sitting in hour-long lectures in maths where all material had to be frantically copied down while also trying (and failing) to pay attention to the lecturer.

It didn't help that I was a slow writer and that my writing was (and still is) almost illegible. Finally, I knew nothing about what constituted effective study techniques. I was the guy who thought that reading over material (often,photocopies of other peoples' notes so that I could read them) or writing it out again was sufficient to learn it. I can't be sure but I think I failed more exams than I passed in that four-year period.

How was your college experience?

I didn't enjoy the lectures. But then I discovered the library and in particular I discovered a genre of literature called '**Popular Science**'. And that's where I spend my four years. Just about every chance I could that's where I would go. It was like my very own Aladdin's Cave. Class colleagues would see me up there and assume I was studying (which would explain why they seemed so puzzled when my results came out). My hero was the American palaeontologist Stephen Jay Gould. I think I probably read just about every one of his books (although I since donated them to the school library in the hope that they might bring somebody else as much pleasure as they brought to me). I think we can divide fans of science into two camps; those who like 'doing' science and those who like learning about it. I am firmly in the latter camp. I would have made a very poor scientist but when it comes to finding out how the world works, I simply can't get enough. I just wish I could remember more of what I read!

When and why did you decide you wanted to be a teacher?

Half my family are teachers (primary and secondary) so that

Pictured with Mary Mullaghy (former ISTA Chair and PCI award recipient) and Seán Finn (UCC physicist and co-author of Essential Science, Folens new science textbook.

was enough to put me off it for years; naturally I didn't want to be anything like them! But shortly after I finished my degree I was offered a part-time job teaching physics, chemistry and science in Cork city. I quickly realised that not only did I get to talk about science all day, I also had a captive audience; they couldn't leave even if they wanted to! AND I got paid to do it. What was there not to like? So I applied to do the 'H.Dip', but because I only got a pass (by compensation) in my primary degree, most of the universities wouldn't even look at me. The only college which would was Trinity, so that's where I went. I did my teaching practice in Maryfield College in Drumcondra and absolutely loved it. But there was one small problem. I was a terrible teacher. I had money for the first time in my life and all my free time was spent playing Gaelic Football and socialising with the local team (come on Rosmini Gaels!). The thought of actually preparing a class was laughable – sure couldn't I just 'wing it' like all my other classes? And I had no experience whatsoever of doing a school experiment or demonstration, never mind learning how to teach it. So mostly we just skipped those parts (we tend to teach as we were taught). I also taught Leaving Cert. Maths but here my exuberance couldn't hide my lack of preparation and there were regular complaints from parents to the Principal about my teaching along with a queue of students who wanted to switch teachers (a few lucky ones managed to do just that). I still feel guilty about the embarrassment I caused both to colleagues and to school management who put their faith in me, not to mention the students themselves whose college options may well have been in my hands. Shortly before I left I did something which I still think took some courage; **I asked the students to write down what they thought of me as a teacher.** Not surprisingly it didn't make for comfortable reading. Apparently I wasn't as funny as I thought I was, and what I considered to be gentle banter was often seen as personally offensive. And that's before they commented on the quality of my teaching. But I needed to hear it – and twenty years later **I still consider it the most important feedback I have ever received on my teaching**.

My natural enthusiasm (I succeeded in installing two computer rooms where previously there were typewriters) ensured that I lasted two further years there after doing the 'Dip' but it was only a matter of time before my credit ran out. Even then I understood that the blame was completely mine, but it didn't help that the science syllabus we were teaching was appalling. I was actually browned off with the whole thing and when I was finally informed that I was surplus to requirements I figured a career change was in order. I was fortunate in Maryfield to have my own personal guardian angel. Máiréad McNamara was the resident chemistry teacher and I think she saw a potential there that I didn't. Máiréad suggested that I should consider the new MSc course in Science Communications that was run jointly by DCU and Queens University. I was inspired by two people in particular there; one was Helena Sheehan who demonstrated that passion wasn't something to hide but rather is a wonderful asset, no matter what you're teaching. The other was the course organiser Kirk Juncker. I used to meet Kirk about 11:30 at night. I'd be coming out of the library (they had new books in since I was there last) and he would be coming out of his office. I asked him once why he always worked so late. He looked at me as though it was the strangest question he'd ever been asked. "Because I needed to prepare for tomorrow's classes". I was dumbfounded. I can distinctly remember sitting in another class – this time given by Mike Bailey in Queens – on how he used the science of dendrochronology to connect meteor strikes to major events in world history and thinking that maybe I could give this teaching lark another go, but this time do it on my terms. What's the worst that could happen?

Two years later I was back in the classroom again and I've always been grateful for that second chance.

Your website has proved very popular with both students and teachers throughout the country. How did it come about?

I was offered a position in King's Hospital. It was a very strange, almost surreal environment. Walking in for my interview and seeing students in their spotless whites playing hockey, tennis and cricket (cricket!); I had no idea we even had schools like that in Ireland. But there was obviously a shortage of physics teachers back then also as I was offered the position almost before I left the interview.

But as a physics teacher I was very much on my own. And as I started putting together resources for my own students I realised how much I would have appreciated a guiding hand along the way, not to mention somebody who could explain to me what half the equipment in the laboratory was for, never mind how to use it. So as I made my mistakes I endeavoured to keep a record of them for my own sake and when I found out that one of my students was setting up his own web-hosting company (hostireland.com) I got him to show me the basics of setting up a website. I was also fortunate in that I knew **Ciarán O'Sullivan** who used to teach Applied Maths in Portmarnock. He simply gave me four large boxes containing every resource he had on every single topic on that subject. Notes, past papers, and most importantly of all – worked solutions. So much of what I have got the credit for in the last 15 years has come about from simply following his example.

A few years later John Hegarty set up a discussion forum for CESI using the googlegroups platform and I immediately saw the potential in doing the same for science teachers.

The YouTube videos came about as a result of frustration

which I felt every time I tried to follow a set of written instructions to get an experiment to work only to realise that I was leaving out some subtle but necessary step along the way. I couldn't understand why there weren't instructional videos like you could get with cooking programs. So, like the little red hen, I figured I might as well do it myself. The experts could criticise some of my errors along the way if they wished, but if there was a chance that they were likely to prove useful to some then that was good enough for me.

The funny thing is, while I get emails from students and teachers all over the country voicing their appreciation for the website I often have to show my own students how to access it because many of them don't even know it exists.

Noel with Siobhan Dean of IBEC, following the announcement of the award.

So what now?

You would think with all this that I would have this teaching lark sewn up. But as time went on I came to realise that, while I was enjoying my teaching, and students seemed to be enjoying my classes, in many ways things hadn't changed that much from my initial years teaching in Maryfield. I still couldn't really see the point of what I was doing. All the material I was supposed to be teaching was the boring stuff.

It is as though we educators take this incredibly exotic jungle of knowledge called SCIENCE and distil it again and again until all the wonder has been removed. We are left with nothing but a heap of dry shavings. We then pour this drivel into our syllabus and textbooks and make our students learn it off by heart so that it can be regurgitated in examinations. And then we wonder why so many young people don't like science. So I put together my own syllabus. And I built another website around it. This one is called **greatideas.ie** and it is what we study in Transition Year.

> "*The more clearly we can focus our attention on the wonders and realities of the universe, the less taste we shall have for destruction.*" (Rachel Carson)

And I love it to bits.

Then there was the issue of the ineffectiveness of my teaching. I could teach a student for three years in Junior Cert and by the time they came back to me in Fifth Year they had forgotten just about everything they had learned in those first three years. I still think a student could come into Physics in Fifth Year having never studied any science before and not be at a disadvantage. That's what makes Applied Maths such a special subject for me. It's not just about getting students to learn off page after page of trivia. It's about teaching them a set of skills which they then apply to solving problems. And yes of course it has its limitations. If all the problems on the exam paper were completely out of left field then there wouldn't be enough students taking the subject to justify its existence. But at least it goes somewhat down that road. Which is why it is so frustrating that of all the subjects the NCCA is trying to do away with, they choose this one on the basis that the exam questions are so similar year after year that there is no valuable learning taking place. It really is like a blow to the gut to read that somebody in that organisation could think this.

So in recent years I am trying to engage with educational research into **what constitutes effective teaching**. Not surprisingly I find that I tick almost none of the boxes, despite what others may think. Like many teachers I am my own worst critic. Many of the concepts which I should be familiar with I had never encountered before in my life. As one critic wrote; "*It is entirely possible for someone to qualify as a teacher and have no knowledge about recent, and even not so recent, advances in cognitive psychology.*"

And so, on the off chance that others may be in a similar situation, I decided to put together a website which would contain all the ideas that I think a practising teacher should be familiar with. It's called **betterteaching.ie**

Along the way I made a fascinating discovery. Remember at the beginning I said that I was a poor student? Turns out that I'm typical of many students today in that I had no idea of what constitutes effective study. It's only now that I think about it that I realise how ridiculous this is. We spend twenty years in a learning environment and at no stage in that process do we take a class on how to learn. Nowadays most secondary schools pay an outside company to come in and give a crash course to Third Year and Sixth Year students, and that's it. Shouldn't the onus be on us as professionals to be embedding those ideas into our everyday teaching rather than expecting somebody else to sprinkle pixie dust on our students in the hope that they will perform miracles? Because it turns out that it's not just the students who don't know what constitutes effective study techniques; many of us adults don't know either. "*Most of our instincts about learning are misplaced, incomplete, or plain wrong and rooted more in superstition than in science.*" (Benedict Carey)

So guess what? I created another website: learningishard.ie

All of this merely serves to mask (quite successfully I suspect) the fact that I still feel like a fraud. Just about all of my teaching is superficial. So now as I enter the second half of my teaching career (when you get paid to do what you love, it's hard to see yourself doing anything else) I'm determined to try and get it right this time around! I can't wait.

Websites:

Online Discussion Forums for teachers of Science (Junior and Senior cycle) and Applied Maths to share ideas and resources.

The Physics Teacher	thephysicsteacher.ie
Better Teaching	www.betterteaching.ie
Learning is hard	www.learningishard.ie
Great Ideas	www.greatideas.ie
Think for Yourself blog	thinkforyourself.ie
YouTube videos	http://bit.ly/1SJ4gSx (1300 subscribers, 1.3 million views)
Twitter:	@physicsteacher

Mary Mullaghy

BTYSTE participation by county

Rory Geoghegan

Using data from the BTYSTE website (http://btyoungscientist.com/qualified-projects-2016/) and the 2012 census (https://en.wikipedia.org/wiki/List_of_Irish_counties_by_population) it is easy to find the number of projects in proportion to the population of each county.

Obviously Limerick has further reason to be proud! Students benefit in many ways from participation in science fairs and other competitions that promote investigative science.

Many students who do not qualify on their first attempt succeed the following year having developed their project and brought it to a higher level.

County	Projects	Population	Number of projects per 100,000
Limerick	59	191,809	30.8
Cork	118	519,032	22.7
Westmeath	18	86,164	20.9
Roscommon	13	64,065	20.3
Kilkenny	19	95,419	19.9
Offaly	13	76,687	17.0
Wicklow	23	136,640	16.8
Leitrim	5	31,796	15.7
Clare	17	117,196	14.5
Longford	5	39,000	12.8
Tipperary	20	158,754	12.6
Sligo	8	65,393	12.2
Waterford	11	113,795	9.7
Donegal	15	161,137	9.3
Carlow	5	54,612	9.2
Louth	11	122,897	9.0
Galway	21	250,541	8.4
Monaghan	5	60,483	8.3
Dublin	98	1,273,069	7.7
Kerry	11	145,502	7.6
Kildare	11	210,312	5.2
Londonderry	12	247,132	4.9
Meath	8	184,135	4.3
Mayo	5	130,638	3.8
Laois	2	80,559	2.5
Armagh	4	174,792	2.3
Wexford	3	145,320	2.1
Antrim	6	618,108	1.0
Down	4	531,665	0.8
Cavan	0	73,183	0.0
Fermanagh	0	61,170	0.0
Tyrone	0	179,000	0.0

(Note that the 'number of projects' refers only to the number of projects that qualified.)

BTYSTE

Preparing for the BT Young Scientist and Technology Exhibition

BT YOUNG SCIENTIST & TECHNOLOGY Exhibition

Driven by innovation, delivered by BT

The BT Young Scientist and Technology Exhibition 2017 will officially open up for entries after the summer holidays in September 2016. Why not encourage your students to start thinking about and working on their project idea or in fact their project during the summer holidays. BTYSTE will be adding more information and videos throughout the next few months to help students to check out **www.btyoungscinentist.com** for updates and lots more information about the BTYSTE.

Also check out facebook/BTYSTE and Twitter #BTYSTE for lots more information. The closing date for entries is 28th of September!

The BT Young Scientist and Technology Exhibition is 53 years young this year, it's the longest running science fair in Europe and one of the longest running worldwide.

ISTA meeting with BTYSTE

On 10th May three representatives of ISTA (Dr Brian Smyth, John Daly and Rory Geoghegan) met with Mari Cahalane (Head of BT Young Scientist & Technology Exhibition), Dr Tony Scott (co-founder of the Young Scientist Competition) and Dr Padraig Dunne (Head of Physics in UCD and a judge at BTYSTE). The meeting, which was held in UCD, was cordial and beneficial. The following clarifications emerged:

- BTYSTE is a **non-profit** ogranisation. Its Board of Directors is independent of BT.
- The **proportion** of entries that qualify is the same in each of the four categories (Biological and Ecological Sciences; Chemical, Physical and Mathematical Sciences; Social and Behavioural Sciences; Technology). Each category has its own team of selectors.
  (Although the chance of selection is the same in each category, the chance of winning a prize is obviously higher in the smaller categories.)
- Selection is based solely on the written application, especially the '**one page proposal**'. Evidence of work over an extended period, or of participation in **SciFest** or other competitions, is very helpful.
- **Sample proposals** (and many other documents) are available on: http://btyoungscientist.com/downloads-2/

Some tips for students

1. Choose a **topic** that will interest and challenge you. It should be something that you are **passionate** about.
2. Find out as much as you can about **what has been done before** by other investigators. Pay special attention to the basic science, especially any relevant equations.
3. Keep an up-to-date **record** of your work and results. Judges like to see evidence of long term investigation.
4. Don't stop if your experiments do not turn out as you expect. **Persistence** is important and it's okay if your hypothesis is proved incorrect.
5. **Use your head**. Try to explain the results of you investigations, in mathematical terms if possible.

START NOW

Don't wait until the Autumn. Now is the time for students to start work on their projects for the BT Young Scientist and Technology Exhibition 2017. That way they will have more time for background reading and for initial testing of their hypothesis.

Eric Mazur — Peer Instruction & the Flipped Classroom

*We were privileged to have **Prof Eric Mazur** from Harvard attend our national conference in Limerick this year. This was made possible thanks to sponsorship from DELL in Limerick. While in Ireland Prof Mazur gave presentations in Trinity College and DELL in Limerick. He also delivered two presentations at the ISTA annual conference. The first was entitled: Educating the innovators of the 21st century and the second was entitled: Wrapping light around a hair.*

Our newest science educator of the year Noel Cunningham posted the following on his Think For Yourself blog. www. ***thinkforyourself.ie***

Eric Mazur is the Balkanski Professor of Physics and Applied Physics at Harvard University and Area Dean of Applied Physics. An internationally recognised scientist and researcher, he leads a vigorous research program in optical physics and supervises one of the largest research groups in the Physics Department at Harvard University. Mazur founded several companies and plays an active role in industry. He is the Vice President of the Optical Society.

Professor Mazur is also a very successful university lecturer and takes his responsibilities in this realm very seriously indeed. He is highly respected by students and peers alike for the quality of his lectures. Over the years his students' results remained impressive and all was rosy in the garden.

Then Mazur decided to perform a little experiment. He knew his students were doing well – he wanted to see how well. He had just read a paper which claimed that many students who do well in physics tests which were of the 'plug and chug' variety struggled when there was any higher order thinking involved ('plug and chug' refers to the process whereby a student just needs to identify the formula which links the variables, plug the numbers into the formula and chug away on the calculator). So he started throwing in test questions that were a little off the beaten track. This was Harvard University after all; students should be well able to apply their knowledge and to solve problems that were just a little different – right? Wrong. It turned out that the students were terrible at answering these questions. Mazur was flabbergasted. He understood fully the implication of his findings; his success as a lecturer "was a complete illusion, a house of cards."

Mazur had just discovered what every physics teacher learns at some stage in their career (but which of us choose to ignore):

> *"The students did well on textbook-style problems. They had a bag of tricks, formulas to apply. But that was solving problems by rote. They floundered on the simple word problems, which demanded a real understanding of the concepts behind the formulas."*

But here's where Mazur differs from the rest of us, although according to him this happened almost by accident. After posing a problem to his students he then asked them to discuss the question with each other.

"It was complete chaos," says Mazur. "But within three minutes, they had figured it out. That was very surprising to me—I had just spent 10 minutes trying to explain this. But the class said, 'OK, We've got it, let's move on.'

Mazur decided to tackle the issue as though it were a science investigation and this in turn led him to develop a method of teaching which he called **Peer Instruction** (coupled with **Flipped Learning**).

The following is a typical scenario where Peer Instruction works well:

Pose a tricky question to the class. Put four possible answers up on the screen. Allow students sufficient time to think about it (by themselves) and get them to vote using their phones. Each student now has to find somebody who chose a different answer and persuade him or her why one particular answer is right and the other is wrong. Students now vote a second time. Hopefully there will be a much greater percentage of correct answers second time around, but at the very least there should be greater engagement with the teacher in the follow-up teacher lead discussions. It can be as simple as that.

Some points to note about Peer Instruction

- This is a link to a very useful flowchart on how to use Peer Instruction effectively: http://www.cwsei.ubc.ca/Files/ReadySetReact_3fold.pdf
- A slightly more detailed list of the essential features and many advantages of Peer Instruction: http://perusersguide.org/guides/Section.cfm?G=Peer_Instruction&S=Features
- You don't need clickers but you probably need wifi. Every student has a phone and there are numerous online programs out there which can collate the information as it comes in real time (Kahoot, Socrative and Quizlet are some of the most popular).
- Peer Instruction goes hand in hand with another of Mazur's ideas; Flipped Learning, but each can work independently of the other. Most people are probably familiar with Flipped Learning but if you're interested you can read more here. http://betterteaching.ie/flippedclassroom.html
- Don't expect to get it right first (or second time). It's a learning process. We want students to see that making mistakes is an integral part of the learning process. We need to be comfortable adopting the same philosophy ourselves. And let students know this in advance.
- Show some of the videos from this page to the students so they know where you're coming from and why. If you can all buy into this process collectively it's much more likely to catch on: http://betterteaching.ie/ericmazurandpeerinstruction.html

I like this one:

- Peer Instruction may work, but not for the reason we think. In this blogpost the teacher found that very few students changed their minds as a result of the discussion, but they did become much more engaged in the rest of the lesson because they wanted see if their reasoning was correct or not. https://uksportsci.wordpress.com/2013/01/07/get-students-to-teach/

- There is some evidence that it's not the actual Peer Instruction itself that's resulting in better understanding – it could be that Active Learning of any description would have the same effect (link to paper). I don't know the answer, but in one sense it doesn't really matter. What matters is that this method has been shown to work, time and time again. So if you can add it to your armoury then who wouldn't want to know about it?
- I have no doubt that Mazur wasn't the first to use either of these two ideas, but he did formalise the process, investigate it quantitatively and has promoted it worldwide so certainly deserves any plaudits that come his way,
- Neither is Mazur the first teacher who admitted how ineffective his teaching was. American high school physics teacher Frank Nochese coined the term 'pseudoteaching' for much of what we do in our science/physics classroom.
- It's a fascinating subject area in that it brings into question all that we do, but as I mentioned up top it's too tempting to just keep on doing what we're doing and assume that everything's ticketyboo. For more on pseudoteaching see here: http://betterteaching.ie/pseudoteaching.html
- Both Peer Instruction and Flipped Learning can be very powerful tools when addressing misconceptions held by students. This is a major problem in science education (assuming you want students to get more from your teaching than just the ability to pass an exam). The following is a link to many useful resources in this area (note: to deal with misconceptions effectively you must first be aware yourself of the misconceptions which students are likely to hold): http://betterteaching.ie/sciencemisconceptions.html

Editor's note

All the web links above are live on the *Think For Yourself* blog: *www.***thinkforyourself.ie**

Pictures

Far left: *Eric Mazur at Dell in Limerick*

Below left*: Eric Mazur video on Peer Instruction*

Below*: Noel Cunningham with Eric Mazur following the presentation of the BioPharmaChem Science Educator of the Year award.*

The Pfizer Chemistry Quiz

An Industry-Education Initiative

Dr Declan Kennedy

One of the most popular events in the activities of the Cork Branch ISTA is the **Annual Leaving Certificate Chemistry** quiz sponsored by **Pfizer** pharmaceuticals. The quiz takes the format of a traditional table quiz with each team consisting of four students from second-level schools in Cork city and county. The venue can accommodate a maximum of 30 teams. Places are allocated on a first-come-first-served basis and there is always a waiting list for these places. The quiz questions are based on the Leaving Certificate Chemistry syllabus and there is also a "fun" general knowledge round.

The quiz was initiated by Pfizer in 1988 as part of the National Chemistry Week activities organised by the Cork branch of the ISTA. The idea for the quiz came from **Dr Cashel Riordan,** Director of Quality Assurance and Environmental affairs at the Pfizer pharmaceutical plant in Ringaskiddy.

Sadly, Cashel passed away recently and a minutes silence was observed in his honour at the beginning of the quiz. Cashel was well known to many science teachers as he was a **former President of the ISTA**. He approached the Cork branch of the ISTA and offered sponsorship of prizes for the winning teams and a perpetual trophy for the team with the highest score. The perpetual trophy is a magnificent hand-carved model of a molecule of cyclohexane.

In the early years of the quiz, marks were written by hand on a large blackboard but nowadays modern technology utilising electronic spreadsheets and data projectors keep the students and teachers informed of progress in the marks attained. The role of quizmaster is filled by the very popular Dermot Kelly of Pfizer and he is assisted by the super-efficient duo of Regina Cusack and Imelda Kiely who take care of all the score keeping and administrative backup facilities.

One of the main objectives of the quiz is to assist in the **promotion of Chemistry** as a subject for Leaving Certificate and, since it is always held in lat April, the quiz also serves as an aid to students in their revision for the Leaving Certificate Chemistry examination. The quiz gained international recognition when Cashel spoke at the International Conference on Industry-Education initiatives in Chemistry which was held in the University of York UK in 1995.

The quiz is organised each year by a committee made up of representatives of Pfizer and the Cork branch of the ISTA. Members of the Cork branch of ISTA set and mark the questions and also help with the smooth running of the quiz on the night itself.

As well as being of great educational benefit, the event is also a great **social occasion**. It allows Chemistry teachers to meet each other in the relaxed setting of the Pfizer social club and also allows chemistry students the opportunity to socialise with their peers from other schools. In addition to sponsoring the prizes for the winning teams and the perpetual trophy for the top team, Pfizer also sponsor a sumptuous **buffet supper** for the teachers and students. The students really love this buffet and one sees **moles of sausages rolls** and sandwiches and cans of soft drinks disappearing at a very rapid rate!

The CBS Mitchelstown team who won the Annual Pfizer Quiz for Leaving Certificate Chemistry students.

Left to right: Mr Dermot Kelly, Pfizer, Sharon Kelleher (teacher), Fionn O'Leary, Michael Lewis, Cieran O'Doherty, Shane Fox and Dr Declan Kennedy (Chairman Cork Branch ISTA). Photo credit: Robert Bateman

The winner of the 2016 Pfizer Chemistry Quiz was CBS Mitchelstown, in second place was Coláiste Choilm Ballincollig and third place was awarded to Clonakilty Community College. The prize for the highest mark in the Organic Chemistry round was awarded to Mount Mercy College, Cork.

The Pfizer Chemistry Table Quiz is an excellent example of a company establishing **strong industry-education links**. Pfizer was one of the first US pharmaceutical manufacturers to set up in Ringaskiddy in 1969 and since that time has made an outstanding contribution to employment and to science education in the Cork area. Full marks to Pfizer for its continued support of Chemistry in our schools and in particular for their sponsorship of the quiz for the past 29 years. We hope that this support will continue for many years into the future!

Dr Declan Kennedy, Department of Education, UCC

Junior Science Quizzes

Kildare Branch Junior Science Quiz

Over 30 teams took part in the Kildare Branch Junior Science Quiz which was held in Scoil Chonglas, Baltinglass, Co Wicklow on 14th March. The winning team were form Newbridge College.

Questions spanned the whole spectrum of the Junior Science course but also introduced science and technology in society.

Only two points separated the top three teams, with a tie-breaker for second and third places. After two rounds of tie-breakers, the nearest answer was accepted to separate second from third teams (the distance between the earth and the moon).

Dorothy Fox (Chair Kildare Branch) Cormac Stopes, Susanne Treacy and Kate Masterson (Newbridge College team members) Deirdre O'Callaghan (Teacher)

Dublin Branch Junior Science Quiz

The Dublin Branch Junior Science Quiz was held on 20th April in Belvedere College. Twenty eight teams competed and Gonzaga College Team A came out on top with a score to 40. Four other teams were just a single point behind: St. Gerards Bray Team A, Belvedere College Team B, St. Gerards Bray Team B and Mount Anville Team A. Following several tie-breaker rounds St. Gerards Bray and Belvedere College were awarded the prizes for second and third place. A close contest indeed.

Rory Geoghegan (IT); Sarah Gallagher (Teacher); Fiachra O'Farrell, James Corney and Hugh Tyrrell (Gonzaga College Team members); Lynn Catherine Anderson (Chair ISTA Dublin Branch); John Daly (Quizmaster)

Institute of Biology of Ireland Gold Medal Winners 2015

The Institute of Biology of Ireland awarded gold medals to the highest performing students in the Leaving Certificate Biology examinations (2015) at a ceremony held in the National Botanic Gardens Dublin last November.

At this annual event three winners from various parts of the country were presented with medals. In addition, each was granted student membership of the Institute of Biology. In his introduction to the awards, **Dr. David O'Connor, Chairman, Institute of Biology of Ireland** emphasised the very high achievements of the award winners. The Institute of Biology of Ireland wished to recognize the hard work and commitment shown by these students and, therefore, it was very pleased to award each of them the cherished gold medal for excellence.

Dr. O'Connor, who presented the awards, also paid tribute to each of the schools and the teachers who contributed to the success of these students. He awarded School Commendation Certificates to each School. In addition, he awarded Teaching Commendation Certificates to each teacher.

Anna Walpole

Presentation Convent Secondary School, Kilkenny.

Teacher: Ms. Caitlin Brennan

Anna is currently studying Actuarial and Financial Mathematics at UCD.

Aisling Doran

St. Angela's College, Griffith College Campus, Wellington Rd., Cork.

Teacher: Ms. Ann Barrett

Aisling is currently studying Medicine at UCC.

Conor Bell,

De La Salle Secondary School, Dundalk.

Teacher: Ms. Cara McAdam

Conor is currently studying Veterinary Medicine at UCD.

Throughout the year the Institute of Biology of Ireland offers a range of activities and lectures, full details of which are available on the IOBI website: **www.ibioli.net**.

Institute of Chemistry of Ireland medals 2015

The top Leaving Certificate Chemistry students of 2015 were presented with their medals by **Margaret Franklin, President of the Institute of Chemistry of Ireland**.

Hayley Blair

High School, Rathgar, Dublin 6.

Hayley is currently studying Law & French in TCD.

Eimear Conroy

Loreto Secondary School, Kilkenny. UCD (Science)

Eimear is currently studying Science in UCD.

Seán Kavanagh

Castleknock College, Dublin 15.

Seán is currently studying Nanoscience in TCD

Eleanor Windle

Dominican College, Mucross Park, Donnybrook, Dublin 4.

Institute of Physics in Ireland student awards 2015

IOP | Institute of Physics In Ireland

Dr Peter van der Burgt, co-chair of the Institute of Physics in Ireland, presented silver medals to the top Leaving Certificate Physics students and the **Earnshaw Medal** for the best physics final year undergraduate project in Ireland.

Friends and members of IOP Ireland, together with the students' families and their teachers, attended the event in the RDS on 8th December 2015.

The top Leaving Certificate Physics students were:

Niall O'Donnagáin

St Peter's College, Summerhill, Co. Wexford

Teacher: Mr Sean Rossiter

Niall was also the top student in Applied Mathematics and he is currently studying medicine at Trinity College Dublin

David Glynn

St Gerald's College, Newport Road, Castlebar, Co. Mayo

Teacher: Mr Joe Daly

David is now studying mathematics at Trinity College Dublin

The **Earnshaw Medal** was awarded to

Cleo Harvey

Dublin City University, for her project entitled *Characterisation of Metal Nanoparticles for Surface-Enhanced Raman Spectroscopy*.

Prof. Colette McDonagh supervised Cleo's project in collaboration with Ocean Optics and she is currently continuing her studies at DCU with a PhD in this area.

Dr Sheila Gilheany

European Girls' Mathematical Olympiad

Two Cork students, Ioana Grigoras and Anna Mustata, have brought home an Irish record haul from the fifth European Girls' Mathematical Olympiad (EGMO), held in Busteni, Romania, with both a silver and bronze medal.

Ioana Grigoras (top) and Anna Mustata

They were part of a contingent of four Irish girls at the **EGMO**, where more than 140 students from 39 countries – including eight invited from outside Europe – competed in a variety of different maths challenges.

The four students who flew over to Romania for the competition, which spanned nearly a week from 10th April to 16th April, were: Antonia Huang (15) from Mount Anville Secondary School in Dublin; Anna Mustata (16) from Bishopstown Community School in Cork; Ioana Grigoras (18) from Mount Mercy College, Cork, and Katie O'Connor, (18) from The High School in Dublin.

Prior to their taking part in this year's European competition, they were training hard as part of the Irish International Mathematical Olympiad (IMO) squad.

The training is conducted annually in special camps in Limerick and Cork, as well as remotely in the form of mail-in problems set by mathematicians from throughout Ireland, under the aegis of the Irish Mathematics Trust.

Both Ioana and Anna also represented Ireland at last year's IMO in Chang Mai, Thailand, where Anna earned an honourable mention. She also won a silver medal at last year's EGMO in Minsk, Belarus.

Mary Mullaghy

Sustainable Energy Awards 2016

Students demonstrate that **One Good Idea** can help change our attitudes towards energy and climate change

Emer Barry

The Sustainable Energy Authority of Ireland's (SEAI) One Good Idea 2016 National Final took place on 11th May at the Print Works in Dublin Castle.

The overall winners were St. Mogue's College, Bawnboy, Cavan with their project "Showerlite" which encouraged teenagers to cut their shower times for greater energy efficiency. St. Mogue's College students also picked up the AIB Innovation award for their project. Through their research they found that adults spend on average 5 minutes in the shower while teenagers spend on average 13.5 minutes in the shower. They are working towards developing a showerhead with an LED light that turns red after 5 minutes in the shower.

Now in its eighth year, One Good Idea, sponsored by AIB, attracted entries from over 113 primary and post-primary schools from across the country, showing an increase of 25% in participation levels from 2015. Finalists showcased their energy efficiency themed projects using drama, song, art and electronic apps.

Other category winners included:

- Primary Category Winner – The third class students from Ardfert Central National School in Kerry won for their project, 'Energy Guards' which promoted energy awareness to their peers and school community using a board game, online quiz and a short drama to teach about energy efficiency in a fun way.
- Primary Runner Up - St Patrick's National School, Bruree in Limerick for their 'Superheaters' project which educated the community on heat loss in homes using local press and radio and also developed a puppet show to teach their peers.
- Junior Post Primary Category Winner – Scoil Phobail Sliabh Luachra, Rathmore, Kerry for their project 'Save Energy Now'. Their One Good Idea was to grow their own food at home to reduce their food miles and their carbon impact. They also organised a gardening gig in the school where a celebrity gardener gave a workshop on how to plant seeds.
- Senior Post Primary Category Winner - Athlone Community College, Westmeath, for their project 'For Peats Sake?' Their One Good Idea was to 're-wet' drained and cutaway bogs to help combat climate change and also to ensure rare plant species survive. They informed people of the importance of peatlands and the impact drainage has on the bog land.

Commenting on the success of the competition, William Walsh, Interim CEO of SEAI said:

> *"Too often we can think that issues like climate change are beyond our grasp. However, the One Good Idea competition taps into the endless creativity, imagination and energy of students. Through their inspiring energy awareness campaigns, these students are demonstrating that we all have a role to play in addressing climate change. We can all be more efficient in our energy use and we can collectively play an important part in this environmental priority."*

Ray O Neill, AIB's Head of Sustainable Business commented: "AIB is supporting SEAI to deliver this One Good Idea programme as part of a range of initiatives we are undertaking around the environment, as it has consistently delivered awareness of key issues in schools and in the wider community through the student campaigns. Primary schools are a recent addition to the competition and the students' confidence and energy in presenting their campaigns is inspiring. Their efforts and those of their supportive teachers and parents are to be commended in raising awareness of climate change."

Prizes included a €1,500 cash prize for the overall winning school, tablets for team members and a voucher for their teacher.

More details on the One Good Idea project are available at www.seai.ie/onegoodidea or follow us on Twitter @ SEAI_Schools.

Emer Barry, Education Programme Executive, Sustainable Energy Authority of Ireland

Taking part in the ESA CanSat competition

Mary Selkirk

Congratulations to the physics and engineering students from Confey Community College, Leixlip, Co. Kildare's who **won the Irish final of the European CanSat** Competition held in Birr, Co. Offaly on the 15th April. CanSat is a competition run by the ESA (European Space Agency) in which a team of six students have to design a 'CanSat' a satellite that fits into the dimensions of a standard drinks can.

The 'CanSat' is then launched in a rocket and dropped from a height of approximately 1000 meters. Its primary mission is to record air temperature and pressure as it falls and to send the information wirelessly to a base station on the ground. Included is the design of a parachute to ensure a decent rate that is within allowed limits. Test flights are run using quadcopters. Students must also select and carry out a secondary mission(s) of their own choice (such as to record GPS information, humidity, forces on the can, solar radiation, 2-way communication etc.). On receiving the wireless data, students then have to analyse and present their findings to a panel of judges on the same day as the launch. Winners were selected based on the quality of satellite design, data analysis and presentation and level of outreach into the larger school and the wider community. Confey students and their 'Confey Can' will go on to represent Ireland in the European final in Portugal in June. Further information about the Confey project can be found on the confey college website: **www.confeycollege.org** where you can click a link to the team's website and view an excellent infomercial video that was created by the team.

ESERO (European Space Education Resource Office) Ireland run the Irish leg of the competition. Starter kits including booklet, arduino, sensors and wireless transceivers are available for TY and/or 5th Year groups wishing to take part as well as training sessions and mentoring. Students learn not only how to program, work with electronics, test, calibrate – they also learn very valuable presentation and communication skills, how to work as a team and how to carry a project through from design to creation and onwards to further improved design. If you think you might be interested in getting involved please visit the ESERO website: http://esero.ie/projects/for more information

It is a fantastic opportunity for students to learn more about science and technology and many other skills along the way and I would really like to let other teachers know about it and what is available to them.

Mary Selkirk,
Maths, Physics and Applied Maths teacher in Confey College Leixlip

She and her colleague Mr. Devereux, an Engineering teacher, decided to get involved in the CanSat competition last in Oct./Nov.

ESA CanSat

Stephanie O'Neill

I would like to congratulate **Confey College** on their achievement, but I would also like to acknowledge the hard work and dedication shown by all the other finalists. Each team did a fantastic job and the quality of their work was incredible.

Teams from Dunmore Community School, Galway; Glanmire Community College, Co. Cork; St. Josephs College, Borrisoleigh, Co. Tipperary; Coláiste Chiaráin, Co. Limerick; Confey College, Kildare; Belvedere College, Dublin and Marist College Athlone were all competing for a place at the CanSat European Final which takes place in **Portugal** from the 22 to 26 June 2016.

About CanSat

CanSat is a European Space Agency competition for 2nd level students (transition year and upwards). It is run by ESERO Ireland in association with the CEIA and five Institutes of Technology. The CEIA along with ESERO Ireland oversee the management of the project nationally.

About CEIA

The CEIA represents high tech companies in the Cork region working with the Industrial Development Agency (IDA), Enterprise Ireland, the Cork Education & Training Board, Science Foundation Ireland, the Cork Institute of Technology and University College Cork, to ensure a sophisticated technological infrastructure is in place to enable the industry to grow and prosper.

CEIA conducts numerous programmes to support STEM education. For details see: **http://www.ceia.ie/education-and-schools/**

About ESERO Ireland

European Space Education Resource Office (ESERO) Ireland aims to inspire and engage young people in STEM subjects (science, technology, engineering and mathematics), using space as a theme and making Ireland's space industry more accessible to students and the public. ESERO Ireland is co-funded by the European Space Agency (ESA) and Discover Science & Engineering (DSE). **www.esero.ie**

Stephanie O'Neill, ESERO Ireland Manager, Science Foundation Ireland

Physics Busking

Eilish McLoughlin and Paul Nugent

Physics Busking is a national STEM Education programme, initiated in 2005 and dedicated to increasing STEM public engagement and education through a yearlong calendar of public engagement events and science communication workshops. Working in collaboration with leading national festival and event organisers, the Physics Busking team of researchers, teachers and enthusiasts bring STEM demos and activities to the shopping streets, gardens and fields of Ireland. Our "busking performances" involve interactive experiments and demonstrations selected for maximum engagement, excitement and education. Based on the traditional stall-type mode of busking (street entertainment), our performances can be tailored to suit almost any event.

Upcoming Physics Busking events for 2016 include Bloom in the Phoenix, Park, Festival of Curiosity, Dublin Maker, National Ploughing Championships, Mallow Maths and Science Festival, Galway Science and Technology fair and several events during national Science Week. New members are invited to join our busking team to contribute to these events and to come along to one of our free science communication workshops. In these workshops, you will get a chance to meet some of our experienced buskers and see them in action, as they show you some of their favourite science demonstrations. Then with props and support, you will get the chance to develop your individual style for showing and communicating science. Workshops are advertised during the year. Places are open to science teachers, researchers and other science enthusiasts. Please visit **http://physicsbusking.ie/**, @PhysicsBusking or email physicsbusking@gmail.com for further details.

Physics Busking is an education and public engagement national collaboration led by Eilish McLoughlin at CASTeL at Dublin City University and Paul Nugent Institute of Physics in Ireland. Physics Busking has been supported by the Science Foundation Ireland Discover funding since 2014.

Above: Physics Busking team at last year's Bloom in the Phoenix Park

Left: Physics Busking at SFI Big Day Out at St. Patrick's Festival 2016 in Dublin

Whitening of the Taj Mahal – the 'Jewel of India'

Mary Mullaghy

In 1993 the Taj Mahal was given the status of a UNESCO World Heritage site and it attracts thousands of visitors from across the globe every year. An immense marble mausoleum on the south bank of the Yamuna river in the Indian city of Agra, it was commissioned in 1632 by a Mughal emperor to house the tomb of his favourite wife. Although it is a timeless tribute of his love its ivory-white marble is not timeless and needs a mudpack to remove the yellow pollution stains. A study has shown 55% dust particles, 35% brown carbon and 10% black carbon particles had collected on the marble, giving it a yellowish tinge. Experts blame the high level of pollution from the factories and vehicles of the city for the yellowing of the marble. The nearby cremation ground on the banks of river Yamuna and the Mathura oil refinery may also contribute to the problem.

The cleaning procedure is said to be modelled on a traditional beauty treatment used by Indian women who apply "*Multani mitti*" (Fuller's earth) to their faces to keep their skin glowing. The affected areas of the Taj Mahal are covered in a 2mm thick layer of Fuller's earth, which contains high levels of lime and hydrous aluminium silicates in a clay like material, and covered with plastic sheets. After two or three days when it dries the flakes are removed from the surface with soft nylon brushes and it is washed with distilled water. This process is repeated two to three times until the marble regains its white complexion. This the fourth time in its history that the 17th century monument has been cleaned. The first mud pack treatment took place in 1994: subsequent cleaning procedures were carried out in 2001 and 2008. The therapy takes three years to complete as it has to be done in phases in small areas due to the large number of tourists visiting on a daily basis. Nottingham Professor Martyn Poliakoff, who attended our Annual Conference in Galway in 2014, has a new video on *Whitening the Taj Mahal*. **https://youtu.be/NokislH5Q1M**

Mary Mullaghy

Book review

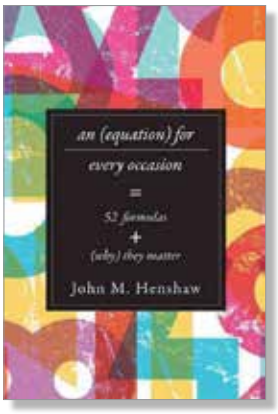
David Keenahan

An Equation for Every Occasion — 52 Formulas and Why They Matter

By John M. Henshaw

Published by John Hopkins University Press, Baltimore, 2014.

ISBN 1-4214-1491-0



This book offers very pleasant reading for those who enjoy Science and Mathematics and the overlap between them. The book has been written for a general audience. It is effectively a book of short stories (52 in total). Each story is approximately a thousand words. Each story begins with a new equation. The terms in the equation are explained and the context in which it has relevance is introduced. Thereafter, each story takes its own course. There is great variety and an abundance of wonderful anecdotes and insights.

The stories may be read in any order, and are so short that one often reads several in quick succession, as each seems to develop ones thirst rather than satisfies it. One often feels tempted to research further, those equations that catch one's imagination.

The formulae that feature, vary from the very simple, like the one for Body Mass Index which is the ratio of mass to height squared to the more subtle and wonderful Euler Identity : $e^{i\pi} + 1 = 0$. There is a refreshing sense of humour in the title of each chapter, such as "Do I Look Fat in These Jeans" and "Because It Was There".

A good bibliography is included so that those who wish to delve deeper into any of the formulae that feature may easily do so.

All in all, this is a really lovely book and I am happy to recommend it.

David Keenahan

Teacher Network Coordinator, Institute of Physics

Newton's Law of Cooling – An Investigation

Richard Fox

I came across an interesting little experiment at the ISTA AGM in Limerick while attending an excellent workshop that was given by Dr. Leah Wallace from the Limerick Institute of Technology. Dr. Wallace had a small rota of experiments for delegates to try in groups of 2 and her focus was investigation and discussion. Students are given a set of apparatus and asked to "Predict" what will happen, "Explore" by trying the investigation, "Explain" what happened and "State" any physical principles that might be relevant or related. One of the experiments was on Boyle's Law and another was relating latent heat to sweating, but the one I hadn't seen done before was on Newton's Law of Cooling.

For the Newton's Law of Cooling we were posed the following problem: "If you have a cup of coffee that is too hot to drink, should you add milk to it immediately, or let it stay black and sit for a while before adding the milk? The objective is to get it cold enough to drink in the shortest time." We were given a kettle, coffee, milk, measuring apparatus and data-logging thermometers to use in our investigation.

On my return to the classroom after the conference, and because we had completed our courses I decided to do the experiment with my second year students as investigative revision this week and see what they would come up with. In the worksheet that I produced for students I included one extra section for student discussion on "Making it a Fair test".

The students came up with some very good ideas I thought, including that Black surfaces are better radiators than lighter coloured ones, so the coffee that was initially black would lose more heat this way for the first few minutes before the milk was added to it than the coffee that was initially white. Other groups were thinking about the black coffee, which was initially hotter losing more steam and hence energy in the first few minutes and were considering the latent heat involved. I had not mentioned Newton's Law of Cooling before in class and only mentioned and discussed it with them after they had actually done their investigation.

Newton's Law of Cooling states that the rate of change of the temperature of an object is proportional to the difference between its own temperature and its surrounding temperature. The results that the students got depended on how long they waited before they added the milk to coffee that remained black for the longest period of time. Most groups found that by waiting between 5 and 10 minutes before adding the milk, they would get colder coffee, in a fair test. However, is it a case that the coffee is too cold at this stage anyway and the wait is too long for an impatient cofaholic? No matter what results the groups got, I found in a great investigation in terms of planning a fair test – equal coffee, milk, starting temperatures, stirring etc. However, accurate temperature recordings are needed to highlight the difference and so the experiment is best done with digital or data-logging equipment, rather than alcohol thermometers.

Richard Fox, Wesley College

Charles-Augustin de Coulomb

Rory Geoghegan

Charles-Augustin de Coulomb (14 June 1736 – 23 August 1806) was a French physicist. He was best known for developing Coulomb's law, the definition of the electrostatic force of attraction and repulsion, but also did important work on friction. The SI unit of electric charge, the coulomb, was named after him.

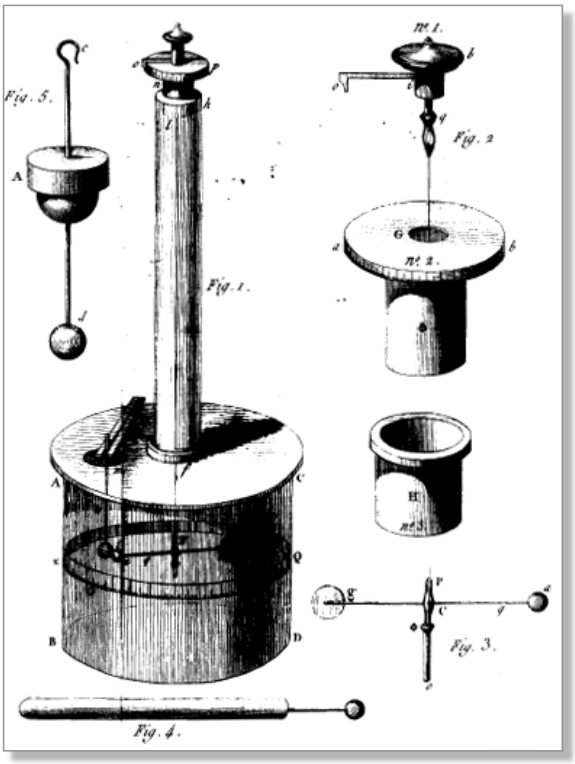
Life

Charles Augustin de Coulomb was born in Angoulême in the mid west of France. He went to school in the Collège Mazarin in Paris where his father lived. His studies included philosophy, language and literature. He also studied mathematics, astronomy, chemistry and botany. He was described by his professor as a smart and active young man.

Coulomb graduated in November 1761 from Mézières Royal School of Engineering. Over the next twenty years he was posted to a variety of locations where he was involved mainly in structural engineering. In 1764 he was sent to Martinique, in the West Indies, where for eight years he was in charge of the construction of Fort Bourbon.

On his return to France in 1772, he was sent to Bouchain. He wrote important works on applied mechanics and he presented his first work to the Académie des Sciences in Paris in 1773. He continued his research while on other postings. He discovered an inverse relationship of the force between electric charges and the square of its distance, later named after him as **Coulomb's law**.

In 1781, he was stationed at Paris. On the outbreak of the Revolution in 1789, he left his job and retired to a small estate which he possessed at Blois. He was recalled to Paris for a time in order to take part in the new determination of weights and measures, which had been decreed by the Revolutionary government. He became one of the first members of the French National Institute and was appointed inspector of public instruction in 1802. His health was already very feeble and four years later he died in Paris.



Research

In 1784, his memoir (*Theoretical research and experimentation on torsion and the elasticity of metal wire*) appeared. This memoir contained the results of Coulomb's experiments on the torsional force for metal wires. His general result is,

> *"... the moment of the torque is, for wires of the same metal, proportional to the torsional angle, the fourth power of the diameter and the inverse of the length of the wire..."*

Coulomb's torsion balance

In 1777 Coulomb invented the torsion balance which he used to measure very small electrostatic forces (above right).

In 1785, Coulomb presented his first three reports on Electricity and Magnetism.

As well as the force law named after him, he also found "that in conducting objects, the fluid, having achieved a state of stability, expands on the surface of the body and does not penetrate into the interior." (The 'fluid' he refers to is the 'electric fluid' or what we now call electric charge.) This effect is sometimes attributed to Michael Faraday who, in 1843, described the effect with his 'ice pail' experiment.

'Mirror galvanometers', which are based on the same principle as the torsion balance, were commonly used in physics laboratories for the most sensitive electrical measurements, until digital meters became affordable.

It is worth noting that most of Coulomb's work was done before the invention of the electric battery by Alessandro Volta in 1800.

Some electrical units

- The unit of electric charge, the **coulomb**, is named in his honour.
- The rate of flow of electric charge is measured in amperes; one **ampere** is **one coulomb per second**.
- Electric potential difference (i.e. voltage) is the energy gained or lost per coulomb as it moves between points at different electric potentials. It is measured in volts; one **volt** is **one joule per coulomb**.

Reference

This account is largely based on a longer Wikipedia entry of the same name.

http://en.wikipedia.org/wiki/Charles-Augustin_de_Coulomb

Rory Geoghegan

Manchester pre-United
— Industrial melanism

Paul Holland

If you've taught Biology, you've probably told the story of the peppered moth. A brightly coloured insect apart from the very odd dark one; it rested on the lichen-covered trees of England during the day. Then came the Industrial Revolution. Smoke and soot turned the trees black with the result that any moth resting on them became very prominent indeed for passing predators. Within a short few years, peppered moths were nearly all black. A relatively uncommon colour trait was better adapted to the new situation. Dark moths blended with the darkened landscape, survived and reproduced – textbook natural selection.

That might be very clear to us but it was not quite so for the scientists of the time. They witnessed the mushrooming of industry in the Manchester area during the 19th century. Trains, iron foundries and 'satanic' cotton mills polluted the air to an unprecedented degree. Idyllic England darkened. We owe a debt of gratitude to the naturalists and collectors of the time who described the colour change in the moths between the 1830s and 1860s. In the 1830s, dark varieties were rare (maybe less than 2%) and prized. Thirty years later, dark moths were plentiful and colourful ones were rare. Stories came through of similar observations in Belgium and Germany.

Lichens had died back in the vicinity of cities and industry. Dark moths flourished. Clearly moth colours and pollution were linked – but how?

With air pollution levels that we can scarcely imagine, sunshine became scarcer. At least one scientist, Lord Walsingham, speculated that dark moths were better adapted to absorbing heat from the intermittent sunlight during the short summers – they could develop and reproduce more efficiently. He did an experiment, placing differently coloured moths on snow exposed to sunlight. The snow melted faster under the dark moths which sank faster to the bottom of the snow. At least the result didn't demolish his theory.

On a trip to Congo in 2009, I was warned not to buy game meat such as chimpanzee in the markets. People in poverty often don't have the choice I had.

There was also a suggestion that bright moth larvae ingested smoke and soot, turning black as a result. A question not asked – but maybe could have been – would have queried whether dark moths were not just different in colour but more resistant to pollution in general. The advantage of colour for concealment was recognised as a potential explanation but not a favoured one. In fairness, dark moths were recorded in non-industrialised areas such as East Anglia. Their lack of concealment did not seem to be a problem and this fact clouded thinking further.

Experiments were performed in breeding the moths and Mendelian ratios of coloured and dark offspring were recorded. However, acceptance of Mendelian theory did not come until the 20th century. Serious research into industrial melanism was planned by the Royal Society about 1910 but the work was either not done or unreported. Only in the 1950s was proper theory fully elucidated and teachers had an exciting new topic to teach. And there's a lesson for us – how many good theories are swirling around us now – unproven, misunderstood, disbelieved, feared – that I, for one, will not have the privilege of teaching? The sorrow of Science lies in what future generations will know that we cannot even guess at.

Paul Holland, formerly Presentation College, Galway

Reference

Biologist, February 1981

Images:
https://en.wikipedia.org/wiki/Peppered_moth_evolution

St. Fin Barre, Science and Symbolism

John Murphy

" – marriage, and birth
And death, and thoughts of these — for which was built
This special shell ? For though I've no idea
What this accoutred barn is worth,
It pleases me to stand in silence here."
("Church Going" by Philip Larkin)

The English poet, Philip Larkin, turned ordinary life into elegant poetry. The English architect, William Burges, and sculptors like Thomas Nicholls, transformed geological materials like sand and stone into a work of art in the form of **St. Fin Barre's Cathedral in Cork**. This "special shell", like the shells of so many sea creatures, is composed primarily of **calcite**. This mineral is largely composed of calcium carbonate ($CaCO_3$).

Calcium carbonate is found naturally in the form of one the following "trimorphs": aragonite, calcite and vaterite (μ-$CaCO_3$).

Limestone can be formed directly when calcium carbonate is forced out of solution in tropical waters, or indirectly from the shells of sea creatures. Creatures such as crinoids take refuge and strength from the fruits of their work on $CaCO_3$ to form beautiful structures of various designs. So too do we, and not only in the form of buildings like St. Fin Barre's Cathedral.

Is it ironic or symbolic that the Cathedral and the creatures associated with it (ourselves included) are so closely linked with the number three? Calcium carbonate is a trimorph; the carbonate ion itself consists of one carbon atom surrounded by three identical oxygen atoms in a trigonal planar arrangement; and the "holy trinity" is an integral part of Christian belief.

Limestone from the nearby quarry at Beaumount in Ballintemple was used in the construction of St. Fin Barre's Cathedral. This limestone belongs to the Little Island Formation (W.E Neville, 1994). It was deposited during the Carboniferous Period (around 300 Ma). This formation, from which much of St. Fin Barre's is constructed, is formed mainly of mudbank limestone of Chaldian to Asbian age (Sleeman, 1991).

The nave columns are of Bath Stone. This is an **oolitic** limestone. It was formed during the Jurassic Period (145- 195 Ma). At that time the region around Bath in England was under a shallow sea. Here the sea floor consisted of sand-sized grains of calcium carbonate. Where these grains grew by the precipitation of the mineral calcite around smaller particles, they are called ooliths.

Certain varieties of coloured stones and even limestones which can be polished are commonly referred to as "marbles". The walls of the nave are lined with such "marbles":"Cork red marble", from Little Island on one side and from Fermoy on the other. The Cork red marble formation includes red crinoidal breccias, mottled grey calcilutites and pale or pink massive calcilutites (Sleeman, 1991).

Saint Fin Barre's Cathedral is built in the Gothic style. The medieval world saw the cathedral as representing the universe in microcosm, revealing God's divine plan. Everything was connected. Think about this. Now consider the following story. St. Fin Barre's father, Amergin, was said to have come from Connaught, and to have been chief "smith" to Tighernach. Fin Barre himself is thought to have been "baptized" at Achaidh Durbchon, near Gougane Barra, close to the source of the river Lee. We are told that at the age of seven, "three" clerics brought him to Kilkenny to study.

Connemara is located in Connaught. Near the end of the south aisle of the Cathedral there is a font made of Cork red marble which has green Connemara marble as supports while grey Kilkenny marble makes up the walls of the Dean's Chapel.

To the right of the pulpit there is a brass lectern studded with rock crystals. The bells of St. Fin Barre's were cast in 1851 by Abel Rudhall of Gloucester. They are made of bronze which is generally an alloy of copper (78%) and tin (22%). Such metals develop a beautiful verdigris as a protective coating during initial surface corrosion - reminiscent of the way shelled organisms protect themselves. I wonder did Amergin, the king's smith and Fin Barre's father, dip sheet iron, folded over and riveted, into molten bronze when improving the tone of an early Christian bell.

John Murphy
Regina Mundi College

The distinctive blue colour, mottled with white calcite and brassy pyrite of the lapis lazuli near the altar can be seen in this image. In his poem "Lapis Lazuli" Yeats wrote: "All things fall apart and are built again". The beauty of the geological history, associated with the stone from which St. Fin Barre's is built, tells its own story of creation .

CROSSWORD

Randal Henly

Clues Across

4. Deposit a fine powder on a flower to cause fertilisation (9)
9. Mammalian organ (7)
10. Material that provides heat insulation (7)
11. He discovered the principle of the pendulum and invented the telescope (7)
12. Quantities associated with levers in short times (7)
14. Annoy an old or sick horse (3)
15. Loud or unpleasant sound (5)
17. Close relative in hospital (6)
19. Remove the testicles of a male animal (8)
23. Fruit that could be a melon but is not! (5)
25. Star that shows a sudden large increase in brightness; may be super (4)
26. Eat the Greek letter for viscosity (3)
27. Sanitate the halogen (8)
29. Organ or cell that responds to some external stimulus (8)
31. Nocturnal catlike mammals of the civet family (6)
34. This part of a river is under the influenced of the Moon (5)
35. A human sense (5)
36. Fog combined with some atmospheric pollutant (4)

Winners — Mar. 2016

Yet another Galway winner! The first correct entry was emailed by Niall Duddy, Presentation College, Athenry, Co. Galway. The next was emailed by Emma Burke, Leopardstown, Dublin. Congratulations.

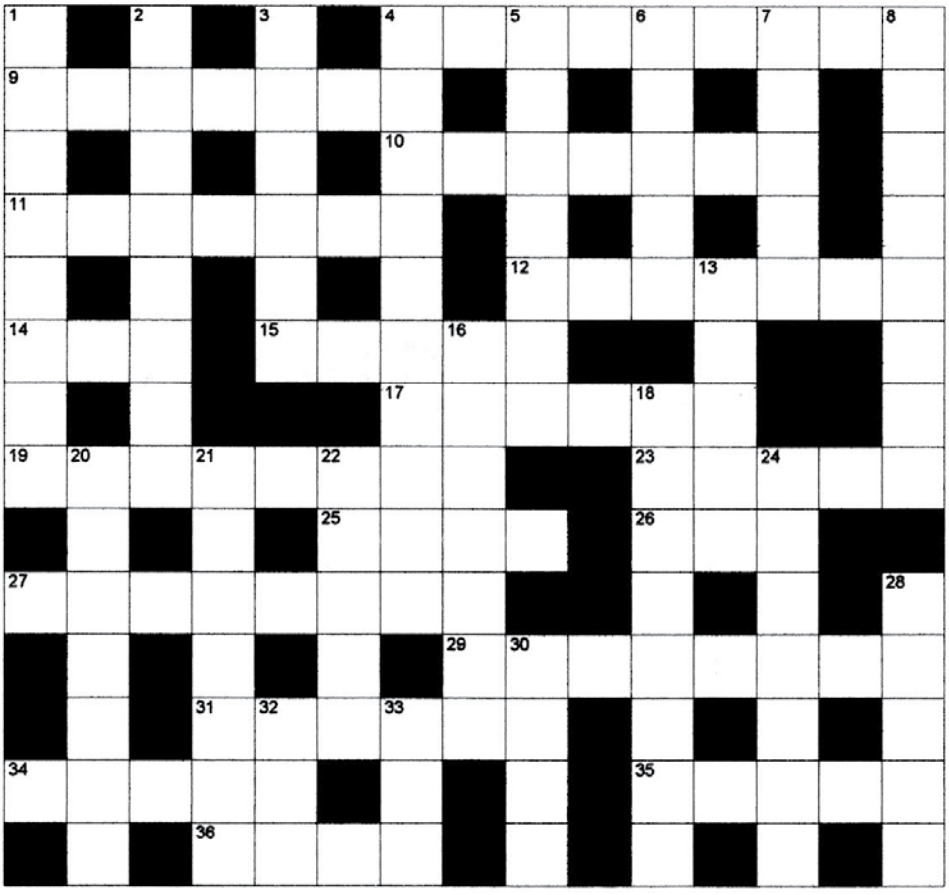
Clues Down

1. Such lines connect terrestrial points that have the same magnetic declination (8)
2. Element of Group 0 (5,3)
3. Unit of volume equal to 4.5 litres (6)
4. Mythical substance supposed by 18th-century chemists to be released from substances during combustion (10)
5. Plants that can combine with and utilise atmospheric nitrogen (7)
6. Large bone forming the upper part of the pelvis (5)
7. Atmospheric gas (5)
8. Fine dispersion of minute droplets of one liquid in another in which it is not soluble (10)
13. White heron (5)
16. SI unit of the biological effect of an ionising radiation (7)
18. Fundamental constituents in electric kettles (7)
20. Poisonous element perhaps associated with Old Lace (7)
21. Lachrymatory agent used as a chemical weapon (4,3)
22. Particle attracted to a cathode during electrolysis (5)
24. Sugar produced by the breakdown of starch by saliva (7)
28. Archimedes' nationality (5)
30. The international trade name of oil giant Exxon Mobil (4)
32. Deciduous tree of the genus Ulmus (3)
33. Ovum (3)

Prize

A prize (any item from the ISTA shop) will be given for the first correct response that is returned to the Editor.

The list of shop items may be viewed on: http://www.ista.ie/publications/index.php



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