SCIENCE

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Eol-Oidí na hÉireann, Volume 51, Number 1, November 2015

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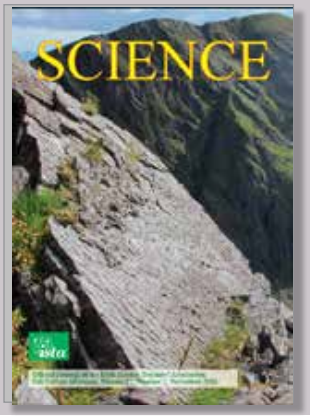
Cover picture: Ancient sand ripples on a mountain top!

On Ireland's highest mountain Carrauntoohil, Co. Kerry, ancient sand ripples can be found. They are, however, not along the usual walkers' route.

Also to be found there are examples of what is known as Lusitanian Flora such as St Patrick's Cabbage and the insect-eating Large-flowered Butterwort.

Thanks to **Michael Maunsell** for the photograph and the accompanying article on page 21.



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Chairperson's Report

Stephanie Leonard

Dear Colleague,

I hope that you had an enjoyable and restful summer and that your return to school has gone well. I would also like to congratulate you and all of your students on their Junior Certificate and Leaving Certificate Results.

ISTA Courses

During the summer, the ISTA contacted the Teaching Council regarding accreditation of ISTA courses. In September, the ISTA participated in a forum with the Teaching Council on this matter. The Teaching Council are now seeking further consultation from teachers on Cosán: The National Framework for Teachers' Learning (CPD). There is an online questionnaire available on the Teaching Council website and there are also workshops being organised in Education Centres around the country. All details of these are available on the Teaching Council website.

Junior Certificate Science

The Junior Science Subject Specification is still not available on the NCCA website. It is currently proposed that it will be introduced for first year students in September 2016. The NCCA have set up a working group of 8-10 teachers who will be working on continuous assessment classroom tasks with students in their schools. The ISTA will keep members informed of any progress in relation to this.

Health and Safety

The ISTA are currently working with the Health and Safety Authority (HSA) on developing Health and Safety resources for Science teachers. We would like to hear from members on what aspects of Health and Safety are the main issues of concern for teachers and I invite members to email any ideas or thoughts on the matter.

Local Branches

Local branches are again very busy organising events for the coming year. Many branches have held reviews of the 2015 marking schemes. All branch events are advertised on the website and I would encourage all members to regularly check the website for updates. I would also like to thank all members of local organising committees for their hard work in organising events.

Science Week

Science week will take place from the 8th – 15th November. There will be many events organised by local branches around the country so we advise you to continuously check the website for details. Details of many events can also be found on **www.science.ie**. The ISTA Senior Science Quiz regional round will take place on the 12th November. This is a hugely popular event and I would like to thank all involved in the organisation of it.

ISTA AGM Limerick

The 2016 AGM will take place in LIT from the 8th – 9th April. We wish the organising committee the very best of luck and offer any support that is needed. There are many notable speakers and workshops on offer and it will surely be a weekend not to be missed. More details will be posted on the website soon.

Website

It is not possible to list all of the items that are on the website at the moment. There are a wide range of competitions including ReelLIFE Science and the Zero Robotics Competition organised by MIT. There is also information on upcoming conferences and CPD opportunities for teachers.

Membership

I urge you to promote membership of the ISTA among your staff. The benefits of joining are immeasurable, particularly for newly qualified teachers. The local branches provide a network for discussion and the CPD opportunities are a great benefit. Many schools are now also allowing attendance at ISTA events for Croke Park hours.

Finally, I would like to wish you and your students well for the coming year. Please ensure to stay in touch with the Association through the website.

Stephanie Leonard,
Chairman ISTA

Stephanie teaches Biology and Chemistry in the Intermediate School, Killorglin

Dates for Diary

City of Physics
Monday 26th October – Thursday 19thNovember
www.cityofphysics.ie

SciFest 2014: National Final. Friday 6th November Marino Conference Centre.
www.scifest.ie

Science Week Ireland:
"Science Week 2.0: Design Your Future"
8th – 15th November
www.science.ie

RSC: Water: A global experiment with hydrogels Tuesday 10th November www.ista.ie

ISTA Annual Senior Science Quiz Thur. 12th Nov. 7.30pm nationwide. **The Final** will be held in TCD on Sat. 21st Nov.
www.ista.ie

RDS STEM Learning
National Conference for Primary School Teachers Sat. 14th Nov. RDS
www.rds.ie/stemlearning

Institute of Biology
FREE talks in the Botanic Gardens
The Value of Pollinators
Friday 13th Nov. 8pm

Canine Genetics Friday 20th November 8pm
www.ibioli.net

I'm a Scientist & I'm an Engineer – get me out of here: 9th – 20th November
http://imascientist.ie and
http://imanengineer.ie

Dublin Web Summit 3rd-5th Nov. (sold out!) RDS
www.websummit.net

Galway Science & Technology Festival
Monday 9th – Sunday 22nd November www.galwayscience.ie

Galileo Teacher Training Programme: astronomy and science workshop in European Space Research & Technology Centre Netherlands 23rd - 27th November

BT Young Scientist & Technology Exhibition
6th – 9th January 2016
RDS
www.btyoungscientist.ie

ASE-UK Annual Conference 6th – 9th January 2016 University of Birmingham. Practical Inspiration Across Science Teaching & Learning

ISTA Annual Conference
April 8th-9th 2016
Limerick Institute of Technology www.ista.ie

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

PDST: Biology, Physics, Chemistry & Ag Science teams are on the road with Resource Workshops in October and November.
www.ista.ie

ISTA Corporate Members

Japanese Knotweed — an unwelcome invasive species

Conor O'Brien

You may not have to go very far in many locations in Ireland to see one of the world's most troublesome invasive plant. Japanese Knotweed (*Fallopia Japonica)* is widely dispersed throughout Ireland and is especially commonly seen in many parts of Cork and Kerry. It is known as an Alien Invasive Species meaning that it is not a native plant and the invasive label means that it grows in an uncontrolled fashion without any native competition. Invasive species have been introduced by human intervention and the unstoppable nature of some invasives means that they can threaten native biodiversity causing a lot of environmental harm by displacing native species.

Japanese Knotweed evolved on the higher slopes of volcanoes in Japan where the harsh conditions forced the plant to develop deep roots and be resistant to adverse conditions to survive and ultimately thrive.

It was brought to Holland as an exotic plant and won a gold medal at Utrecht as the most interesting ornamental plant of the year in 1847. It soon became a much sought after ornamental plant for the unsuspecting Victorian gardens in stately homes throughout Britain and Ireland.

Knotweed has never spread by pollination in Europe - there are no seeds produced to be dispersed by the wind. This is because all plants on these shores are female plants sharing the same DNA as the first plant imported to Holland. It spreads however by vegetative regeneration from small pieces which quickly grow into whole new plants. It has been shown that a snippet of root or rhizome as small as 0.7g or a piece of vegetation as small as 0.1g will produce viable plants. Thus Japanese Knotweed should not be cut as a control measure, in fact colloquially most of the recent spread along roadways is probably due to indiscriminate hedge and road verge cutting and also when earthen banks are constructed at the roadside using soil or spoil infested with the plant. Knotweed is almost impossible to compost and it is reported in the UK that local council composting units have contributed to the spread in Britain.

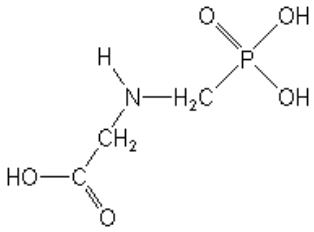
Knotweed is very hard to kill as the roots go 3 metres deep and form a radius of 7 metres around each individual plant. The complex root system is said to have been used by Railway Companies in the UK in the past to stabilise embankments - interestingly large stands of knotweed can be spotted along many stretches of railway throughout Ireland.

In spring knotweed sends dark, reddish-purple coloured shoots which develop into light green stalks. The stalks quickly grow to 2-3 m over the summer months producing delicate white flowers which hang in clusters from the stalks. The dense canopy of shovel shaped leaves prevents sunlight penetrating and totally obliterates the native plants beneath thus reducing biodiversity. By early autumn the leaves disappear leaving bare woody stalks which eventually topple over. New stalks spring up between the dead ones early the following spring.

There are four main methods of control which have been used

1. Bury and cover – *impractical given in place infrastructure and required budget*
2. Foliar Spray – *effective, Glyphosphate (such as Roundup Biactive®) is the preferred systemic herbicide but takes several seasons*
3. Stem Injection – *very effective, requires specialist injector gun, safe but labour intensive*
4. Cut and pour – *very effective, but labour intensive: problem with cut stems disposal*

It is widely accepted that Glyphosphate herbicides are the most effective especially if administered in September/October when the plant is retrenching to the root system with the onset of the first frost.



N-(phosphonomethyl)glycine (Active Ingredient of Roundup)

My interest in knotweed elimination arose from my community involvement as Chairman of Glounthaune Tidy Towns. Glounthaune is a small village 10km to the west of Cork City and has had a long history of active community engagement - it has Community Association with a large Meals on Wheels operation, Glounthaune was a Cork Co. Council nominee in the national Pride of Place 2014 competition, and has an active Tidy Towns committee for many years.

Glounthaune Tidy Towns carried out a detailed survey of Japanese Knotweed in October 2014 covering a distance of 6km along the old N25 route (which also tracks the Cobh-Midleton railway line) and found 76 individual 'stands' of knotweed with an estimated 150,000 individual stems covering almost 1 hectare in total. They also carried out trials using the stem injection technique early in October 2014 (instead of the more usual spraying) on four stands. This involves injecting herbicide into the hollow stem near ground level. This resulted in almost 100% effectiveness when inspected this year.

Support was then sought from Cork Co. Council HQ but they diverted the approach to the Cobh Municipal District, which includes Glounthaune. Financial support in the form of a Community Contract (under an Amenity Grants Scheme) was received in May 2015. Supported by additional local fundraising, Glounthaune Tidy Towns embarked on an eradication programme in July, with an emphasis on stem injecting but using herbicide spraying where conditions prevented stem injection (e.g. accessibility difficulties, plants not developed enough to stem inject).

A number of the Tidy Towns committee attended two Alien Invasive Species seminars/workshops one sponsored by IRD Duhallow, the other by SECAD Midleton (South East Cork Area Development). This enabled three teams of two to be trained locally in the stem injection technique, 4 were local college student volunteers, supplemented by two TUS workers under the auspices of SECAD.

Stem Injection 'Gun"

During the second half of August 2015, the teams have completed 7 days of stem injecting using two different stem injecting proprietary systems. Approximately 20,000 individual plants (stems) have been treated using the Roundup Biactive. Late August/September is the optimal time for stem injecting as the plant retreats into the complex root system for the winter. At this time of the year the plant draws down the last of the nutrients from the leaves for overwintering and this reversion can be used as a vehicle to transport the injected herbicide deep into the root system. The stem injection was supplemented by selectively spraying relatively inaccessible stands especially those adjacent to the railway on steep embankments or in dangerous roadside locations.

By mid September there were encouraging visible signs that the knotweed was retreating - it will take a number of follow up campaigns over the next two years to totally eliminate it.

Conor O'Brien BSc PhD
President ISTA

News & Views

Mary Mullaghy

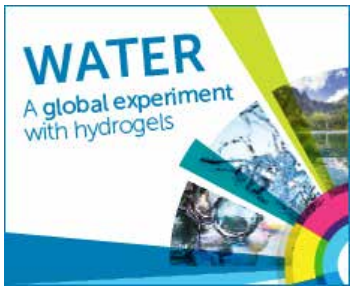
Honorary doctorate for Sr Mercedes Desmond

Congratulations to **Sr Mercedes Desmond**, one of the pioneers of science education in Ireland and a founding member of ISTA, who received an honorary doctorate from **UCC**.

See page

A Global Experiment

Thousands of students all over the world are expected to take part in the **Royal Society of Chemistry (RSC)** 2015 global experiment. This year the theme is **"Water: a global experiment with hydrogels."** Students are invited to explore the effects that hydrogels (a man-made product) have on the water cycle before sharing their results with other classes across the globe. **http://www.waterexplorer.ie/ireland**



STEM Learning Conference

A STEM Learning Conference will take place on Saturday 14th November 9.30am - 3.30 pm in RDS. It will focus on creative approaches to Primary School Science. Participants will explore new ways to bring science and maths into children's everyday lives through a series of hands-on workshops and networking sessions.

The Teaching Council

The Teaching Council have a Draft National Framework for Teacher's Learning called Cosán. As part of the second phase of consultation on the development of a national framework for teachers' learning, they are inviting teachers and all partners in education, to provide feedback on the draft framework. www.teachingcouncil.ie

Institute of Biology of Ireland public lectures

The talks will be held in the Botanic Gardens. For details see www.ibioli.net/events.html or www.ista.ie/news/institute-biology-ireland-2

Frontiers of Physics 2015

The Annual IoP Ireland Conference took place on Saturday 19th September in the School of Physics in NUI Galway. A full day of lectures, demonstrations, and workshops, resources and networking for all teachers of physics including Junior Science Teachers. The keynote presentation will be delivered by the eminent physicist and author Prof. Frank Close OBE, FinstP, Exeter College, University of Oxford. Pictured here with Sheila Gilheany from IoP. **www.iopireland.org**

Féilte

The annual Festival of Education in Learning and Teaching Excellence, is a celebration of innovation in teaching. The theme of this year's event was ***"Sharing Teaching – Connecting Learning"*** and took place on the first Saturday in October.

City of Physics

Everything, from the atomic to the cosmic, is converging in Dublin this November. After the success of DART of Physics last year Dr Shane Bergin TCD and Dr Aoibhinn Ní Shúilleabháin UCD head up a team of enthusiastic physicists to bring the wonder of physics to the public. **www.cityofphysics.com**

Apps4gaps

Apps4Gaps is an all-Ireland competition aimed at encouraging young people to provide concepts and create applications utilising Open Data freely available. The **Alice Perry Medal** will be awarded to the best working app. Prizes for best apps: 1st. **€1500**, 2nd. **€1000** and 3rd. **€500.** See **http://apps4gaps.ie/**

ESA/GTTP Teacher Training Workshop 2015

The sixth ESA/GTTP Teacher Training Workshop will be held at the European Space Research and Technology Centre (ESTEC) in Noordwijk, the Netherlands, 23rd – 27th November 2015.

Smart Futures

Smart Futures, the Government-Industry programme promoting science, technology, engineering and maths (STEM) careers to secondary school students in Ireland has redeveloped its website and launched a brand new online booking system for secondary schools to requests free career talks.
www.smartfutures.ie

Naughton Scholarships

The prestigious Naughton Foundation Scholarships have been announced. From 600 entries 29 students from 24 counties were the lucky recipients. Next year it is hoped that students from all 26 counties will receive the very generous awards to cover the fees for STEM college courses.

SciFest News

Christopher Carragher Scifest 2014 and Simon Bluett SciFest 2012 both overall winners received **Naughton Scholarships**. At International level, Christopher won second place in the Computational Biology and Bioinformatics category at **Intel ISEF 2015** and Ellen Fitzgerald, Aoife Dolan & Niamh Nyhan from Sacred Heart Secondary School, Clonakilty won a first prize and gold medal at **INESPO 2015** in Amsterdam. Also Louis Madden from St Macartan's College, Monaghan has qualified for the regional finals of the Google 2015 science fair.

Global Action Plan's New Initiative - "Water Explorer 2016"

Leading environmentalist Duncan Stewart, Olympic pentathlete, Natalya Coyle, and high performance swimmer Bethany Carson, today launched Global Action Plan's innovative 'Water Explorer 2016' programme in the Dublin's National Aquatic Centre. Schools around the country are being encouraged to sign up to the water conservation programme and help save the equivalent of 500 bath tubs of water in those schools taking part by June 2016.

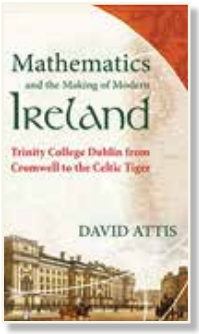
ICI Chemistry Newsletter Competition 2015-16

As part of the celebrations for the International Year of Light the Institute of Chemistry Annual Newsletter Competition theme this year is Photochemistry. Closing date Friday 18th December. This years winners were announced at the ChemEd Conference in UCC.

SSPC National Crystal Growing Competition

Following the success of the 2014 Synthesis and Solid State Pharmaceutical Centre's (SSPC) National Crystal Growing Competition, the SSPC has launched the 2015 national crystal growing competition, in partnership with the **International Union of Crystallography's (IUCr)** global competition.

Mathematics and the Making of Modern Ireland



Dr David Attis launched his new book, Mathematics and the Making of Modern Ireland: Trinity College Dublin from Cromwell to the Celtic Tiger. It is a comprehensive account about Ireland's mathematical achievements and the central role played by Trinity College Dublin in this legacy.

ReelLIFE SCIENCE

ReelLIFE SCIENCE schools video competition is run by NUI Galway. This year Canadian Astronaut, Commander Chris Hadfield, Aoife McLysaght, Professor of Genetics in Trinity College Dublin and the overall winners of the BT Young Scientist & Technology Exhibition 2015 are the judges.
http://reellifescience.com/

Formulae and Tables

Declan Finlayson has produced a A PDF of ***Formulae and Tables*** which is now available on the ISTA website.

ISTA Senior Science Quiz

The Annual ISTA Senior Science Quiz Regional Rounds will take place on Thursday 12th November at 7.30pm in 12 venues nationwide during Science Week. Dr Aoibhinn N*i* Shuilleabh*a*in will act as quizmaster for the Final, sponsored by PharmaChemical Ireland, in Trinitry College on Saturday 21st November.

I'm a Scientist and I'm an Engineer

I'm a Scientist and I'm an Engineer will be running in Ireland this November to blow away the mad scientist stereotype and show students a slice of real science and engineering.
http://www.cityofphysics.com/sun.html

Celebrating George Boole's Bicentenary

In 2015, University College Cork celebrates the bicentenary of George Boole's birth, the first Professor of Mathematics at the college. A mathematical genius who was largely self-taught, his invention of Boolean algebra and symbolic logic pioneered a new mathematics. He is described as the 'father of the information age' and his legacy surrounds us everywhere, in the computers, information storage and retrieval, electronic circuits and controls that support life, learning and communications in the 21st century.
www.georgeboole.com

BOOLEAN LOGIC GAME LAUNCHED BY THE CEIA

To mark the bicentenary of the birth of mathematical genius, George Boole, the **CEIA —** Cork's Technology Network, recently launched an interactive Boolean logic game for students.

Funded by **Science Foundation Ireland (SFI)** and in partnership with the Boole2School programme at UCC, the role-playing card game represents the true and false values of Booleans in every day uses, and is designed to be used by schoolchildren as an engaging and fun way to understand logic.

www.ceia.ie/ceia-boolean-roadshow-bo01ean-logic-game/

Keep up to date

A comprehensive list of all competitions, news and events is available on our website. www.ista.ie

Chemed 2015, UCC

Brilliant Ideas and Great Resources for Teaching Leaving Certificate Chemistry

Declan Kennedy

The 34th Annual ChemEd Conference was held in the Eureka Centre, University College Cork on Saturday 17 October 2015. It proved very popular with teachers and was attended by 160 chemistry teachers from all over Ireland. The conference was officially opened by Professor Paul Ross, Head of College of Science, Engineering and Food Science (SEFS). UCC who gave an overview of the teaching and research being carried out in the college of SEFS.

The opening talk **Teaching Atomic Structure to Leaving Certificate Standard** was given by Dr Fiona Desmond, State Examinations Commission. In this talk Fiona pointed out that the teaching of Section 1 of the Leaving Certificate Chemistry syllabus is of crucial significance to pupil understanding of the fundamental concepts of chemistry and matter. She pointed out that presenting this complex abstract material in a meaningful way is a great challenge for teachers and is worth reviewing regularly. She considered various approaches to teaching this area of the Leaving Certificate Chemistry syllabus and presented a wide variety of demonstration experiments and models to assist teachers in their teaching of this topic.

Dr Fiona Desmond showing the crystals she made to Dr Declan Kennedy at ChemEd

In the second presentation Michael King, Commercial Manager, Phillips66 Ireland brought us on **A tour of Whitegate Oil Refinery**. When I taught in Colaiste Muire Cobh I regularly brought my students to visit Whitegate Oil Refinery which was only a short trip away. In recent years, it has become more difficult for school groups to visit the plant due to stricter Health and Safety regulations. As a secondary school student, Michael King was among my students to visit the oil refinery and he is now the Commercial Manager for Phillips66 Ireland Limited which owns and operates the refinery. In his talk Michael brought us on a tour of Whitegate Oil Refinery by means of a Powerpoint presentation showing the various areas of the refinery that are relevant to the Leaving Certificate Chemistry syllabus and explaining what happens at each stage of the process. A CD containing a copy of the Powerpoint presentation was given to every teacher in the audience at the end of his presentation.

The third presentation entitled **Teaching Instrumentation on the Leaving Certificate Chemistry Syllabus** was given by Dr Mila Pravda, Department of Chemistry, UCC.

In this talk Mila discussed the key principles of Gas Chromatography (GC), High- Performance Liquid Chromatography (HPLC), Infra-Red Spectrometry (IR) and Ultraviolet Spectrometry (UV) as applicable to the Leaving Certificate Chemistry syllabus. He introduced four videos which have recently been specifically produced on the above topics to help teachers of Leaving Certificate chemistry bring these techniques to life in the classroom. The videos were sponsored by Folens who sent a film crew to the Chemistry Department UCC to shoot the various types of instrumentation in operation.

After this talk, Mr Conor Walker, Folens, formally launched the videos and a free DVD containing the four Instrumentation videos as well as other sample videos were distributed by Folens during the lunch break.

Michael King speaking at the ChemEd conference on A tour of Whitegate Oil Refinery.

A long lunch break took place from 12.45 - 2.30 p.m. This allowed teachers time to enjoy a "brown bag" lunch, visit the liquid nitrogen plant in UCC and visit the various workshops. I am very grateful to Dr Donnacha O'Connell, Chemistry Department UCC, who conducted the visits to the liquid nitrogen plant and to the Workshop presenters who set up a wide selection of experiments from the current Leaving Certificate Chemistry syllabus as well as some from the proposed new Leaving Certificate chemistry syllabus.

The experiments and their presenters are summarised in Table 1 (over)

The various experiments set up in the Eureka labs proved very popular as it gave teachers the opportunity to pick up hints and tips about the experiments and to discuss these experiments with experienced teachers.

In the **Spectroscopy in a Suitcase** workshop, Dr Trevor Carey, Department of Chemistry, UCC, and Dr John O'Donoghue RSC outlined the free resource available from the Royal Society of Chemistry and showed the Spectroscopy in a Suitcase package in operation. Teachers were also informed how to organise a visit to their Leaving Cert Chemistry students by an RSC representative.

After lunch Dr Marc Stuckey, IGS Wilhelmshaven Secondary School, Germany presented **Ideas and Experiments for teaching Thermochemistry**. In this talk Marc discussed various approaches to teaching topics on the Leaving Certificate Thermochemistry section of the syllabus. He introduced the use of commercial instant cooling packs and instant heat packs to demonstrate endothermic and exothermic reactions and to help embed an STS approach to the teaching of chemistry.

Marc's talk was followed by a short presentation given by Dr Conor O'Brien, President of the Irish Science Teachers' Association. In his presentation Conor spoke on the topic of **Health and Safety Training for Science Teachers** and outlined a project that is currently being organised by the ISTA to produce an accredited training programme in this area for science teachers.

Conor Walker and Jonathan Saint, Folens, presenting copies of the new DVD on Leaving Cert. Chemistry to Marjorie Ryan and Hilary Lynch.

The day concluded with a presentation **State Examinations Commission Assessment of Leaving Certificate Chemistry** by Dr Fiona Desmond. In this talk Fiona explained the role of the Chief Examiner and described trends in Leaving Certificate Chemistry participation and performance. She also discussed areas of good and poor Chemistry candidate performance at Higher and Ordinary Levels. The allocation of marks in the 2015 examination papers were described and useful advice was given to teachers on how their students can best approach their studies and future examinations.

I wish to express my sincere thanks to the sponsors of Chem Ed who helped to make the conference such a successful one: PDST, Royal Society of Chemistry, Folens, Whitegate Oil Refinery and Anyone for Science. I also wish to thank the Workshop presenters for setting up the various experiments in the Eureka labs. Great credit is due to the organising committee whose members were invaluable in ensuring the smooth running of the conference : Brendan Fanning , Seán Finn, Ryan Gallagher, Rory Geoghegan, James Holden, Tim Lordan, Michelle Lyons, Geraldine McCarthy, David O'Connell, Alvaro Pascual Sanchez and Sudirman Sudirman.

We are very fortunate in Ireland to have outstanding science teachers who are so dedicated to their profession. The fact that so many teachers gave up their free time to attend a continuing professional development course on a Saturday with many of them travelling long distances is hugely impressive. Well done to all of you!

Dr Declan Kennedy, Senior Lecturer in Science Education, Department of Education,University College Cork

Title of Experiment	Presenter
To measure the value of the Universal Gas Constant, R	John Lucey
To plot a pH titration curve for a strong acid vs. strong base titration.	Robert Nolan
To conduct an activity using a conductivity sensor to investigate the relative ability of (i) different solutions of salts of the same concentration and (ii) different concentrations of the same salt to conduct an electric current.	Sean Finn
To estimate the concentration of free chlorine in swimming-pool water or bleach using (a) a comparator or (b) a colorimeter.	Alan O'Donoghue
To prepare ethene and examine its properties (combustion, tests for unsaturation)	Tim Lordan
To prepare ethyne and examine its properties (combustion, tests for unsaturation)	Declan Kennedy
The bomb calorimeter	Trevor Carey
Spectroscopy in a suitcase	Trevor Carey
To extract clove oil from cloves by steam distillation	David O'Connell
To isolate clove oil (eugenol) from an emulsion of clove oil and water by liquid-liquid extraction using cyclohexane.	David O'Connell
Demonstration of electroplating (copper and nickel)	Rory Geoghegan
Electrolysis of sodium sulfate and potassium iodide solutions	Paul Joyce
To oxidise phenylmethanol (benzyl alcohol) to benzoic acid with potassium manganate(VII) solution (potassium permanganate) in alkaline conditions.	Ryan Gallagher

David O'Connell demonstrating the steam distillation of cloves during the ChemEd workshop.

Rory Geoghegan demonstrating some electroplating experiments during the ChemEd workshop.

Sean Finn demonstrating the conductivity experiment on the proposed new Leaving Certificate Chemistry syllabus, at ChemEd.

SSPC National Crystal Growing Competition

Grow your own crystal to win!

Following the success of the 2014 Synthesis and Solid State Pharmaceutical Centre's (SSPC) National Crystal Growing Competition, the SSPC has launched the 2015 national crystal growing competition, in partnership with the International Union of Crystallography's (IUCr) global competition.

The competition is supported by SFI (Science Foundation Ireland).

Competition Overview

The aim of both the SSPC national and IUCr global competition is for an individual student to grow a single crystal using either any of the materials listed on the website (www.sspc.ie/crystal_growing). Those entering the national competition will be judged by SSPC experts and those entering the global competition will be judged by an international panel of judges who are experts in crystallisation and crystallography!

Who can participate?

The competition is open to post-primary school students in Ireland. There are two categories, one for the national competition and one for the international one. A student could win both! There will be one winner from each category. Teacher supervision is required for crystallisation of compounds other than salt and sugar. Please view the **Material Safety Data Sheets** for Health and Safety instructions and indications for materials available on http://www.sspc.ie/crystal_growing

Prize

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International Category: Young Crystal Growers Certificates and Medals

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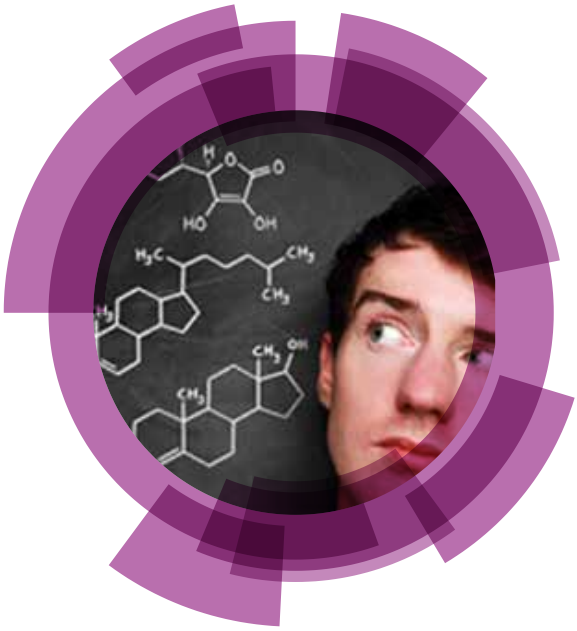

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Science Magic, Tricks, and Mysteries

for Primary Science

Maeve Liston

As part of Limerick Life Long Learning Festival 2015, Mary Immaculate College ran a 'Science Magic, Tricks, and Mysteries' workshop for children and adults in March 2015.

The activities carried out by the participants were based on a variety of different concepts on forces and balancing, properties of materials, static electricity and heat. The children and parents thoroughly enjoyed the sessions and the activities and problems posed proved to be a great hit. This article describes a selection of the many activities that were carried out on the day and that could be used in your lessons or for your own open nights and science fair etc. All the activities used materials that you would have at home so that the participants could try them again when they got home.

Problem Posed	Solution	Concept
		The fork, toothpick and spoon balance because the centre of gravity is directly below where the toothpick rests on the glass. As long at the centre of gravity of an object is supported the object will balance.
	Pour 100 cm^3 of water into the can. Tilt the can at an angle of 45° on the groove at the bottom of the can. Keep trying until you get the feel for the tilt and the balance. 	The centre of gravity is in the centre of the empty can. When you tilt it to 45° the centre of gravity still remains in the centre of the can but as the can is no longer upright, it will fall over. When the can has a little bit of water in it, the centre of gravity will be in the centre of wherever most of the water is. So when the can with water is at an angle of 45°, the centre of gravity shifts enough to remain in the 'centre' of the tilted can and therefore allowing it to balance.

Problem Posed	Solution	Concept
	 Rub the balloon with a woollen cloth and place it near the empty drink can. You will see the can moving towards the balloon.	As the balloon is rubbed with the woollen cloth, electric charge is transferred from one to another causing a build-up of static electricity. The can is attracted to the charged balloon and so will roll towards it.
	 Rub the plastic ruler with a woollen cloth and touch the snakes head (made out of very light tissue craft paper) with the ruler. Slowly lift the ruler. The snake will uncoil and rise up.	As the ruler is rubbed with the woollen cloth, electric charge is transferred from one to another causing a build-up of static electricity. The static will attract the snake. The tissue paper is so light, the charged ruler can lift it.
		Both cans have the same shape and volume but the can of diet coke floats and the normal coke sinks because is is much denser. This is due to the high sugar content of the normal coke. A standard 330 cm^3 can of coke contains about 16 grams of sugar.
	Add salt to the glass of water with an egg in it and you will see it rise up to the top of the glass. 	A fresh egg is denser than tap water and therefore sinks to the bottom of the glass. When the salt is added to the water it becomes more dense than the egg and so the egg floats to the top.

You may have seen these activities in the past, but do not under estimate the power of the old favourites to get children thinking. These activities worked very effectively in engaging and initiating discussions among children and their parents, where they shared their predictions and ideas on how they would solve the problem. There was a great buzz in the room trying out their ideas in order to solve the problems.

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Sr Mercedes conferred with Honorary Doctorate

Declan Kennedy

There were great celebrations on 2nd November when Sr Mercedes Desmond was conferred with an honorary doctorate by University College Cork. The ceremony took place as part of the celebrations of the 200th anniversary of the birth of George Boole, the first professor of Mathematics in UCC.

The citation for Sr Mercedes was read by Professor Aine Hyland, Emeritus Professor of Education UCC. Sr Mercedes Desmond was born in Donoughmore, Co. Cork in 1922 and entered the Mercy Convent in St. Maries of the Isle, Cork in 1942. Although she had never studied science at secondary school, Sr Mercedes enrolled as a student in UCC to study physics under Professor J. J. McHenry. One of her external examiners was Professor ETS Walton who won the Nobel prize for physics for his work on splitting the atom. Sr Mercedes also studied mathematics and chemistry and in 1948 she graduated with a B.Sc. degree and subsequently a H.Dip in Ed.

In 1949 Sr Mercedes was assigned to St. Aloysius School, Sharman Crawford Street, where she taught Physics, Chemistry and Mathematics throughout her teaching career. In 1962, along with a small group of other science teachers, she played a key role in founding the Irish Science Teachers' Association. Professor Hyland paid great tribute to the ISTA for ensuring the possible standards of science education in Ireland. St Aloysius School became the home of the Cork Branch of the Irish Science Teachers' Association and for over 40 years. Sr Mercedes would personally open the school for the monthly meetings of the ISTA and would welcome teachers with tea and coffee and delicious baking.

Sr Mercedes immersed herself in science education both at local and national level. She participated in and organised numerous inservice courses for science teachers ranging from glass blowing to electronics to ecology field trips to astronomy. These courses were organised by the ISTA within the network of universities and Institute of Technology throughout the country. Since the founding of the ISTA she has served at all levels of the ISTA, has represented the Cork branch on the Council of the ISTA and has represented the ISTA at conferences at home and abroad.

Sr Mercedes was appointed principal of St Aloysius school in 1978 and during her term as principal, enrolment in the school rose to 1200 students making it the largest girls secondary school in Ireland at one stage.

Professor Hyland gave great praise to the Sisters of Mercy. She recalled how as a former student she had the benefit of being taught mathematics by a Mercy nun and that when she sat the Leaving Cert only 38 girls took the honours mathematics exam paper - and she was one of 16 girls who achieved an Honours grade. She pointed out that conferring this Honorary degree on Sr Mercedes, UCC is also honouring all those religious women in Ireland throughout the decades who not only provided excellent educational opportunities for girls, but who, like Sr Mercedes, were outstanding role models and exemplars of female leadership.

In her acceptance speech Sr Mercedes said that she was deeply honoured and humbled to be conferred with this Honorary Doctorate and although she was 93 years of age she felt very young as she was still less than half the age of George Boole whose birthday was being celebrated on that day! She recalled that George Boole's chosen profession was that of a secondary school teacher in Lincoln, He was a gifted teacher of mathematics and science and she accept this doctorate on behalf of all the members of the Irish Science Teachers' Association, the Irish Mathematics Teachers' Association and on behalf of the Sisters of Mercy. Interestingly, she pointed out that the Mercy University Hospital was established in 1851 and these Mercy Sisters lived next door to George Boole in Grenville Place where he wrote his famous book "An Investigation of the Laws of Thought" which was published in 1854.

She concluded by saying that she hoped that George Boole would be an inspiration to the present and future graduate of UCC who pursue the same career of George Boole as teachers of Science and Mathematics.

Heartiest congratulations to Sr Mercedes on being such a worthy recipient of this great honour. May God continue to bless her with good health and we thank her for her outstanding contribution to the ISTA.

Dr Declan Kennedy, Senior Lecturer in Science Education, Department of Education, UCC

Below: Sr Mercedes pictured with Professor John O'Halloran, UCC, Professor Aine Hyland UCC and Dr Declan Kennedy

The words we use in science

Ted Forde

‘On average, a second level mathematics examination paper contains more vocabulary than a corresponding English examination paper’. As a science teacher, I remember being surprised to read this some years ago. Intuitively, it had always appeared to me to be the other way around. But then, language has been pivotal to the teaching and learning of science and mathematics.

When the topic of scientific words is raised it is often in the context of precision of meaning. Precision is generally seen as a good thing. (The opposite can be the case with a subject such as poetry where word opaqueness is often desirable.)

I came across an article recently (Wellington, 1983) that looks at another aspect of scientific language, namely, differences between scientific words. Wellington claims that there are some word differences that can lead to confusion among learners.

A random selection of words might include the following:

momentum	wave	oesophagus	valency
trachea	particle	power	red
inertia	differential	work	electricity
electron	energy	force	gene
compound	amoeba	mole	field

For example, he takes the word ‘trachea’. Its meaning comes from a real object, one that is easy to observe. A different situation applies to a word such as ‘inertia’. Wellington describes ‘inertia’ as a concept in the sense that its meaning comes from the observation that it is difficult to push a stationary object like a heavy rock. What is observed is an experience rather than a direct object.

And while a word such as ‘inertia’ can be related to everyday experience the same cannot be said for words such as 'electron’ and ‘photon’. These entities are not commonly observed. Neither are many mathematical symbols.

He proposes the following table in which scientific words are divided into four different categories; the level of abstraction increases going down the table.

Level 1: Naming words

1.1 Familiar objects, new names (synonyms)
1.2 New objects. New names.
1.3 Names of chemical elements.
1.4 Other chemical nomenclature.

Familiar naming words include ‘trachea’, ‘pelvis’, as discussed already. Words new to many young students might include ‘tripod’ and ‘coverslip’. All are real and observable and thus, at the lowest level of abstraction.

Level 2: Process words

2.1 May be shown or demonstrated
2.2 Not easily demonstrated

These would include demonstrable words like ‘distillation’ and ‘condensation’ and less easily demonstrable words like ‘photosynthesis’ and ‘evolution’.

Level 3: Concept words

3.1 Derived from experience
3.2 With special meanings
3.3 Theoretical constructs (total abstractions, idealizations)

Concept words make up the largest category. For example, these include familiar words such as the colours of the spectrum (3.1). However, words such as ‘work’ and ‘energy’ pose greater learning challenges for many students (3.2) while words such as ‘mole’, ‘electric field’ and ‘quantum’ refer to theoretical constructs rather than to direct experience (3.3).

Level 4: Mathematical ‘words’ or symbols.

Mathematical symbols are placed in category four in that they bear no necessary relation to the real world.

Applications of the table

1. Classifying words in the manner shown, suggests the need to adopt different teaching strategies in dealing with each level.
2. Words more likely to lead to confusion among students are more easily identified.
3. Trends in subject take-up may be linked to the level of abstraction of subject terminology. For example, the physical sciences contain a high proportion of abstract words and have generally lower levels of take-up than other sciences at senior level.
4. In relation to more abstract words Wellington suggests that, among other strategies, devices such as appropriate analogies and models may prove useful in helping student understanding.
5. As students mature one would expect an increase in their ability to deal with greater abstraction. This ties in with the notion of the spiral curriculum.

References

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Illingworth, V. (1990) *The Penguin Dictionary of Physics*.

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

The Naughton Foundation Scholarships

The scholarship programme was established in 2008 by Martin Naughton, founder and chairman of the Glen Dimplex Group, the largest global manufacturer of electrical heating appliances. An engineer by profession, Dr. Naughton has overseen his company grow to become the world's largest manufacturer in domestic heating appliances with plants in the Republic of Ireland, United Kingdom and North America. He is an alumnus of De La Salle College Dundalk, where he funds an annual scholarship programme. He is well known for his philanthropy and generosity, funding a number of educational institutions, notably Trinity College Dublin and the University of Notre Dame.

The aim of the Naughton scholarships is to promote the study of engineering, science and technology at third level in Ireland. Each year a number of exceptional students are awarded scholarships to study at undergraduate level at any publicly funded university or third-level institution in Ireland. The scheme started in 3 counties and has continued to expand annually, now including 24 counties and with plans for 2016 to become a nationwide scheme with the inclusion of Dublin and Cork for the first time.

An award ceremony took place in the Trinity Biomedical Science Institute at Trinity College, where the University Presidents and the founding patrons of The Naughton Foundation, Dr. Martin Naughton and his wife Carmel, presented the winning students with their awards and cheques. Each Scholarship is worth €5,000 per annum for each year of a student's three or four year undergraduate degree. The secondary schools they attended also receive a prize of €1,000 towards their school's science facilities, for their support of these students.

Since its establishment in 2008, Naughton Foundation Scholarships worth €1.2 million have been presented to 110 young people in the fields of science, engineering and technology. This year there were 29 lucky recipients. The whole process from start to finish is managed effectively by all the members of the Naughton Family. For more information go to the website **www.naughton.ie**

Mary Mullaghy

Musings

Ian McCulloch

While I enjoy the Annual Meeting immensely there are some ramifications associated with attending. Firstly, Rory is such a stalwart and committed ISTA member that it is difficult to ignore his requests for "a few lines" for the next "Science". I relish this opportunity to demonstrate my "talent" for utilising many words when a more carefully chosen few would suffice. However, it does impinge on my ever-busy retirement schedule. Secondly, I come away inspired to re-create some of the demos I am impressed with (more disruption of my schedule). This involves delving into my "it will come in useful sometime" boxes which is good as it reduces the rate (only a little) at which contents increases.

After this year's entertainment, Hugh Hunt's lecture was the one,which generated most work.

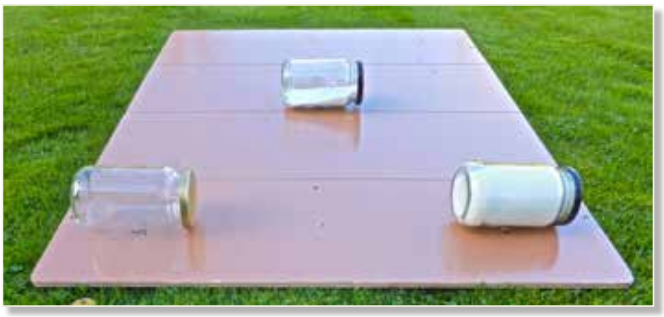
I sprayed one side of an old tennis racquet so that it was more obvious that, when flipped, it rotated so as to conserve angular momentum.

I also threaded a piece of rope, about 2 metre long, through some half-inch qualpex. I then attached a tennis ball to one end and a 2 litre milk container full of water to the other. By holding the qualpex and rotating the tennis ball enthusiastically the milk container can be lifted. Interestingly for an academic, Hugh doesn't have

an aversion to centrifugal force —he suggests that it is the tennis ball's generation of same which provides the necessary tension in the rope.

I did think about making a boomerang but the instructions at http://www2.eng.cam.ac.uk/~hemh/boomerang_makeit.pdf were sufficiently intimidating for me to postpone the attempt. I suspect that the launching technique might prove a challenge as well. All told, there is a distinct probability that my boomerang wouldn't come back!

During my visit to the Science on Stage workshop David Keenahan had a demo involving jars of sugar, which I reproduced (almost) subsequently. If you let go the three jam jars in the first picture simultaneously, the situation as seen in the second picture evolves. The empty jar and the one full of sugar travel down the runway at roughly the same speed whereas the one that is about quarter full, moves much more slowly. This is because the sugar continually shifts in this jar, which uses up sufficient energy to hinder its progress significantly. As with most of these sort of demos some care is required. The quantity of sugar, its distribution and position on release, as well as the slope of the runway, need to be "played with" to achieve the best outcome.



The success of this runway exercise has prompted me to abandon, for the moment anyway, my variously filled Wavin pipe sections tests, that you may have read about in previous issues (those of you who don't automatically bypass the Musings that is!).

When the AGM was over we stayed for lunch in the UCC staff dining room. Cyril Isenberg happened to be at our table. During the course of conversation he became aware that I had taught Maths as well as Physics. He offered this little arithmetical "enigma":

Choose a three digit number (hundreds digit must be greater than the units one, also no zeroes) - say,
5 4 2

- Reverse the digits 2 4 5
- Subtract to give 2 9 7
- Reverse the digits again 7 9 2
- Add the last two numbers to give 1 0 8 9
- The "enigma" is that the result is always 1 0 8 9

a	b	c
c	b	a
(a - c - 1)	9	(c+10-a)
(c+10-a)	9	(a - c - 1)
10	8	9

In the garden we have had lots of goldfinches and coal tits this summer. The man in our bird food shop thinks that there have been two broods this season. Our regular badger visitor has been excavating the back grass enthusiastically. One of the highlights was a visit from a heron who wandered around for a while before taking himself off to wetter pastures.

I was reading an article this morning at breakfast about how to succeed at the Young Scientist Exhibition. As I started to butter my toast I realised that this task was being particularly straightforward, unlike during the height of summer when the butter nearly flows out of the dish or the depths of winter when you almost need a hammer and chisel.

So, is there a Young Scientist project in the spreadability of butter? Is it temperature dependent? Is it a function of the milk used to make the butter? Are there additives when making the butter which affect this property?

Have a good year.

Ian McCulloch
Formerly of Sandford Park, Dublin

Demonstration Experiment (No. 1 of 10)

Randal Henly

I was recently asked, after I had given a lecture-demonstration, what were my best experiments. In the context of the conversation, the question referred to demonstration experiments rather than conventional class experiments. However, the answer to the question was not quite straightforward: did 'best' refer to the most entertaining experiment, or to the most educational one, or what? In any case, I can think of many 'best experiments'!

So I jotted down my 'top ten', demonstrations that illustrate in an entertaining way topics in both physics and chemistry (query: are there many entertaining educational experiments in biology? Maybe Alison or Siobhan might come up with something?). Many of my really 'best' experiments involve a lot of preparation and often specialised apparatus, but for my 'top ten' I have chosen experiments that are reasonably easy to set up and require simple apparatus— apparatus that should be available in every school laboratory. Following, is No. 1 on the list.

1. A Density Spectacle (or, A Touch of Magic?)

Requirements:

Two 250 cm^3 cylinders, cylindrical mask* to fit, yellow and blue food colouring, diluted milk, sugar syrup, yellow oil.

Procedure:

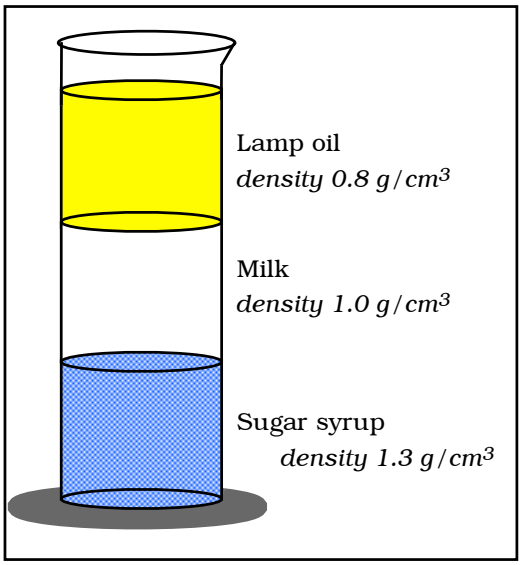
Those that have seen my '*Fun with Science*' presentation will recognise this experiment. '*What colour is formed when blue and yellow liquids are mixed*'? Teacher mixes blue and yellow liquids and the resulting liquid is green — as predicted. '*And when some white is added, will it become lighter or darker?*' Some white is added, making the colour light green — again as predicted.

Teacher now dons his magicians' hat and repeats the experiment, but masks the cylinder(*) before pouring in the blue and yellow liquid, followed by the white. '*So what colour will it be this time*? Mask is lifted, revealing three layers, blue, white and yellow.

Explanation

This is of course an experiment involving density and immiscible liquids. The first blue and yellow liquids are water, coloured with a few drops of food dyes. The white liquid is diluted milk (about a 50/50 mix).

(*) A cardboard tube of suitable length and diameter is ideal



The second blue liquid is sugar syrup, and is prepared as follows. Add 1 kg of sugar to about half a litre of water. Heat the mixture to almost boiling point, stirring regularly, and then allow it to cool. A reasonably clear sugar syrup results. Add sufficient blue food dye (10 to 20 drops) and stir well to mix. Of course you can make up a smaller quantity, reducing the amount of the ingredients proportionally.

The second yellow liquid is ornamental lamp oil. This can be purchased in large hardware stores such as Woodies and B&Q, but it is becoming increasingly difficult to obtain. Oil-soluble yellow dye is available from laboratory suppliers and this dissolved in paraffin oil or white spirit gives a suitable liquid.

When carrying out the experiment use a funnel. When mixing the second group of liquids, add the blue and then the yellow, pause for a few seconds to let them separate (a bit of patter is needed here) and then add the white **slowly** (milk and sugar syrup **can** mix since they are both aqueous), so don't add the milk quickly in which case its momentum could bring it down into the sugar syrup. Let the set-up stand for five or more seconds while the layers stabilise. You will need a bit more patter to fill in the time. Ideally this demonstration can be used when teaching about density but there are other times too when it can be profitably shown.

There are of course lots of variations of the colours used, and of the patter that can accompany the demonstration. When I show this, particularly to primary-school children, there are usually lots of gasps of astonishment when the mask is lifted.

Randal Henly

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Evidence of ancient plants and desert environments on Ireland's highest mountain.

Mike Maunsell

In August 2015, I climbed Carrauntoohil (1038.6m) in Co. Kerry, Ireland's highest mountain. Having climbed the mountain many times over the past 35 years, I had a particular reason for this ascent. With an interest in mountain botany and geomorphology, I had wanted to survey some of the special plants on the mountain and the ancient sand ripples near the summit.

Accompanied by fellow climber and mountain researcher, Matthew Joy, we set off early one morning with an uncertain weather forecast and a grey sky. The plan was not to climb Carrauntoohil by any of the popular walking routes, but to climb the spectacular and exposed 'Howling Ridge' using a rope and climbing equipment. Soon after we started climbing the day began to brighten up and became calm and sunny; we enjoyed clear views and on nearing the summit we could see as far as Galtymore in Co. Tipperary.

Above and Right: wave-formed ripple marks on Beenkeragh Ridge. (also on the cover)

While this was to be the first ever survey of flora on 'Howling Ridge', I had a particular interest in recording certain plant species, including Fir **Clubmoss** which is one of four species of Clubmoss found in Ireland, all of which are protected. Clubmosses are an ancient group of plants that have an evolutionary line stretching back to the Devonian period (417–354 million years ago). Forests of tree-like forms, up to 30 metres tall, (today they are 5-12 cm high) were the dominant plants during the Carboniferous period (303–359 million years ago) and the main plants that formed into the coal deposits we have today.

I also surveyed for Saxifrage, such as the native St Patrick's Cabbage, and insect eating plants like the Large-flowered Butterwort. The latter two plants are part of a group of wild flowers native to Ireland, but mainly absent from Britain, known as the Lusitanian Flora. This unique collection of Mediterranean plants came originally from the Iberian Peninsula (North Spain and Portugal) and in Ireland, most are found only in the South and West. There is no conclusive explanation for their presence here.

The Large-flowered Butterwort catches and digests insects for vital nutrients; its sticky leaves trap insects that walk or fly onto them. The leaves roll at their edges to prevent escape – an unlikely occurrence – since butterworts possess the strongest known natural glues. After digestion the dry insect husk blows away.

Needless to say, it was to be a long day, between climbing, stopping to record species in detail, getting photographs and GPS readings. We soon agreed that a day just wasn't long enough; on making it to the summit we promised to return as soon as possible to continue the survey.

But, the day wasn't finished yet! I wanted to investigate some geological features that occur in the area. These are the small–scale, wave-generated ripple marks on some of the slabs of rock on the ridge between the peaks of Carrauntoohil (1038.6 m) and Beenkeragh (1008 m).

Above: St Patricks Cabbage (a Saxifrage) and Fir Clubmoss

Below: Large-flowered Butterwort (which was featured in an Irish stamp)

The ripple mark are evidence that these rocks, near the highest point in Ireland, were formed due to the deposition of sediment (sand, in this case) by river systems in a relatively flat, desert like environment, between 410 and 355 million years ago, when Ireland was located below the equator. Since then, the Old Red Sandstone has been folded by huge forces, so much so, that the sandstone that was once laid down horizontally, is now standing almost upright in places, resulting in the Ireland's highest mountain range, the MacGillycuddy Reeks and other sandstone mountain ranges across Southern Ireland.

Interestingly, by examining the ripple patterns and the shape of the ripples, (Photo 3) we can tell the direction of flow of the current that formed them millions of years ago. The upstream or "stoss" side of the ripple is exposed to the full brunt of the current, and is a site of erosion. The downstream or "lee" side of the ripple is in the "current shadow" and has slightly less energetic water conditions. As a consequence, sand can settle in these slightly protected spots, accumulating on the downstream face of the ripple.

Standing on the Beenkeragh ridge, we wondered how these ancient ripple features, the highest ripples in Ireland, had survived successive period of glaciation, which had been so destructive in this area and could grind even the hardest granite of other mountains to a smooth surface.

Another research session is planned for the area, but next time over three full days. We will examine the ripples in more detail and target other mountain flora, hopefully in weather similar to that which we enjoyed on this climb.

Mike Maunsell is a lecturer in Conservation & Biodiversity Management and is the founder of Mountain Research Ireland, which works to protect Ireland's Mountain environments through research and collaboration. Mike has over 35 years of experience as a mountaineer and researcher in mountain environments throughout the world.

International Acclaim for SciFest Winners

Sheila Porter

On 6 November the Best Project Award winners from each of the 15 **SciFest@College** regional science fairs will compete at the **SciFest@SFI Discover** 2015 national final in Dublin for the opportunity to represent Ireland at the **Intel International Science and Engineering Fair (ISEF)** in Phoenix, Arizona in May 2016, courtesy of Intel Ireland. Other travel awards presented on the day will include an all-expenses-paid trip to represent Ireland at the **International Environment and Sustainability Project Olympiad (INESPO)** 2016 in Amsterdam and an award which will see the lucky winner/s participating in the **Long Night of Science** in Berlin in June.

SciFest students have competed at Intel ISEF on four separate occasions and have won a total of five major awards. This year Christopher Carragher from Our Lady's School, Castleblaney and the overall winner of SciFest 2014 competed at Intel ISEF 2015 in May in Pittsburgh, Pennsylvania. Christopher was awarded second place in the Computational Biology and Bioinformatics Category and also had an asteroid named after him. Now studying engineering in DCU Christopher was recently awarded a **Naughton Foundation Scholarship**.

Commenting on the experience Christopher said *'I met students from all over the world, and heard speeches from*

Intel ISEF 2015: Christopher Carragher with his teacher, Kathryn Higgins

INESPO 2015: Aoife Dolan, Ellen Fitzgerald and Niamh Nyhan at the presentation of Awards

famous scientists like Nobel laureates Sir Harold W Kroto and Martin Chalfie. It's been great to see all the projects that other students from around the world have been working on and it has been brilliant to spend a week together sharing our ideas.'

What started out as an idea, developed into a worldwide success for West Cork students Ellen Fitzgerald, Aoife Dolan and Niamh Nyhan from the Sacred Heart Secondary School, Clonakilty, Co. Cork. Their project entitled 'Non-Integrated LED Bulb' involved an LED bulb that they designed to integrate into existing street lamp fittings without affecting the performance with regard to lux levels and uniformity. They estimated that their innovative solution would provide an 80% saving on cost per annum and up to a 50% reduction in Ireland's annual carbon footprint. Ellen, Niamh and Aoife competed in Amsterdam against 47 countries from all over the world and came away with a first place gold medal award. The girls' participation in the INSEPO event was sponsored by the Sustainable Energy Authority of Ireland.

On returning home the girls wrote a report summing up in the following quote what the experience meant to them *'The experience was life changing and rewarding. Our months of hard work had paid off as we represented our country and won. Without the constant support and help from those at Garrabridge, CAPPA, SEAI, CIT, INESPO and SciFest, our trip would not have been a success. We came away from our week in Amsterdam with not only pride and a sense of accomplishment, but with life long memories and friends from all around the world. SciFest has given us many great experiences and an opportunity to delve into the world of science. We would strongly encourage students to take part in SciFest to develop their skills and fulfil their true potential.'*

In June Rachel Ní Dhonnachadha and Ciara McLoughlin from St Vincent's Secondary School, Dundalk travelled with their teacher to Berlin to attend the Berlin Long Night of Science. This award is supported and organised by the Department of Foreign Affairs and the Irish Embassy in Berlin which put together an exciting itinerary for the Irish party's stay in the city. This included not only VIP status during the Long Night of Science but also a tour of Berlin, visits to the Reichstag building, the technology museum and the Science Centre Spectrum. It was also arranged for the girls to meet and talk with Professor Axel Hoffmann, Academic Director, Institute of Solid State Physics, Technische Universität.

Rachel said *'Overall it was an amazing experience and one I feel quite lucky to have been given the opportunity to go on. We got to see the city of Berlin and also all of the science that is currently going on in Berlin. It was a fantastic and very enjoyable trip and I really appreciate SciFest for giving me the opportunity.*

At home the first SciFest@School took place in St David's Holy Faith Secondary School, Greystones on 29 September. It was a great success and congratulations to Carolyn Cavey, science teacher, who was the chief organiser. More details on SciFest@School are available on the SciFest website at www.scifest.ie/scifestschool.

Dates for the regional SciFest@College science fairs are posted on the website as they become available. Teachers are asked to check the website, www.scifest.ie regularly. The closing date for submission of entry forms to SciFest@College

Shannon and Rachel Ní Dhonnachadha, winners of the Long Night of Science Award at SciFest@SFI Discover 2014

2016 is 11 March 2016.

Sheila Porter

SciFest CEO

Recipient of the Science Educator of the Year award in 2015.

Schools Chemistry Newsletter Prize 2015/16

Celebrating The International Year of Light 2015

First Prize: €100 sponsored by

The Institute of Chemistry of Ireland

Irish Chemical News, the journal of The Institute of Chemistry of Ireland, may consider publishing articles from the winning newsletter.

Extracts may also be circulated with **Chemistry in Action.**

Two runners up prizes: €50 each

The competition is supported by

The Irish Science Teachers' Association

- This competition is open to all second level students, including transition years, interested in Chemistry (both North and South).
- Only individual entrants are allowed.
- Students should submit a Newsletter on the theme of ***"Chemistry and Light"***, suitable for the non-scientist, outlining clearly and accurately any aspects of the topic in an engaging, informative and easily readable manner.
- The newsletter should consist of four A4-sized pages.
- Sources of information must be cited (four maximum)
- The name and contact details of both the student and teacher including the school name should be clearly stated.
- The entrants are strongly encouraged to use good quality graphics/photographs to illustrate their newsletter.
- An electronic Microsoft Word file should be submitted as an email attachment to: info@instituteofchemistry.org
- Closing date is **Friday, 18th December 2015.**
- Failure to abide by rules will mean automatic disqualification.

The Institute of Chemistry of Ireland will nominate an adjudicating panel. Strict adherence to the guidelines will be taken into account when assessing each newsletter.

Winning students will be contacted and awarded their prizes at the **2016 ChemEd Conference**, which will be held in University of Limerick on Saturday 22nd October 2016.

Limestone, lime and limewater

Using sparkling water to demonstrate important carbonate reactions

Rory Geoghegan

Limestone and Lime

The underlying rock in about 50% of the Irish Republic is limestone which was formed in the Carboniferous era (300–340 million years ago). The main ingredient in limestone is calcite (calcium carbonate, $CaCO_3$) — often making up over 95% of the rock.

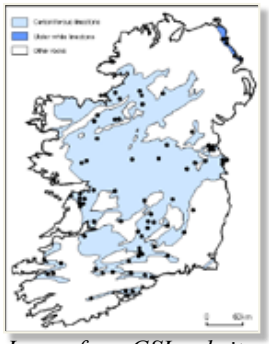


Image from GSI website

For thousands of years people have used limestone as the raw material for the production of **lime** (calcium oxide, CaO; also known as quicklime or burnt lime). Lime was used to make plaster and mortar in the construction of buildings. To this day it is an essential ingredient in making concrete.

Annestown lime kiln

Calcite is not easily decomposed; a temperature of at least 825 °C is required and in practice a temperature of around 1000 °C is generally used.

$CaCO_3$ ==> $CaO + CO_2$

When calcium oxide cools it can absorb carbon dioxide again to reform calcium carbonate.

Calcium hydroxide

Pure calcium oxide is a white solid. It reacts with water in the ratio of about 3:1 (56:18) to form another solid called 'slaked lime' or 'hydrated lime' — calcium hydroxide, $Ca(OH)_2$. The reaction is quite exothermic.

$CaO + H_2O$ ==> $Ca(OH)_2$ $\Delta H = -63.7$ kJ/mol

The lime that is sold for making concrete is in fact calcium hydroxide and is usually labelled 'Hydrated lime'. Agricultural 'lime' is usually not lime but just crushed limestone ($CaCO_3$); it reduces the acidity of soil but doesn't make it alkaline.

Limewater

Calcium hydroxide is alkaline but it is not very soluble in water — less than 2 g per litre. This solution is called **limewater**.

$Ca(OH)_2$ <==> $Ca^{++} + 2OH^-$

To make limewater just put about 10 g of calcium hydroxide in a 1 L bottle and add water. Shake it and then leave it to settle, preferably for 24 hours. Most of the calcium hydroxide will settle to the bottom. Pour off the clear limewater when required and top up the remainder with water. It should last for years.

The limewater test

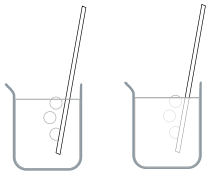
To a small extent, carbon dioxide reacts with water to form carbonic acid:

$CO_2 + H_2O$ <==> H_2CO_3

Carbonic acid reacts with calcium hydroxide solution (limewater) to form calcium carbonate as an insoluble precipitate.

$Ca(OH)_2 + H_2CO_3$ => $CaCO_3 + 2H_2O$

This reaction is not easily reversed.



The reaction can be demonstrated by blowing into limewater in a beaker or wide test tube for a minute or two. It can be demonstrated much more quickly and dramatically by adding some 'sparking water' to limewater. (**Sparkling** water is just carbonated water; it contains dissolved carbon dioxide some of which reacts with the water to form carbonic acid, which gives it its 'tang'.)

1. To show this add **a little** sparking water to some limewater.

Whitewash

This same reaction occurs (slowly) as whitewash absorbs carbon dioxide from the air and hardens to a white crust of calcium carbonate.

$Ca(OH)_2 + CO_2$ => $CaCO_3 + H_2O$

Formation of limestone caves

Limestone, which is mostly calcium carbonate can be slowly dissolved by carbonic acid in rainwater.

$CaCO_3$	+	H_2CO_3	=>	$Ca(HCO_3)_2$
solid		*solution*		*solution*

The product is **calcium hydrogen carbonate** and it is soluble in water.

2. To show this, add some **more** sparking water to the previous suspension (1, above); the white suspension dissolves.

Note: The solution is no longer limewater; it is in fact temporarily hard water — a solution containing calcium ions. (This is an easy way to make temporarily hard water.)

A gryke in the Burren

This is the reaction that causes the formation of caves and grykes in limestone areas such as the Burren.

3. Heat some of this solution in a test tube. The previous reaction will be **reversed** and calcium carbonate will be precipitated as carbon dioxide is driven off.

$Ca(HCO_3)_2$ => $CaCO_3 + CO_2 + H_2O$

This reaction occurs as **limescale** forms in kettles.
It also accounts for the formation of **stalactites** when solutions of calcium hydrogen carbonate slowly evaporate and leave behind insoluble calcium carbonate.

Rory Geoghegan

Are You 'Ocean Literate'?

Dr John Joyce

Did you know that the Sea is the largest physical feature on 'Planet Earth' – covering over two thirds of its surface?

Did you know that half the oxygen in our atmosphere – enough for 'every second breath' that we take – is produced by seaweeds and microscopic algae in the Sea?

And, more importantly, did you know that many of our day-to-day actions – from taking the car to work instead of the bus, to leaving a plastic bottle on the beach – have an effect on the overall health of the Sea which, in turn, has an effect on our own health and wellbeing?

Are you, in fact, 'Ocean Literate'?

'Ocean Literacy' has been defined as ***'an understanding of the ocean's influence on you and your influence on the ocean.'*** As fish stocks decline around the world, marine pollution levels continue to rise and the problem of plastic debris – visible on the surface and in the deepest ocean trenches of the Sea as well as lurking invisibly as 'microplastics' pellets in the digestive tracts of marine animals – pose a new and growing threat, there is increasing concern that we have been 'Ocean Ignorant' for too long - and that this ignorance could come back to bite us – with a vengeance!

'Ocean Literacy' is relevant to every sector of society, from citizens to scientists and from industry to government. But, given that the citizens of tomorrow are still at school, a profoundly positive effect could be had on the promotion of Ocean Literacy by 'weaving' this vital subject into existing lessons taught in the classroom.

I say 'weaving' because, as yet, there is no single subject strand on the Irish school curriculum dealing directly with the vital subject of Ocean Literacy. Irish pioneers in this area include the Sherkin Island Marine Station in Cork (run by Matt Murphy and his family) and the Connemara Environmental Educational and Cultural Centre (run by Leo Hallissey and friends) – who began operating marine outreach programmes to primary schools. These programmes included the temporary placement of marine aquariums into schools to bring the sea to the classroom. Another, more ambitious project called Planet Aqua - involving a detailed colour folder of ocean literacy lesson plans for primary schools and public exhibitions in both Dublin and Cork – was operated by AquaTT between 2005 and 2007 (*See*: www.planetaqua.ie)

Through marine-themed education modules and support materials, students get the opportunity to take part in cross-curricular activities using seashore aquariums in class, attending seashore safaris, completing marine project work, as well as attending workshops at key centres.

The Explorers team is also involved in a number of public outreach events throughout the country where they show and talk about animals from the seashore and beyond. In addition, the Marine Institute facilitates open days on its research vessel the *RV Celtic Explorer* where students get to meet marine scientists and researchers at work in Ireland.

The ***Explorers Education Programme™*** offers over one hundred downloadable lesson plans, resources and activities for primary school teachers to inspire their student's interest and knowledge in our ocean, marine environment, species and seashores. Many of these materials, funded by Science Foundation Ireland, were developed by teachers for teachers to ensure that the marine themed lesson plans could be integrated into existing subjects and strands already taught in primary schools.

Recognising how difficult it would be to establish 'Ocean Literacy' as a separate subject or strand on the existing curriculum, the *Explorers Education Programme™* runs a special week-long training course for primary school teachers in collaboration with local education centres and public aquaria in Galway and Blackrock, teaching teachers how to incorporate marine subjects into the *existing* curriculum. This hands-on practical course inspires teachers to focus on their strengths and interest in the ocean and how the marine can be used in cross curricular teaching. Using SESE subjects including science, geography and history - as well other subjects such as maths, language, PE and arts education, teachers learn how to teach about living things on the rocky seashore. Examples range from the life of a simple sand hopper to the scavenging crab that eat anything in its way, from the effects of litter on the beach and the need for environmental awareness and care, to the art of using flotsam and jetsam to create sea monsters, sand sculptures and seaweed mazes on the shore.

Back in the classroom, teachers learn about Ireland's ocean territory through geography, as well as conducting simple experiments to learn about energy, forces and materials in the context of the Sea. The training course also provides teachers with the opportunity to learn evaluation techniques, practice writing poetry and newspaper articles, as well as telling stories on great Irish maritime heroes and heroines such as Brendan the Navigator, Grace O'Malley the pirate queen, John Phillip Holland the inventor of the modern submarine and Francis Beaufort, the great marine cartographer and inventor of the 'Beaufort Wind Scale' to illustrate the history strand.

The Explorer lesson plans and teachers resources can all be downloaded directly from the www.explorers.ie

Left: Celtic Explorer Open Day Galway

Above: Teacher Training Course Sandycove Dublin

Sea for Society

On a European scale, ocean literacy is becoming increasingly recognised as a vital topic for study by the European Commission, resulting in the 'Mutual Mobilisation and Learning (MML) project **'Sea for Society'** under the Science in Society programme and two major EU ocean literacy projects – **'ResponSEAble'** and **'Sea Change'** (which also includes partners from the USA) being funded over the last few years - and the creation of EMSEA – the European Marine Science Educators Association which has its third Annual Conference this year in Crete.

'Sea for Society', which involves a consortium of partners across Europe, has investigated the societal barriers to creating a 'Blue Society' in which humankind lives in sustainable harmony with the Sea. Finding that the most influential barriers were 'Attitudes and Awareness', *Sea for Society* partners are now in the process of mobilising their resources across Europe to educate and inform citizens about the vital importance of the Sea in their everyday lives. As this project comes to an end, *Sea Change* and *ResponSEAble* will take up the running to achieve its goal of bringing about a fundamental 'sea change' for the better in the way European citizens view their relationship with the Sea.

Becoming involved in 'Ocean Literacy' is simple. All you need to do is to **stop and think** once in a while about how your everyday actions could adversely affect the health of the Sea. Almost everything we do – from our choice of transport, our use of energy and fresh water, the products we buy and the way we dispose of our litter – has some effect.

And, if you think that might be difficult . . . just think of a world in which the oxygen in the atmosphere is declining, the climate is wracked by storms, massive floods make millions of acres of land uninhabitable and riots caused by food shortages happen on a daily basis!

Then you will understand just how vital 'Ocean Literacy' is. If you would like further information on ocean literacy or any of the projects mentioned in the article, please contact us at - info@aquatt.ie or visit www.aquatt.ie

Other useful websites:

Sea for Society - http://seaforsociety.eu/np4/home.html

Explorers Education Programme™ - http://www.explorers.ie

Sea Change - http://www.seachangeproject.eu

ResponSEAble - http://www.responseable.eu

SeaLife - https://www.visitsealife.com/bray

Galway Atlantaquaria - http://www.nationalaquarium.ie/education

Clean Coasts – http://www.cleancoasts.org

Dr John Joyce – AquaTT Senior Scientific Project Manager

Young people at Planet Aqua Exhibit

Young People on RV Celtic Explorer

International Space Settlement Contest

The High Frontier - John Scottus Primary School's success in the annual Schools Space Settlement Contest 2015

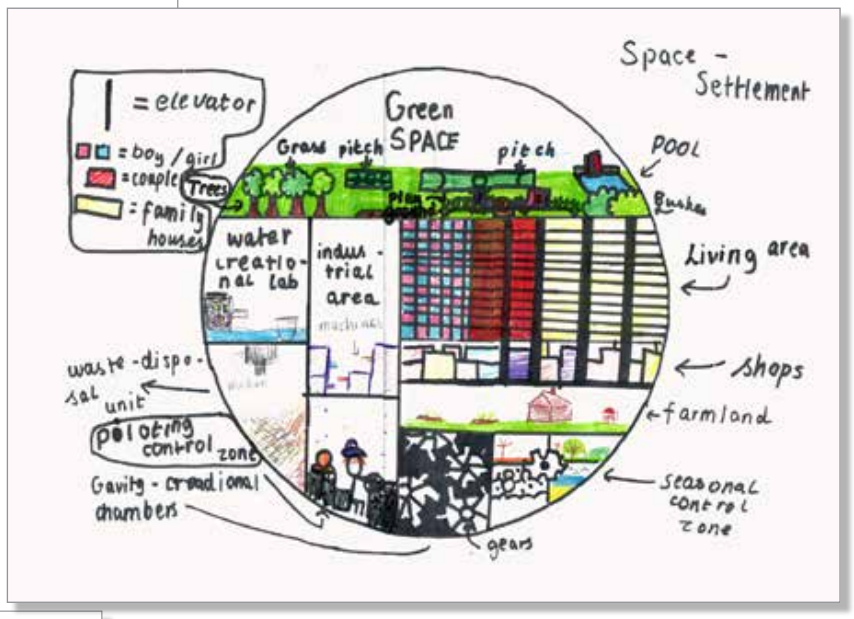
Noel Brady

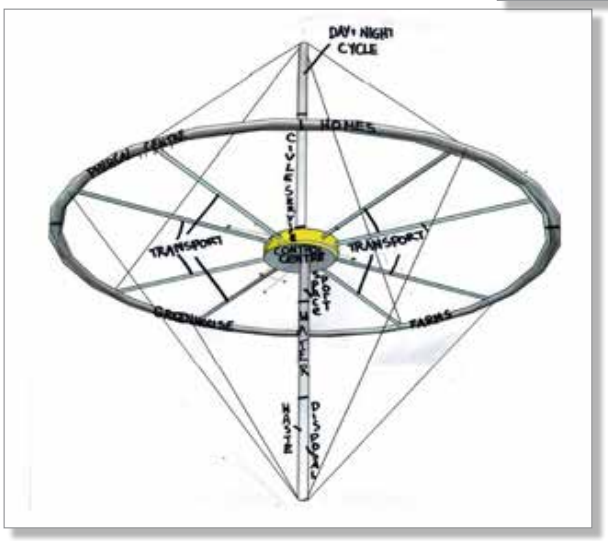
Each year NASA's Ames Research Centre sponsors an International Space Settlement Contest for primary and secondary schools. As an open competition the contestants must focus on orbital settlements. These settlements "must be permanent, relatively self-sufficient homes, not temporary work camps". The potential range of enquiry includes all that is contained in Earth's biosphere. The problem would be challenging even for university level students Therefore schools are encouraged to undertake work that encompasses "designs, original research, essays, stories, models, artwork or any other orbital space settlement related material."

When I introduced the project to Darren Sheils, the 6th class boys teacher, I expected some reservation. However Darren embraced the potential for the project and saw the educational opportunity. Together with Mrs Margaret Dempsey, the 6th class girls teacher the students were included in an adventure. Following an introduction to Dr. Gerard K. O'Neill's seminal work in the 1970's on "The High Frontier" the students were directed to a potential settlement of 10,000, a sideway glance to Hippodamus's classical ideal for a city.

Following excellent motivation and support provided by Mr Sheils and Mrs Dempsey, the students devised a number of physical designs in physical and computer models for "Inception" (their space station). The principles of orbital dynamics, centrifugal force, radiation protection and propulsion were worked into easily recognizable forms in fiction (2001) and fact (the ISS). In the end two distinct scenarios emerged from the wide ranging study; the "Spoke" and the "Spindle". In parallel to the "design" element various teams worked up more specific research in relation to thematic sections;

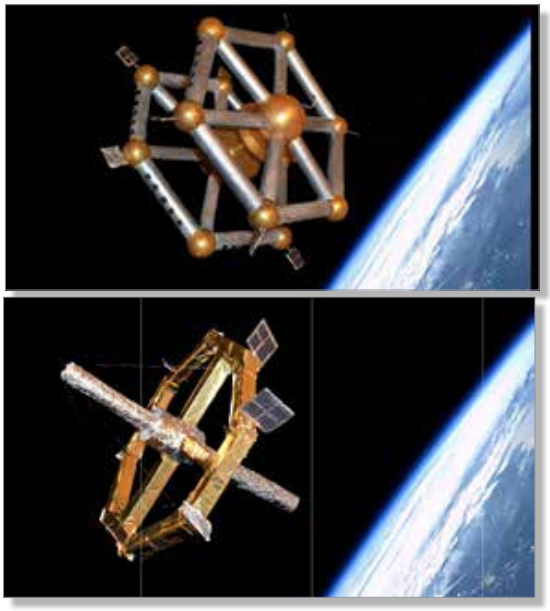
- Space Station (Design)
- Space Elevator (Access)
- Gravity (In the station)
- Control and Protection of inhabitants
- Living Arrangements
- Water (Use and reuse)
- Atmosphere (Weather)
- Green Space (Recreation)
- Agriculture (Feeding the population)
- Hydroponic Demonstration
- Energy (Production and Use)
- Communication
- Transportation (in the station)





These wide ranging topics immersed the pupils in questions that expanded with every turn. They identified areas that they would need to consider for future designs, including;

- Form of governance / trade / languages / emergency services
- Places of worship for religions / what happens when people die?
- Digital archive of human history to avoid same mistakes
- How would we deal with crime?
- Mining machinery for use in space
- Specialized machinery for farming
- Food / seed storage
- More variety of insects for pollination
- Commercial enterprise (space tourism)



What the students believed worked well in their plans included;

- New methods of growing plants / crops will be thought of — hydroponics
- Perfect water purifier
- Solar panels for maximizing energy production
- Bicycles will help humans to be healthier and stronger in space
- Space elevator uses less energy and will cost less than a rocket

And they believe that the positive outcomes would include;

- One of mankind's greatest engineering feats
- Encourage space exploration
- Potential of new zero gravity sports / entertainment
- To encourage actual building in space
- Encourage people to think about living a healthier and sustainable lifestyle
- Place of refuge for people on Earth if there was a disaster on Earth
- Encourage more inventions
- More social opportunities with like-minded people
- People will become more aware of the need to conserve energy

Prior to the submission to NASA John Scottus had an opportunity to present their work at the Young Scientists Exhibition 2015 which was well received by all who visited the booth. The John Scottus 6th class Inception Space Station project received the First Prize Large Team for Grade 7 and Younger from NASA and the certificates were presented recently in Dublin. The certificates are only paper, it is the experience they have gained in tackling a tough problem, working in teams, learning about their habitat and developing coherent ideas about the future that is of greater value. They have through an open educational environment illustrated what is possible, a light that others might follow.

Noel Brady advisor and parent
John Scottus Primary School

The EU Inspiring Science Project in Coláiste Bríde.

Karen Hopkins

Coláiste Bríde Presentation Secondary School in Clondalkin Dublin, is one of a number of secondary schools in Ireland participating in the EU Inspiring Science Education (ISE) project. Coláiste Bríde is working closely with The International Centre for Innovation and Workplace Learning in Dublin City University, which is one of 15 EU project partners involved in the Inspiring Science Education project.

The ISE project is a two year pan-European project which brings together 5000 primary and secondary schools in 15 European countries. The aim of the project is to provide digital resources and opportunities for teachers to make science education more attractive and relevant to students' lives.

Coláiste Bríde was awarded funding for teacher overseas training through the Erasmus+ (KA1) programme by Léargas. Four teachers from Coláiste Bríde travelled to Cascais in Portugal during the February mid-term to undertake training in Inquiry Based Learning (IBL) and eLearning tools. The eLearning tools the teachers were trained on by the renowned research organisation Núcleo Interactivo de Astronomia (NUCLIO) were Stellarium, SalsaJ and Impact Crater. Teachers also learned how to create inquiry learning scenarios through the Go-Lab portal. The Go-Lab portal is the most popular eLearning tool with our teachers. The portal enables teachers to create and use personal inquiry learning spaces in which online labs, online simulations and other educational resources are organised by inquiry based learning stages in a virtual learning environment.

Students working on their IBL class on Refraction & reflection of Light.

One of the first outings included a cultural trip to one of Portugal's most beautifully preserved medieval hilltop towns Évora where we visited the 16th century Church of Graca, the best-preserved Roman monuments in Portugal the Temple of Diana and the Capela dos Ossos (chapel of bones). We also visited the megalithic sites of Almendres, the Anta Grande Zambojeiro Dolmens and the pre-historic monument Cromelach. We went stargazing on two occasions during out trip, once to explore the stars over Cascais and another day we examined the sun for solar flares. On our last day in Portugal we visited a" classroom of the future" at the secondary school Escola Secundária Dom Manuel Martins, in Setúbal. Here we went through an IBL scenario on sustaining life on Mars.

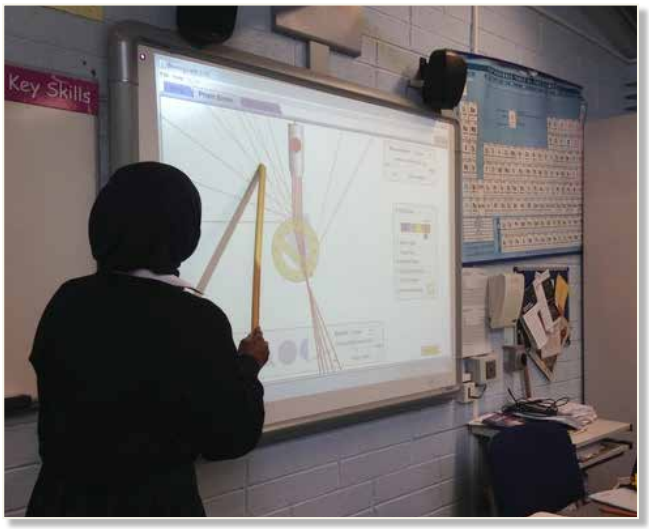
Using the SkyView App to search for the Irish summer sun!

Since their return our science teachers are implementing inquiry based projects with their science students on a number of curriculum related junior certificate science topics. In March this year our students took part in the international Eratosthenes experiment with 350 schools in 37 different countries. Our students used eLearning tools and instruments to measure and calculate the circumference of the earth. Our school shared our data with a number of schools across Europe and Morocco. Sadly the autumnal equinox day in September was too cloudy to share any data with our international counterparts.

The ISE co-ordinator in Coláiste Bríde led a summer camp with local primary school students in conjunction with the School Completion Programme in July. The young astronomers made sundials, located cardinal points, constellations and searched for planets using the iPhone app SkyView. One of the highlights of the summer camp was Terminal Eleven, the makers of the SkyView app, tweeting us @ise_CB to say that they were 'ecstatic' we were using their app for education purposes. On the second day the students explored the Solar System using the free astronomy software Stellarium. They explored the sky at night on their birth dates, looked for shooting stars, the moon, the milky way, explored time travel, re-lived the recent solar eclipse in March 2015, saw the night sky for their birth dates, examined the surface of the moon.

Searching for solar flares using NUCLIO's telescopes.

The ISE team in Coláiste Bríde are monitoring our students throughout the course of the ISE project. A 6th year physics class reported that using the eLearning tool Worldwide telescope to conduct a project was 'fun and educational'; 'fun way to learn'; and 'interesting and helpful'. 57% surveyed reported a higher level of confidence using ICT, 86% found it enjoyable, 100% said it was an easy way to learn and 86% would recommend the IBL class to their friends. 86% of the primary school students surveyed found using IBL with the eLearning tool Stellarium an easier way to learn about Astronomy, 100% had never used an elearning tool prior to the summer camp, 43% reported that the eTool helped them understand a Science topic. When asked would they like to study Science in secondary school, 50% reported yes, 29% reported no and 21% were unsure.



Student presenting results of a group investigation

Our project ends at the end of December 2015 and we intend to squeeze in a few more activities during our Science Week celebrations. We highly recommend any primary or secondary school to apply for the Erasmus+ funding through Léargas.

Follow Coláiste Bríde's Science Department on twitter @ ise_CB. For any teacher interested in the Inspiring Science Education project visit http://inspiring-science-education.net/. For more information on how to apply for an Erasmus+ mobility, visit http://www.leargas.ie/.

Karen Hopkins, Coláiste Bríde ISE school co-ordinator

Story of a killer

Paul Holland

Starting in the 1700s, maybe before, people in northern Italy began to notice a new disease. It started with dermatitis and diarrhoea, in some cases proceeding to dementia and death. Popularly known as 'pelle agra' (rough skin), it acquired the name pellagra. Nicknamed the Italian scurvy, its symptoms were sometimes compared to those of leprosy. In those days, the only treatment – if any – was confinement in a lunatic asylum. Ironically, while there, many people recovered enough to be released, only to suffer relapse and death after a time at home.

Medical knowledge was rudimentary but patterns became evident. Pellagra was a poor people's disease. It occurred in areas where a lot of maize was grown. Maize had been introduced from the New World. It was a very high yield crop and its short growing time meant it could be planted in a season if a wheat crop failed. Maize growing was expanded at the expense of wheat and rice. Major changes also took place in agriculture.

Man suffering from pellagra, showing typical skin lesions. (Image: Wikipedia)

Landlords developed lucrative cash crops (such as maize). Peasants paid rent to the landlord rather than run their own holding. Maize became their staple and at times like winter and spring was often the only food they had. (It was baked into polenta, a type of cake)

There are parallels with Ireland and the potato, but the disasters were of a different nature and magnitude. Maize is a fine food but it is deficient in niacin (nicotinic acid). The temporary recoveries achieved at the lunatic asylums came down to the fact that, bad as the diet people were on in these places, it was more balanced than what they got at home.

By 1880, nobody denied that maize and pellagra were correlated but what was the link? Clodomiro Bonfigli, director of a lunatic asylum, identified poverty as the real problem. He argued that poorer people needed to have more than a maize-dominated diet. This would require changes in agricultural practice which might not suit vested interests. Maybe that's why the government leaned towards the view of Cesare Lombroso, a lecturer and insane ward director. He claimed that poison produced when maize or polenta became mouldy was the culprit (He never found the poison). Acting on this theory only required some new food regulations – which took decades to implement anyway. By then, a stronger economy and social structure was improving matters all round. With the onset of World War 1, wheat imports multiplied and pellagra in Italy became history.

Science too had improved. Insights were growing into the causes of disease. In 1912 a Polish scientist K. Funk was researching beriberi – he established that the process of husking rice eliminated a "vitamine" (vital amine), resulting in a deficiency in the diet that led to symptoms. At last, a lot of medical conditions were actually understood and could be more easily prevented or dealt with.

Pellagra was also a problem in poorer parts of the USA in the early 1900s. "It's an ill wind....." , boll weevils destroyed cotton crops forcing farmers to diversify. They planted more food crops and buried pellagra. Once again the old advice about nutrition – a bit of everything, too much of nothing – is proven sound, and doesn't require too much intelligence to apply either.

The story of pellagra has many lessons which are relevant to this very day.

Paul Holland, formerly Presentation College, Galway

Reference

History Today magazine, September 2014.

Irish Primary Teachers Prepare for Space.

Carla Hayes

For the first time this year, the European Space Agency (ESA), opened up its annual **Summer Teacher Workshop** to primary school teachers. The Workshop was promoted in Ireland through **ESERO** (European Space Education Resource Office) Ireland and applications were welcomed from across the 22 ESA member states. Seven of the 50 (approx.) places available on this pilot programme were secured by Irish primary school teachers from Dublin, Cork, Mayo, Tipperary and Waterford.

The three day event focused on bringing space to the classroom took place at the European Space Research and Technology Centre (ESTEC) in the Netherlands from 8th to 10th July. This year the programme was built around five key topics: Gravity, Rosetta, Planet Earth, Light and Human Space Explorations. Lectures and workshops were delivered by space experts from around the world, including Dr Matt Taylor the Project Scientist who landed Rosetta, ESA's Philae probe, on Comet 67P/Churyumov-Gerasimenko last November.

After his address, primary teachers on the course conducted a number of experiments that involved comets and were based on the Rosetta mission. One of the highlights of that workshop involved testing a comet for water using custard.

Each theme was explored in the same way. Hands-on demonstrations and "mini-missions" followed an address from a key-note speaker. Of course there was a little help from Paxi, ESA's educational mascot, an "explorer" from another planet here to help children (and teachers) learn about space.

The final theme of the conference, Human Space Explorations, was introduced by Andre Kuipers, the first Dutch astronaut who returned to space for a second time. His latest mission is to bring more STEM learning and technology to every classroom. In his address to the Conference Kuipners referenced almost every subject on the primary school curriculum as he shared his inspiring story. From his training days at space centres in Houston, Moscow, Cologne and Tokyo to successfully completing two Soyuz missions to the ISS, Kuipers made reference to history, visual arts, geography, English, maths SPHE and of course science lessons. Afterwards primary teachers, assisted by Portuguese ESA education experts, set up and demonstrated experiments to investigate food and space, including one that simulated the experience of eating in low gravity conditions.

This week exceeded my expectations. ESA's new primary schools programme really brings space in the classroom to whole new level. It is very child orientated and teacher friendly. I'm really looking forward to the next school year when, with the help of Paxi, I can begin to apply what I have learned to the benefit of the children.

After three stimulating days, the teachers returned home with lots to think about and assimilate. Their task now is to share their knowledge with their students, colleagues and parents. They will continue to work with ESTEC Ireland to develop techniques to optimise children's engagement with space in the primary classroom. The aim is to inspire more children to develop a fascination with STEM subjects and to encourage them to continue their studies through second and third level.

Carla Hayes, Bayside Junior School, Sutton

All-Ireland Pollinator Plan 2015-2020

Ireland is buzzing as 68 organisations come together to save our Bees

Dr Úna Fitzpatrick

If you're an Irish farmer growing strawberries, tomatoes, apples or oilseed rape you'll know how important pollinators are. Without them you'll see greatly reduced yields. The annual value of pollinators for human food crops has been estimated at €153 billion world-wide, and at least €53 million in the Republic of Ireland. The free service they provide is worth over £7 million per annum for apples in Northern Ireland and €3.9 million for oilseed rape in the Republic of Ireland.

If pollinators died off, it would be impossible to grow your own fruits and vegetables. Peas, beans, courgette, pumpkin, currants, raspberries and many others all need to be pollinated. It's not just crops; about three-quarters of our wild plants also require insect pollinators. Without pollinators the Irish landscape would be a very different and much less beautiful place. Their contribution to tourism and branding our produce abroad is enormous but often goes unrecognised.

Bees are our main pollinators. This is because they are entirely dependent on plants for their food. The young are fed exclusively on pollen, and the adults rely on nectar as an energy source. Whilst feeding on flowers, bees transfer pollen between flowers and so act as pollinators.

In Ireland, we have 98 different bee species. This includes the honeybee; 20 different species of bumblebee; and 77 different species of solitary bee. Research tells us that to maintain pollination you need healthy honeybees in combination with

Solitary bee *Megachile willughbiella* ©Steven Falk

a diversity and abundance of wild bees. In the UK it has been shown that if all honeybee hives were used for crop pollination, they could only provide about one third of the service required by crops. The rest is provided free of charge by wild pollinators.

Without pollinators we won't starve, but it would be much more difficult to have a healthy balanced diet rich in fruits and vegetables. Bees need the same things we all do - somewhere safe to live and enough food to feed themselves and their families. Unfortunately we're not providing that anymore in Ireland, yet we're still expecting them to carry out pollination when we need it.

We know bees are declining. One third of our 97 wild species are threatened with extinction in Ireland. We know it's because we've drastically reduced the areas where they can nest and the amount of food our landscape provides for them. We've also inadvertently introduced pests and diseases that negatively impact their health, and we subject them to levels of pesticides that make it difficult for them to complete their life cycles.

If you're a pollinator, finding enough food is the biggest challenge you face. Declines in wildf lowers are subjecting our pollinators to starvation. This is partly due to changing farming practices, but our tendency to tidy up the landscape rather than allowing wild flowers to grow along roadsides, field margins, and in schools, parks and gardens is also playing a big part.

By taking small actions to provide bees with food and shelter across the landscape we can tackle the problem, but it requires all of us to help - from farmers to local authorities, to schools, gardeners and businesses. We can stand back and watch the problem happen, or we can try to do something. The All-Ireland Pollinator Plan is about coming together to try and create an Ireland where pollinators can survive. It's a shared plan of action. By working together, we can collectively take steps to reverse pollinator losses and help restore populations to healthy levels.

In publishing the Plan, Ireland becomes one of the first countries in Europe to develop a strategy to address pollinator decline and protect pollination services. The Plan was developed by a 15 member steering group and identifies 81 actions across five objectives. Sixty-eight governmental and non-governmental organisations have come together to support the Plan. Responsibility for delivering the 81 actions has been shared out between the supporting organisations, who include: Department of Agriculture, Food & the Marine, Teagasc, Bord Bia, Northern Ireland Environment Agency, Heritage Council, Fáilte Ireland, An Taisce Green Schools, Federation of Irish Beekeepers' Associations, Iarnród Éireann, National Trust, Tidy Towns, Ulster Farmers' Union, Ulster Wildlife, and Waterways Ireland.

The Pollinator Plan proposes taking action across five objectives:

- Making Ireland pollinator friendly (farmland, public land and private land)
- Raising awareness of pollinators and how to protect them
- Managed pollinators – supporting beekeepers and growers
- Expanding our knowledge on pollinators and pollination services
- Collecting evidence to track change and measure success

The main objective of the Plan is to start making Ireland pollinator friendly by taking actions on farmland, public land and private land. If we want pollinators to be available to pollinate our crops and wild plants for future generations we need to manage the landscape in a more sustainable way and create a joined-up network of diverse and flower-rich habitats as well as reducing our use of chemical insecticides. This doesn't just mean in the countryside, but in our towns and villages as well.

It's about taking small actions on farms like maintaining good quality flowering hedgerows to provide food and shelter for bees. It's about moving away from the 'lawn and lollipop' approach of short grass and occasional trees in many of our public parks. It is not difficult to understand that as a consequence they provide little nesting habitat or food for our pollinators and other biodiversity. It's about allowing wild flowers to grow along transport routes to create pollinator highways across Ireland. It is not about allowing all public land to 'go wild' but rather taking small actions, where appropriate, to achieve a more sustainable balance.

It's also about schools, and seeing outdoor spaces, however small, as potential pit stops for our busy bees. In time for next spring, when wild bees are coming out of hibernation, clear guidelines will be available on simple actions that can be taken on school properties to make them more pollinator friendly. These won't be costly, but rather small management changes that can help provide bees with food and shelter. The Plan is supported by An Taisce Green-Schools who will help roll out this initiative.

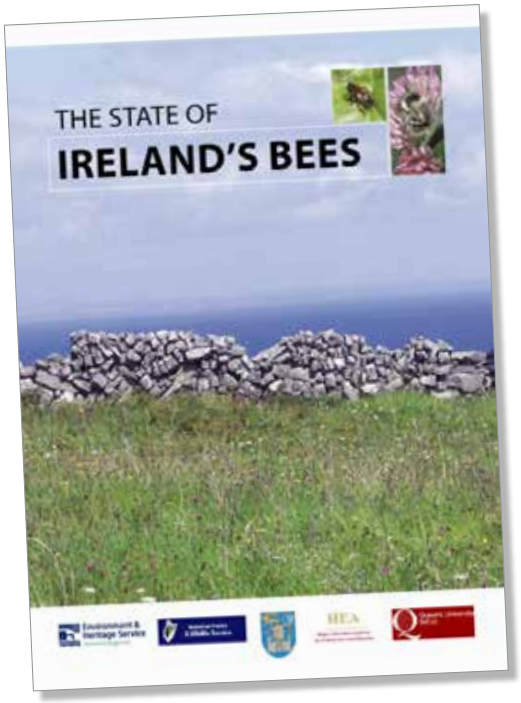
Raising awareness is an important component of the Plan. Nowhere is this more relevant than in the education sector. It is planned that the suggested actions that can be taken on school properties, will be tied closely into freely downloadable lesson plans for all age groups on bees, pollination and general environmental issues. These will be developed over the life of the Plan by the steering group and relevant supporting partners.

The Pollinator Plan is not just about protecting bees. It's about protecting the livelihood of farmers and growers who rely on their free pollinator service, and protecting our own ability to go into a supermarket and buy Irish fruit and vegetables at an affordable price. It's about protecting the wild plants who depend on insect pollination. Those wild plants provide fruits, seeds and shelter for our birds and mammals, and habitats that enhance many other animal populations. In coming together to take action to protect pollinators, we not only make crop production more sustainable, but we help protect the general health of our environment. http://www.biodiversityireland.ie/pollinator-plan

Dr Úna FitzPatrick

National Biodiversity Data Centre

Chair of the All-Ireland Pollinator Plan Steering Group



This booklet can be downloaded as a PDF from http://www.biodiversityireland.ie/projects/irish-pollinator-initiative/bees/the-state-of-irelands-bees/

Concept Mapping- a tool to assist in the learning and assessment of Primary science

Padraig Egan

One of the main aims of the Primary Science curriculum should be the development of two types of understanding; conceptual understanding and procedural understanding.

Children's conceptual understanding is concerned with the development of scientific knowledge and with their deepening understanding of fundamental scientific ideas'. (DES, 1999). A concept map is a practical versatile educational tool useful in eliciting, representing and assessing pupils understanding. The process of constructing a concept map is a very effective teaching and learning strategy which is graphic in nature, encouraging the learner to think and focus on the relationships between terms (Liston, 2012). Concept maps can provide a graphical summary of pupils ideas, understanding and what they have learned, with an emphasis on the relationship between different concepts (Nowak and Gowin, 1984)

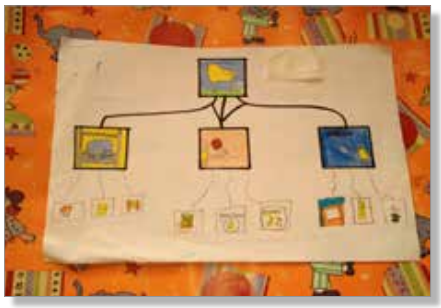


Fig. 1. A pictorial concept map

What is a Concept Map?

Concept maps are graphical tools for organising and representing material. They can be two dimensional hierarchical diagrams which illustrate the relationships between and among individual concepts their purpose is to link new knowledge to knowledge already possessed and as such are not only a learning tool but can also be used as an assessment tool showing a teacher what a pupil knows. A concept map begins with a general idea which is displayed at the top of the map and then develops into a hierarchical structure by working its way down to more specific knowledge or understanding. Links between concepts are shown by the hierarchical structure in which the lower concepts are beneath those of the higher levels. Different relationships between concepts are identified using cross links.

Concept maps in science education

In science education, concept mapping has been widely used in a variety of ways. It has been used to help pupils build and organise their knowledge base in a given topic. It can also be used as a study tool for synthesising information from a variety of sources. Concept maps engage the learners in the construction of knowledge by linking sub concepts to more general, inclusive and abstract concepts thus bringing about meaningful learning. Concept mapping has not only been found useful in promoting pupils' understanding of science concepts, it also facilitates pupils abilities to solve problems and to answer questions.

Concept mapping can also be used with the very young child and right through primary school. Stow (1997), for example, shows how concept mapping can help children focus on their own learning and hence provide a simple framework for young children to review and celebrate their achievements in science. Stice and Alvarex (1987) demonstrate that concept mapping is not only a useful revision tool for young learners but can also be a means to show pupils that knowledge is more then facts. Primary grade pupils are capable of developing very thoughtful concept maps which they can explain intelligently to others. (Symington & Novak, 1982). Novak, Gowin & Johansen (1983) found that first and second class science pupils who used concept mapping demonstrated superior problem-solving performance after six months of use. Teachers can examine how well a student understands science by observing the sophistication of their concept map. Teachers can also observe gaps in learning and modify lesson plans based on the information from students' concept maps (Vanides et al. 2005).

Examples and the use of concept maps

- Concept maps can be used to demonstrate the many uses of, for example, a simple farm animal such as a hen.
  - The hen provides us with eggs, meat and feathers (as demonstrated in Figure 1).
  - Eggs can be used for a variety of things such as baking cakes, frying and on their own e.g. boiled.
  - The meat of the hen can also be used e.g. nuggets, wings, breast etc.
  - The feathers can be used for art, pillows etc.

A concept map can be illustrated in various ways from drawings such as in Figure 1 or else the older classes can use 'post it's' as demonstrated in Figure 2 (next page).

How to use Concept Maps

Prior to using concept maps, in the science classroom the teacher must gain experience in using them. It can be helpful to engage in the concept map process with another colleague. A brain storming session using a map can be used and together confidence can be built in undertaking the maps.

The following steps can be undertaken in constructing a concept map within a lesson:

1. Decide on what topic you want to explore. The focus question is important to guide the students on what they need to know. The teacher should hold a group discussion, and ask the children to discuss what they have learned through the exploration of the topic.
2. The students should be encouraged to create their own maps and construct their own meaning based on discussion and observation 'honeybees' and 'castes'.
3. The pupils will then be asked to review their maps in small groups. The children will be asked to share their ideas and to find any similarities or indeed differences within their individual maps, they will be encouraged to discuss these and come to a conclusion on what they feel are the most important aspects of their concept maps.
4. Each group will be asked to discuss their concept map with the class and a whole class map can be developed.

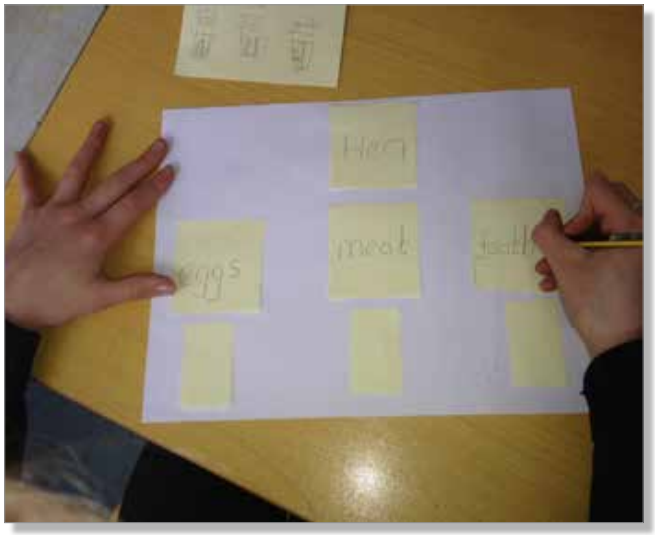


Figure 2

Other ways of using concept maps in the classroom

Concept mapping can be undertaken as a whole class, individual or group activity. The maps can be constructed using words or pictures. There are also a number of database packages that that can be utilised for designing and modelling how to construct concept maps: **2Investigate**, **Textease**, and **Flexitree**,. Concept maps are a very successful resource to promote more effective teaching, learning and assessment in science. In general teachers find them highly motivating and provide much opportunity to stretch students' ideas. Teachers will find once they use them they will begin to look to elsewhere in the curriculum where they can be utilised.

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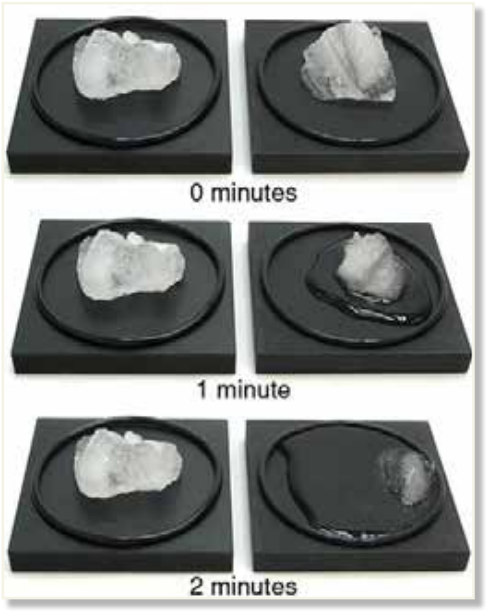
Every Lab should have one — "Amazing ice melting blocks"

Richard Fox

I picked up a pair of these blocks at a science fair somewhere over the years. I know that that is not very helpful but I can see that they are available from the "Amazon" and "teachersource.com" websites. They weren't the easiest to find on these websites, but I found them eventually with the search facility by typing in "Amazing ice melting blocks". Having said that, they are relatively expensive for what they are, so industrious teachers might make up a pair or class set. I find them very useful when covering the heat section of the Junior Cert course.

What are they? Well they are two blocks, that from a distance look identical. They have similar dimensions and are painted black. However, they are made from different materials. One is usually wood painted black and the other is usually metal painted black.

When you place an ice cube on each of them, at the same time, to make it a fair test, they start to melt. The ice on the metal block melts significantly faster than the one on the wooden block. The metal is a much better conductor of heat from the desk into the block of ice than the wood, which is a good insulator of heat. I find it very useful when discussing conductors and insulators of heat. I then clean up the ice and water and ask the students to touch the blocks and ask them quietly to estimate the temperature of what they are touching. The vast majority of students will say to you that the metal is very cold and perhaps estimate its temperature to be about 0°C. They will say that the wood is warm and estimate it to be 20 or 30 °C. I then ask them to measure the temperature with a thermometer and they are quite surprised to see that both are at room temperature of about 20 °C.



It often comes as quite a shock to them that most things in the room are at the same temperature.

Richard Fox,
Wesley College

Who do you think you are kidding Mr Caesar?

Paul Holland

Christ was around by AD 9 but it's unlikely the Roman Emperor Augustus Caesar had heard of him. Had he believed in Christ or Santa, Augustus would probably have asked for the return of the 17th, 18th and 19th legions, lost in one of Rome's most catastrophic defeats at Kalkriese, near present-day Osnabruck in Germany. The site has only been conclusively identified in recent years and reconstructed for people to see, imagine and wonder on the might have been.

In 56 BC, Julius Caesar clashed with German tribes. Rome built up garrisons on the Rhine extending up towards the North Sea. Raids into Roman territory were a nuisance and both Julius and his successors came to the view that the frontier should be advanced to the Albis (Elbe). Troublesome tribes would be subdued and the perimeter of the empire would be shortened, requiring fewer frontier garrisons. Invading armies led by Drusus and Tiberius defeated German tribal armies, not without some close calls. The going wasn't easy in a land of forests and swamps which lacked infrastructure and where severe weather precluded winter campaigning.

In 3 BC a Roman force crossed the Elbe. The reception Rome got was mixed with some tribes outright friendly, others hostile and others, more dangerously, ambivalent. It was clearly going to be a long time before Germania Major became a full-blown province of Rome. For the present, it was scattered garrisons and outposts – a military district. Taxes were collected and hostages for good behaviour were brought to Rome, one of them a youngster the Romans called Arminius.

The Germans were well-received in Rome, many of them serving in the Imperial Guard. Arminius got an education and served on campaign with the Roman army. He was a fast learner and would have been a good scientist. He observed what made the legions so formidable and hypothesised on how they might be beaten. Most likely, he was well on the way to testable theory by the time he became a trusted lieutenant of Varus, the Roman commander appointed to Germany in AD 7.

In the summer of AD 9, Varus took 3 legions across the Rhine along the Lippe river valley. He cut a path north and established a camp near the Weser in the territory of the Cherusci, Arminius' tribe. The few scant accounts indicate that he arbitrated in local disputes while his force collected taxes and engaged in engineering work. The Germans may have appreciated the material development but resented the imposition of a foreign culture. Scattered parties of Romans were massacred. Varus did not realise that Arminius was the instigator. By September, the Romans were ready to return to their winter quarters on the Rhine by the way they had come. There was trouble to the north and now Arminius proposed to Varus that he detour in that direction both to reassure wavering tribes and put manners on the rebels. Not every Roman trusted Arminius and the local chief Segestes (whose daughter had eloped with Arminius) privately warned Varus that he would be heading into a trap. Varus wasn't convinced and, to encourage his troops, promised them plenty of booty when they swept aside the rebels. The die was cast.

The legions set out into dense forest. Arminius and his German cavalry left them, ostensibly to muster support among loyal tribes. Within a day or so, the attacks began. On the congested forest paths, blocked by felled trees, the Romans were strung out and were gradually picked off. Bad weather intervened and soon the Romans were abandoning wounded and destroying supplies they couldn't carry. Over a few days, their situation became catastrophic. Patrols sent to find Arminius were destroyed by him. Finally the Romans advanced between forested hills and a swamp. To their side was a rudimentary rampart manned by tribesmen blocking their progress – they couldn't eliminate it. Arminius himself came in for the kill but, by then, Varus and his senior officers had fallen on their swords. Arminius made a present of Varus' head to a chieftain Maroboduus who, sickened by the whole affair, sent it to Rome. The remaining Roman garrisons east of the Rhine were annihilated but one of them succeeded in fighting its way to safety. Augustus in his final years often cried to himself "Vare! Vare! Rede legiones!" (Varus, give me back the legions)

Within a few years, the Romans returned to Germany east of the Rhine, defeated Arminius and his armies and, by AD 41, recovered the last of the captured Imperial Eagle standards. Arminius himself was killed by some of his own associates in AD 21. But although the Germans were defeated, they were not subdued and the entire venture was abandoned as being too costly for any gain that might be achieved. For similar reasons, Scotland (Caledonia) remained unconquered by Rome.

Christmas was never to come to the Roman province of Germania Major.

Note: There are many forested hills and swamps in that part of Germany so for centuries nobody was sure where the fighting had been. The discovery of large quantities of slingshot – used by the legions but definitely not by the German tribes - finally settled the issue.

Paul Holland,

formerly of Presentation College Galway

Frontiers of Physics 2015 in NUIG

Paul Nugent

Almost 90 teachers, student teachers, presenters and exhibitors converged on NUI Galway on September 19th for the 15th annual IOP Ireland Frontiers of Physics Teachers Conference. The event, which is supported by the Professional Development Service for Teachers, combines cutting edge physics with practical workshop sessions.

Keynote speaker, Prof Frank Close gave a riveting account of Bruno Pontecorvo, the father of neutrino astronomy and a brilliant nuclear physicist, who disappeared through the Iron Curtain at the height of the Cold War.

Many aspects of physics were highlighted by speakers from NUI Galway including Dr Miriam Byrne, speaking on the quality of air in schools, Dr Matt Redman on our astrophysical origins and Dr Mark Foley on biomedical physics, while Dr Veronica McAuley and Martin McHugh from the School of Education spoke on teaching and learning with videos and 'hooks'.

Complementing the highlights of physics research were practical sessions on bringing physics to the classroom These workshops were designed to be suitable for all teachers of physics including teachers of Junior Cert.. Science. These included International Year of Light with Sean O'Gorman, Eleanor Nolan on CERN and particle physics, Rebekah D'Arcy on states of matters while the *Science on Stage* team had series of demonstrations and ideas that they had picked up at the recent *Science on Stage* event in London. (Submissions for *Science on Stage 2017* have opened.)

The event closed with a session reviewing and discussing the 2015 Leaving Certificate physics papers and marking schemes.

Many thanks to all the presenters who are making their talks available on **www.talkphysics.org**

With almost 20 exhibitors at the event there were also plenty of opportunities to pick up helpful materials and resources for teaching.

Planning for ***FoP2016*** has already begun. It will be held on 24th of September 2016 in the new campus of DIT Grange Gorman.

Paul Nugent

Photonics Explorer: a new tool for practical activities in light

Sean O'Gorman and Seosamh Ó Braonáin

Sean O Gorman of NUIG writes about a new programme and practical kit for the support of learning about light, while Seosamh Ó Braonáin gives some examples of how he has used the kit in the classroom this term.

EYEST (http://www.eyest.eu/) is a Belgium based non-profit organization established in November 2011 by members of the Brussels Photonics Team of the Vrije Universiteit Brussel and dedicated to ' Excite Youth for Engineering, Science and Technology'.

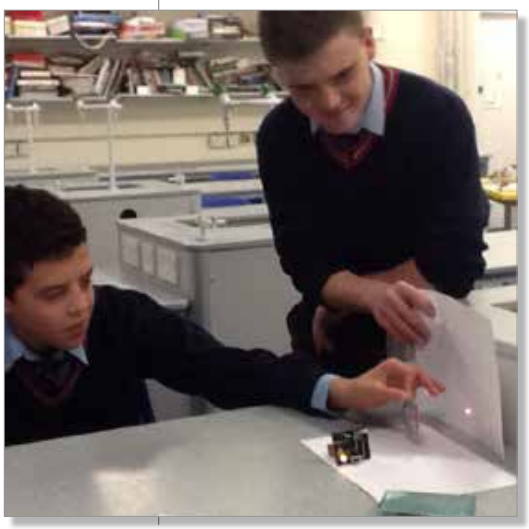
The mission of EYEST is to raise the interest of young people towards science, engineering and technology by creating and disseminating educational programs and by supporting teachers in their endeavour to convey the fascination of science and engineering to pupils and students, and as such to inspire the next generation of scientists and engineers. The development of EYEST's educational programs is financially supported by sponsoring companies and governments and they are made available to teachers, students and schools completely free of charge. EYEST is currently responsible for the fundraising for and the assembly of the Photonics Explorer kit as well as for its distribution throughout Europe . The Photonics Explorer kit is an intra-curricular educational kit for secondary schools and given to teachers in conjunction with teacher training courses.

As a member of the GoPhoton initiative (gophoton.eu) during this special year of celebrating light, I am delighted to act as a local associated partner of this initiative and agreed to contribute by running a workshop during the Frontiers in Physics weekend in NUI Galway. I got a fantastic response from the teachers involved with very positive feedback, with many kits being handed out and more on the way from Belgium. It was so encouraging to see the enthusiasm for improving the physics education in our schools and promoting knowledge about Science in general but in particular Photonics. We want everyone to know the answer to the questions: What is Photonics? Why is it important? The fact is that light and light based technologies pour into every aspect of our modern lives and many of us are oblivious to their importance. By spreading a practical knowledge of the intricacies of light, the Photonics Explorer aims to spark the interest of the students (and the teachers) involved in Photonics. Of course we hope it spreads further so that everyone starts to embrace the power of light, celebrate light in your own way this year. We hope to see you at the **Galway Science and Technology Festival at NUI Galway** where we will be running our **PhotonicSplash (19th-22nd Nov.)** with lots of fun Photonics Shows, talks and events.

Sean O Gorman, NUIG

The Photonics workshop at **Frontiers of Physics 2015** was a great hands-on introduction to the use of the Photonics Explorer kit. This year I have introduced a new five-week module in Transition Year on Waves and Vibrations in my school and I was looking in particular for investigative activities to explore the wave nature of light. I was fortunate to be able to obtain one of the kits and immediately put it to use in the following weeks in this TY module. The set of neat, small (eyesafe) lasers along with the polarising filters allowed an excellent investigation on the polarisation of light by a sugar solution. It was also straightforward to show diffraction and interference with the diffraction gratings supplied and to extend this to measuring the thickness of a human hair using a diffraction pattern. A CD with the kit had excellent worksheets and teacher notes, including on safety.

I have also used the lasers with some of my Junior Cert. Science and Leaving Cert. Physics classes to work on refraction, including total internal reflection.



I can certainly recommend any interested teacher to take any opportunity to get involved in a workshop on the Photonics Explorer kit.

Seosamh Ó Braonáin, Wesley College and Physics Editor of SCIENCE

CROSSWORD

Randal Henly

Clues Across

1. This type of chemical reaction absorbs heat (11)
1. Red, green and blue (7,7)
9. Cyan, magenta and yellow (9,7)
10. One of the main classes of living things (7)
11. Sodium, or a football team! (6)
12. The indigo plant or the blue ye obtained from it (4)
13. A detector of a physical property (6)
16. Morning time in an example (2)
17. In short, 22/7 (2)
18. This natural product is a mixture of fructose, glucose, maltose and water (5)
20. The 0.1 prefix (4)
21. The twin brothers Castor and Pollux in the Zodiac (6)
23. Flows of fluids or electrons (8)
24. Flatten using an old coal-powered machine (9)
26. Nicest changed to six legged (6)
27. Large flightless bird in the femur (3)
28. Metallic policemen (7)
30. A time of year when the Sun reaches its highest or lowest point at midday (8)
32. Sets of organs in the body each with a common function (7)
33. Violently rotating column of air connecting a cumulonimbus cloud to earth (7)

Clues Down

1. Blaise, the French scientist after whom the SI unit of pressure is named (6)
2. A sloping surface or plane (7)
3. Hardens a metal by alternate heating and slow cooling (7)
4. Units of time (5)
5. A vital element (6)
6. A barrier in the Earth's stratosphere (5,5)
7. It is caused by the lack of Vitamin C (6)
8. Huge sea wave caused by a marine earthquake (7)
13. A human sense (5)
14. Horizontal underground stems from some plants (7)
15. The mammary glands of cows and other animals (6)
18. You'll find it in vinegar (6,4)
19. It's common to both an atom and a cell (7)
22. Resistant to a particular infection or toxin (6)
24. Aromatic or pungent mixtures from some vegetables (6)
25. Blows up like a volcano (6)
26. A snow house (5)
29. Male sheep (3)
31. Metal element found in the actinides (3)

Winners — May 2015

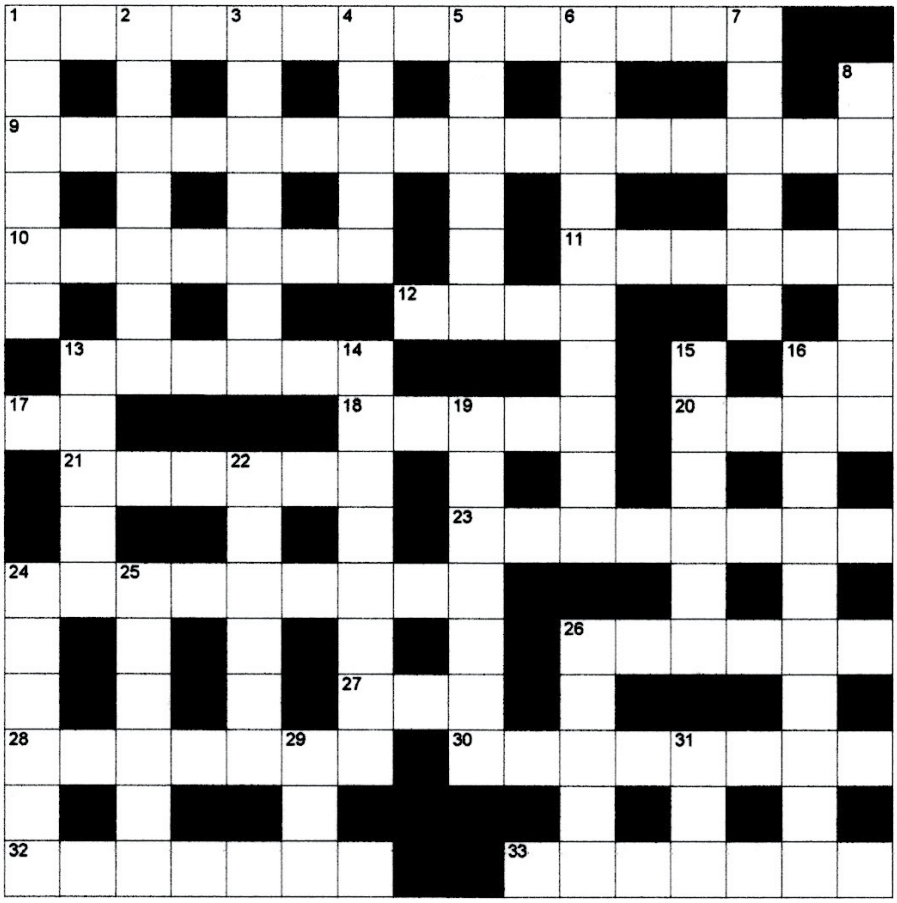
The first correct entry was emailed by CBS Roscommon Science Department: Breege Grennan, Fiona Leavy and Louise Gallagher — proving that three heads are better than one when it comes to crosswords.

Congratulations.

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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