
Contents

1.	Contents	
2.	Editorial #108	
3.	Education News and Views	
5.	Spectroscopy in a Suitcase goes national!	John O'Donoghue
7.	STeP into Science: Engaging Student, Teachers and Guardians in Debates	
	Regina Kelly, Sibel Erduran, Grainne Walshe, and Liam Guilfoyle	
8.	Proceedings ChemEd-Ireland 2015	
9.	Cool Chemistry: Learning About Instant Cooling Packs in Chemistry Lessons	Marc Stuckey & Declan Kennedy
18.	Liquefaction of Air in the Leaving Certificate Chemistry syllabus	
		Donnacha O'Connell
24.	A Limerick Periodic Table: 7 Nitrogen	Peter Davern
25.	TEMI: Reports on the Leiden Conference, 2016	
29.	Implementing Changes towards Inquiry-based learning	Brigid Corrigan
34.	Specific Gravity: The 'Ryder' Method	Adrian J. Ryder
36.	Elementary Chemistry	
39.	Chemical Education in Ireland: 2015-2016	Peter E. Childs
44.	The Instrument Makers No.10 John Joseph Griffin	Adrian Ryder
47.	Chemical Quotations: #7 John Dalton (1766-1844)	
48.	Places to visit: Allihies, West Cork	
55.	Chemical Anniversaries: John Dalton 1766-1844	Peter E. Childs
57.	Conference Reports	
62.	E-learning from Nature: An Erasmus+ Project	Marie Walsh
63.	Diary 2016-2017	
64.	Chemlingo: what's in a name - nitre or natron?	Peter E. Childs
65.	Some organic acids (1)	
66.	Information Page	

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Editorial #108

A winter of discontent

An industrial dispute between the ASTI and the government has been rumbling all year. The temperature looks like heating up in the new school year. Not only is the ASTI refusing to cooperate with the introduction of the new Junior Cycle programme in any way (see below), but they have also rejected the Lansdowne Road agreement which has implications for salary payments, cover for substitution etc. In the worst scenario this may lead to school closures this Autumn as the ASTI is the dominant player in 2/3rd of Irish second-level schools. The other union, the TUI, has taken the opposite position on both issues. Once again the ASTI is taking a hard-line position and the dispute also illustrates the problem of having two unions representing one group of workers. This is especially problematic where two unions are present in the same school. This is not the case for primary teachers, where there is one union for teachers North and South, although it is also the case for third level academics, where 3 unions are involved.

New science course launches

The new JCSA science course starts this September, although only TUI members will have attended the in-service courses run by the PDST. The new course will start even in ASTI schools but the ASTI has refused to cooperate in any way with the new courses and will not undertake in-school assessment. Even though most of the grade will now depend on a terminal examination, a percentage of marks are intended to be based on in-school, teacher assessment. This is one of the sticking points for the ASTI, whose members do not want to assess their own students for external certification, even though they assess their students all the time. Schools where the TUI is the union, will be cooperating fully but a number of schools have mixed unions due to their history (Community and Comprehensive schools). A teacher cannot be a TUI member in an ASTI school and vice versa. This amounts to a recipe for confusion and for conflict in the coming school year. The first assessments for the new English course have a deadline this term and students will lose 10% of their marks if they do not do them.

The publishers have shown their confidence in the new Science course by launching no less than 6 new Junior Science textbooks on the market, given out at the ISTA conference in April in Limerick. It will be interesting to see how the different books fare in the very competitive schools textbook market.

The new course will also mean a new terminal examination and it will be interesting to see if the new examination will be in line with the philosophy of the new course.

The new science course is shorter than the old course by 15% (200 versus 240 hours) and there have been concerns that the content has been ‘dumbed down’. Chemistry without bonding is a case in point. If so, there is a major question about its suitability as a foundation for subsequent senior cycle science courses. These may now need to be ‘watered down’ from 2019 to match the new junior cycle courses, to avoid too large a jump in content and demand. This in turn raises questions about the suitability of the new Leaving Certificate courses from 2021 as a foundation for 3rd level science, engineering and healthcare courses.

In an age where there is increasing international competition for jobs in STEM areas, producing less well-prepared students from second level may not turn out to be a good bargain. I personally have never been convinced by the argument that ‘less is more’ and reducing the content and intellectual demand of courses is not an infallible recipe for producing more motivated and more capable students. At the end of the day, less is usually still less, and will make the job of third level lecturers even more difficult in turning out STEM graduates who can compete successfully in the international marketplace.

Peter E. Childs

Hon. Editor

STOP PRESS:

A new Government Action Plan on Education was launched on Sept. 16th and we hope to discuss it in the next issue. It has just one mention of STEM education and we are still waiting the long-delayed report of the STEM Review Group. **So much for the importance of STEM education to Ireland’s economy!**

Education News and Views

The Editor welcomes contributions and news of interest to chemistry teachers in this section.

Last outing for the Junior Certificate

On 14th September 2016 the last set of Junior Certificate (JC) results were issued. From next year students will get a Junior Cycle Profile of Achievement (JCPA), which will include other items besides the terminal examination results. English was the only subject at present where the new Junior Cycle was underway, but from this September the new courses in Science and Business Studies have started. By 2019 all 21 subjects will have been introduced, in 5 phases. Each subject will have a terminal assessment after 3 years (as at present), but also two classroom-based assessments in second and third years, assessed by the teacher. The element of teacher assessment is the main objection to the new courses by the ASTI union, whose members are not cooperating with the introduction of the new Junior Cycle. The new courses are starting anyway and the moment students in ASTI-controlled schools will lose their marks for school-based assessments. The ASTI members will also not participate in the CPD courses in preparation for the new courses.

The Junior Cycle for Teachers (JCT) is a support service for teachers and a separate team will be set up for each subject, as well as a headquarters team. (www.jct.ie) The science team is led by John Hennessy and the other members are Áine Woods, David King, Dónal Ó Laoire, and Eadoin Norris. One day's CPD has already been given and there will be a further day per teacher in the first 3 years of the new course. The new science specification, with 46 outcomes, can be found at: <http://www.juniorycycle.ie/Curriculum/Subjects/Science/Science>

2016 LC Science Results

The 2016 LC results published on August 17th showed a small increase in numbers and % share for Chemistry, and an even bigger jump for Biology. Agricultural Science continues to be the 3rd most popular science, although Physics numbers increased a little this year. The amazing thing about the Irish statistics is the dominance of Biology, with four times the market share of the other science subjects. Biology is the 4th most popular subject overall and the most popular of

the elective subjects. The gender differences are most marked in Biology (girls>boys) and in Physics (boys>girls), with a small excess of girls taking Chemistry.

A total of 55,708 students offered the LC in 2016.

Subject	HL	OL	Total	%
Biology	25,212	8,890	34,102	61.2
Chemistry	7,658	1,431	9,089	16.3
Ag. Science	6,270	1,624	7,894	14.1
Physics	6,003	1,749	7,752	13.9

For a graph showing % uptake since 2004 see p. 40.

2016 JC results

In 2016 a total of 60,247 students sat the JC examination. The three core subjects are English (99.1%), Mathematics (98.9% and Irish (87.2%), each offered at Higher, Foundation and ordinary level. Other subjects are only offered at Higher and Ordinary levels. Science is the 4th most popular subject after English, Mathematics and History. 55,471 students took science, 43,898 (79.%) at Higher Level and 11,573 (20.9%) at Ordinary Level. A high proportion of students take the Higher Level paper in science (79.1%), only exceeded by Geography (85.4%). Science is not compulsory but most students take it and so it provides a foundation for the 5 Leaving Certificate science subjects. At present over 90% of students stay on to take the senior cycle.

ChemEd-Ireland 2016

This year's ChemEd-Ireland conference is in Dublin City University on Saturday October 22nd, and is organised by Dr Odilla Finlayson. Contact odilla.finlayson@dcu.ie for more details.



TEMI is dead; long live TEMI

The FP7 project TEMI, Teaching Enquiry with Mysteries Incorporated, finished at the end of July 2016. (See issue #107, Spring 2016, for a special issue devoted to TEMI.) However, the TEMI team at the University of Limerick plans to continue

disseminating the TEMI idea as part of the legacy of the project, in the following ways:

- a) Workshops for trainee science teachers in UL prior to 4th year teaching practice;
- b) Articles and TEMI ideas in *Chemistry in Action!*;
- c) Workshops for ISTA branches during the 2016-17 school year;
- d) A workshop at the 2017 ISTA conference;
- e) Free access for teachers to ideas on the UL TEMI website as well as on www.teachingmysteries.eu;
- f) Free access to TY modules based on the TEMI approach.

For more information on c) and f) contact laurie.ryan@ul.ie for e) contact sarah.hayes@ul.ie

Nature of Science Symposium at UL

The Nature of Science (NoS) is a unifying theme of both the new Junior Science specification and the proposed new LC science courses. An international symposium on the topic, Nature of Science in Science Education, is being held at the University of Limerick through EPI*STEM, the National Centre for STEM Education, on October 26-28th, chaired by Professor Sibel Erduran. For information contact: helen.fitzgerald@ul.ie

RDS Primary Science 2017

In 2017 the Royal Dublin Society (RDS) is running a Primary Science Fair in Dublin (Jan. 12-14) and again in Limerick (January 19-21), with double the number of projects, and for the first time in Belfast (June 8-9). Full details from: www.rds.ie/primarysciencefair

EuCheMS DivChemEd News

As part of the ECRICE conference held in Barcelona 7-10 September (see p. 59), the EuCheMS Division of Chemical Education (the sponsoring body of the conference) held its annual Council meeting. The member countries submit annual reports on chemical education in their countries (see p.39). Dr Peter Childs is the Irish representative, on behalf of the Institute of Chemistry of Ireland. One of the Council's activities is to decide on the venue of future conferences, as it sponsors two series of conferences: the European Conference on Research in Chemical Education (ECRICE), which considers research in chemical education at all levels, and Eurovariety in University

Chemistry Education (Eurovariety), which focuses on research and practice in third level (university or college) chemical education. The next Eurovariety will be in Belgrade, Serbia from 27-29th June 2017 (previously it was held in Tartu, Estonia in 2015); the next ECRICE will probably be in Greece in 2018. The original plan was to combine ECRICE and the International Conference on Chemical Education (ICCE) in 2018, as was done successfully in 2012 in Rome. However, this plan fell through and the 2018 ICCE will be in Sydney, Australia. The Council discussed the matter and hopes that in 2020 ECRICE and ICCE will be combined in Germany.

New Institute of Education at DCU

The School of Education at DCU, St. Patrick's College, Mater Dei and the Church of Ireland College have merged into a new Institute of Education, located on the St. Patrick's College campus (DCU2). Dr Anne Looney, formerly Director of the NCCA, has been appointed the new Director of the Institute. CASTeL comes under its brief and it now involves 25 staff members, covering primary, secondary and tertiary level education. This makes CASTeL the largest science education centre in the country.

Professor Sibel Erduran leaves UL

In 2014 UL appointed Sibel Erduran as the first Professor of STEM Education and Director of EPI*STEM, the National Centre for STEM Education (the renamed NCE-MSTL). Professor Erduran came to UL from the University of Bristol and in January she takes up a post as Professor of STEM Education at the University of Oxford. Professor Erduran's research interests lie in the nature of science and in argumentation, and while in UL initiated a number of projects, for example the STEP project (p. 7). We wish Sibel well in her new job and hope that UL moves quickly to fill the vacant post.

Permission for Science Centre

In September it was announced that planning permission had been given for the new National Science Centre in the North Wing of the National Concert Hall in Earlsfort Terrace. It is expected to cost €13 million and will be open by 2018. Ireland is the only European country without a proper interactive science centre, so it is long overdue.

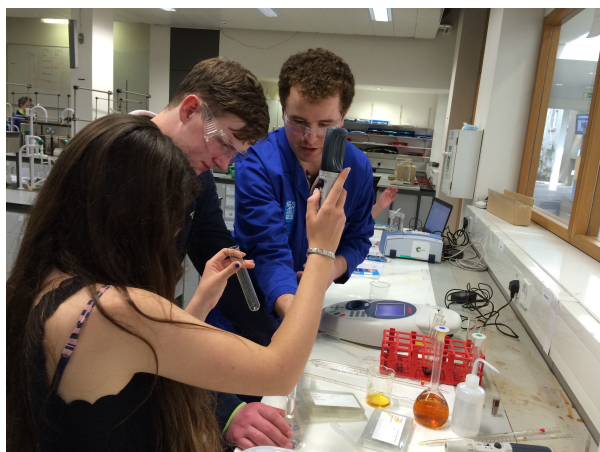
SIAS: Spectroscopy in a Suitcase goes National!

John O'Donoghue

RSC Education Coordinator, Trinity College, Dublin 2

John.odonoghue@tcd.ie

Spectroscopy in a Suitcase (SIAS) is a Royal Society of Chemistry outreach initiative which brings portable spectrometers into the classroom. It is currently run by three host institutions in Ireland (Trinity College, University College, Cork and Cork Institute of Technology) and coordinated nationally by the RSC Education Coordinator John O'Donoghue, who is based at the School of Chemistry in Trinity College Dublin. The free practical workshop focuses on the application of spectroscopy in a forensic investigation of a 'crime scene'.

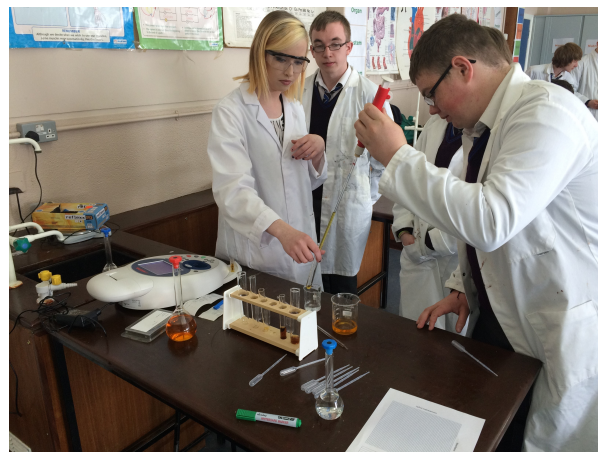


Amber TY Programme, TCD

Spectroscopy features on the Leaving Certificate Chemistry curriculum, but engagement with teachers informs us that it's a subject that can be hard for students to grasp without any context or equipment. SIAS gives school students the opportunity to learn about spectroscopy through our free hands-on workshop. As well as covering the principles of spectroscopic techniques, the activities use real-life examples to demonstrate the applications of the techniques and enrich the curriculum.

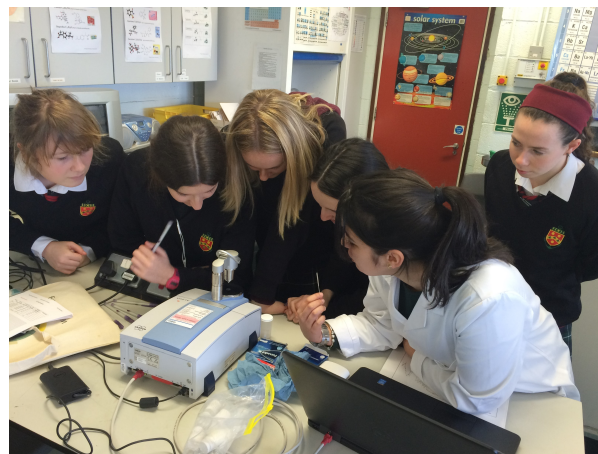
The 2015/2016 academic year was the busiest yet in Ireland with 130 sessions completed by our hard working SIAS Ambassadors from Trinity College Dublin, University College Cork and Cork Institute of Technology. We visited over

2,500 students in 95 schools across 14 counties in Leinster, Munster and Connacht.



New UL host at Athenry Vocational School

We also completed workshops within our host institutions for the ChemEd-Ireland conference, the Amber TY Programme and other Chemistry Summer School projects. Other trips this year include the Irish Science Teachers Association (ISTA) National Conference in Limerick, where we had our IR spectrometer on display for teachers to use, and the CALMAST Robert Boyle Summer Festival where we provided a SIAS workshop for TY students. We also ran a workshop during the Chemistry Demonstration Workshop in Limerick in June.



The High School, Zion Road, Rathgar, Dublin

Each host institution has access to portable IR and UV-Vis spectrometers which are commonly used in analytical chemistry laboratories for a variety of applications around the world. Bringing school students into contact with 3rd level institutions is a key aspect of the workshop, allowing budding scientists to ask questions about further study in chemistry and life in college. For many students, this is their first time meeting a chemist from outside their school. Hearing about these role models' experiences and research can give students the insight, confidence and encouragement to pursue a future in STEM. The programme also enables early career scientists (our SIAS Ambassadors) to gain experience of outreach, science communication and teaching activities.



St Joseph's Secondary School, Rush, Co. Dublin

Since the SIAS programme started in Ireland in 2014 it has seen increasing demand from schools all over Ireland. We're therefore delighted to announce that additional host institutions will be join us for the 2016/2017 academic year, thanks to support provided by the Science Foundation Ireland (SFI) Discover grant programme. In April the RSC provided ambassador training sessions for the new SIAS hosts in NUI Galway run by Peter Crowley, the University of Limerick run by Sarah Hayes, and University College Dublin run by Peter Evans. We would like to extend a massive welcome to our new SIAS host partners, who join the current hosts at Trinity College Dublin run by John O'Donoghue, University

College Cork run by Trevor Carey and Cork Institute of Technology run by Christine Nolan.

The RSC look forward to collaborating with all the host institutions to bring Spectroscopy in a Suitcase national for the 2016/2017 academic year. We are now taking bookings for the 2016/2017 year across all counties in Ireland. You can sign your school up here: <http://www.rsc.org/Education/SIAS/SIASBooking.asp>

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The RSC Education Coordinator in Ireland:

The RSC Education coordinator, Dr. John O'Donoghue, provides resources and assistance to all chemistry teachers in Ireland. John has experience in Chemistry, Education and Outreach across the island of Ireland. He gained his BSc and PhD in Chemistry from University College Cork and completed a postgraduate certificate at CIT in Business Management and Entrepreneurship. He also completed a postdoctoral Research fellowship at Queen's University Belfast in the area of Materials and Process Engineering. After working in the pharmaceutical sector for a time he moved into the education sector, teaching highly gifted children at the Centre of Talented Youth in UCC and DCU for over 5 years. Through his outreach and education activities he has worked with numerous Irish science organisations and spearheaded international events with NASA, EMC and KPMG.

The position of RSC Education Coordinator for the Republic of Ireland is based at the School of Chemistry in Trinity College Dublin, and John currently manages the activities of the Royal Society of Chemistry here with particular focus on supporting the education sector, communicating chemistry to the public and coordinating the RSC's presence regionally, including links to local member activities. He can be reached at john.odonoghue@tcd.ie

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STeP into Science: Engaging Student, Teachers and Guardians in Debates

Regina Kelly, Sibel Erduran, Grainne Walshe, and Liam Guilfoyle

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The STeP into Science project aims to facilitate the teaching and learning of the Irish lower second-level curricular objectives on Nature of Science, through engaging teachers, students, and guardians in school debate events on socio-scientific issues. Effective engagement of students in STEM requires addressing a range of issues such as the curricular context, the teachers, and the guardians. The proposed project is thus needed to address coherence between the curriculum, teaching and guardian involvement in a coordinated fashion. The project is funded by Science Foundation Ireland, and is led by Prof. Sibel Erduran at EPI-STEM, The National Centre for STEM Education at University of Limerick with the partnership of the JCT.

The ultimate aim of the project is to foster students' motivation, interest, and engagement in STEM. Examples of socio-scientific issues include badger culling and genetically modified foods. The inclusion of socio-scientific issues in STEM Education is a goal that has been promoted internationally (e.g. Zeidler et al., 2009). The Irish science curriculum at the Junior Cycle level promotes skills such as communication and argumentation that are required for engaging in debates. Yet, coordination of successful debates with Junior Cycle students can pose a challenge for teachers given the pedagogical strategies demanded by debates (e.g. mediating role play and argument evaluation) are not typically part of traditional teaching practice. Hence the project has two main aims: (a) to facilitate science teachers' professional development in teaching of socio-scientific debates; and (b) to engage students and guardians in socio-scientific debates. Considering both socio-scientific issues and the coordination of debates are aspects of pedagogy that are relatively unfamiliar to teachers (Sadler,

2004), the training aspect is crucial. In order to facilitate the debates, forty teachers were trained nationally in May 2016 to learn about effective pedagogical strategies for coordinating debates in class and as an event. Relevant resource packs were developed for teachers, students and guardians by EPI*STEM in consultation with JCT and the workshops were facilitated by the JCT.

In September 2016, teachers will implement lessons on debates and set homework tasks for students to complete with guardians. The project will engage guardians by providing resources that students will take home for their input. Debate events will be coordinated by the teachers during Science Week 2016 where guardians will be invited to attend as audience members. The debates will take place in schools and will be mediated by teachers. Hence, the project will promote engagement of students, teachers, and guardians in STEM related debates in the context of socially relevant issues.

The success of the project will be measured for the quality of impact on teachers', students', and guardians' attitudes and understanding of socio-scientific issues and their engagement with socially relevant STEM topics. It is intended that supporting teachers' understanding and skills about socio-scientific debates will mean that students can get the most effective learning experience. It is envisaged that students' participation in debates around socio-scientific issues is likely to engage them in ways that will raise their interest and motivation in STEM. Promoting guardian involvement in their child's school based activities aims to assist parents in supporting their children's STEM-related homework in the future.

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Proceedings ChemEd-Ireland 2015

The annual ChemEd-Ireland conference was held on October 2015 in University College, Cork, hosted by Dr Decan Kennedy and the Eureka Centre. The theme was ***Brilliant Resources and Great Ideas for Teaching Leaving Certificate Chemistry***. As usual in Cork there was a big turnout and we have three items in the Proceedings. For many years now we have published the Proceedings in Chemistry in Action! as a permanent record and to make the talks more widely available. However, it does depend on the speakers providing their talks in a suitable form. Also in 2015 we had two talks by Dr Fiona Desmond: one on teaching Atomic structure, which has been covered and published before and an update on the 2015 examinations, which duplicates a lot of what has previously appeared or in published in the annual LC Statistics article. For these reasons these two talks have not been included.

The non-stop provision of tea and coffee was a welcome feature as well as the brown bag lunch, which allowed large numbers to be catered for efficiently and allowed time for teachers to attend the workshops running during the lunch break.

Conference programme (talks in the Proceedings in bold)

9.00 – 9.45

Registration Eureka Centre, Kane Building, UCC.

9.45 – 10.00

Welcome and Official Opening Professor Paul Ross, Head of College of Science, Engineering and Food Science. UCC.

10.00 – 10.45

Teaching Atomic Structure in the Leaving Certificate Chemistry Syllabus. –

Dr Fiona Desmond, State Examinations Commission. 10.45– 11.15 Tea / Coffee

11.15 – 12.00

A tour of Whitegate Oil Refinery.

Michael King, Commercial Manager, Phillips66 Ireland. (A CD containing a copy of the Powerpoint presentation was given to every teacher in the audience!)

12.00 – 12.45

Teaching Instrumentation in the Leaving Certificate Chemistry Syllabus

Dr Mila Pravda, Department of Chemistry, UCC.

12.45 – 2.30

Lunch and Workshops During lunch participants are invited to participate in a number of activities as follows:

- Launching of videos on Instrumentation - Mr Conor Walker, Folens. Attend the launching of the new videos that have been specially made for the Leaving Certificate Chemistry syllabus and obtain a free DVD of these videos sponsored by Folens.
- Key practical skills developed by the Mandatory Experiments on the Leaving Certificate Chemistry syllabus - Dr Declan Kennedy UCC and team.
- Visit to Liquid Nitrogen plant. - Dr Donnacha O'Connell, Department of Chemistry, UCC.
- Spectroscopy in a Suitcase. Dr Trevor Carey, Department of Chemistry, UCC

2.30– 3.15

Ideas and Experiments for teaching Thermochemistry.

Dr Marc Stuckey, IGS Wilhelmshaven Secondary School, Germany.

3.15 – 4.00

Marking of the 2015 Leaving Certificate Higher Level Chemistry Examination

Dr Fiona Desmond, State Examinations Commission, Athlone.

3.15 – 4.00

Open Forum. Close of conference.

The 2016 ChemEd-Ireland conference will be hosted by Dublin City University and will be held on Saturday October 22nd and organised by Dr Odilla Finlayson. The 2017 ChemEd-Ireland conference will return to the University of Limerick and will probably be on Saturday 21st October.

Cool Chemistry: Learning About Instant Cooling Packs in Chemistry Lessons

Marc Stuckey¹ & Declan Kennedy²

¹Integrierte Gesamtschule Wilhelmshaven (Integrative Comprehensive School in Wilhelmshaven) and co-operative member of the Institute for the Didactics of the Sciences (IDN) - Chemistry Education Research Group, Department of Biology and Chemistry, University of Bremen, Germany; ² School of Education, University College Cork.
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This paper discusses the role of instant cooling packs in teaching some key concepts in thermochemistry at Junior Certificate and Leaving Certificate level. It outlines a lesson plan dealing with instant cooling packs which was presented at the ChemEd 2015 conference held at UCC. The lesson plan outlines the usefulness of the cooling packs in teaching thermochemistry and includes various laboratory investigations to help appreciate the process of solution formation and the accompanying energy changes.

Introduction

Thermochemistry is an important area of the Leaving Certificate chemistry syllabus. In addition, in the Chemical World strand of the new Junior Certificate science syllabus, one of the learning outcomes is that "students should be able to consider chemical reactions in terms of energy, using the terms *exothermic*, *endothermic* and *activation energy* and use simple energy profile diagrams to illustrate energy changes". The concept of endothermic reactions may easily be demonstrated to students by means of instant cooling packs. These packs may be familiar to some students through their various sporting activities. In cases where someone suffers a sprain or bruising, cooling the injured area helps to contract the blood vessels and thus prevents potential swelling inflammation occurring (Zeilberger, 2011).

Cooling packs usually contain a salt (e.g. ammonium chloride) or colourless crystals (such as urea), as well as water. The water and the solid material are physically separated from each other by a partition. After the packs have been vigorously shaken and compressed, the partition between the chemicals is broken and this allows the salt to dissolve in the water to begin the cooling process. One advantage of cooling packs

is the fact that they are portable since the cooling occurs due to the dissolving process. A disadvantage of the instant cooling packs is that they can only be used only once.

Having studied the concepts of solute, solvent and solution at Junior Certificate science level, students should be familiar with the dissolving process of salts and other substances in water. The use of cooling packs helps students to understand and explain the dissolving process at particle level in order to subsequently be better able to comprehend the energy aspects associated with this process.

Some curricula in Germany have recently stipulated that students must be able to explain the dissolution of salts and describe the energy balance of the dissolving process of salts from an energy aspect using the concepts of hydration energy and lattice energy (Lower Saxony Core Curriculum, 2015). The use of instant cooling packs takes both of these concepts into account (the dissolving process and energetics) and can be easily demonstrated in the classroom without overloading the students with regard to content. The dissolving process of salts and water is firmly established in most curricula throughout the world and justifies the use of cooling packs when covering this topic in the classroom.

A lesson plan using the cooling packs

The objective of this lesson plan is to help students understand the energy changes that take place when instant cooling packs are used. The lesson plan has been used with 14 - 15 and 16 - 17 year old students in Germany. The lesson may be used with Transition Year chemistry students or Leaving Certificate chemistry students in Ireland. In the case of Junior Cycle Science students, a modified version of the lesson plan which excludes the concepts of lattice energy and hydration energy could be used.

To introduce the topic, the students are shown an instant cooling pack to grab their attention. This stimulus may possibly remind some students of their experience with these cooling packs in the area of sports or other activities. Instant cooling packs are then distributed among groups of students and the each group is encouraged to investigate the cooling pack. Some brands of cooling packs do not give any indication on the packaging as to the substances contained in the cooling pack. This raises the first question that the students must answer: *What substances are present in the cooling packs?*

Since the substances contained are not labelled on the packaging, the students, arranged in their groups, carefully cut open the cooling packs, paying close attention to the contents and noting their observations. As a result of discussion with the class, suggestions regarding the contents may include reference to “water” and “salt”. The knowledge of the students regarding the structure and properties of water and salt gained from previous lessons could be revised and summarised on the blackboard or on a Powerpoint slide.

During the preparations of this lesson plan, materials were developed around the following four areas:

- How can it be proven that we are dealing with water and salt (or urea)?
- How does salt dissolve in water?
- Is the resulting solution always cold when a salt dissolves in water?
- Do the salts also dissolve in other liquids?

The proof regarding the presence of water and salt (or urea) in the cooling packs could be worked on by two groups of students (each containing three to four students). The students are free to choose their method of obtaining evidence, e.g. the use of anhydrous copper sulfate to test for the presence of water and the use of a simple electrical conductivity test of the solution or molten salt to test for the presence of ions. If cooling packs containing urea are being used, the Biuret-test could be performed.

In order to help students to obtain a clear mental picture of the dissolving process (Example M1), students are provided with water molecules and ions (M1a) made of cardboard. The students also receive a worksheet (M1) containing scanned film frames in which the dissolving process should be sketched step-by-step at the particle level (Prechtl,

2009; Prechtl, 2011). To answer the questions in the Worksheet, the students require a good capacity for abstract thought. In order to understand the dissolving process, the students must revise their previous knowledge about this process. This task could be completed by two groups of students who could summarise the process on some Powerpoint slides.

The fact that the dissolving process of salt in water is not always endothermic could be determined through experiments by two groups of students using different salts. Various salts are inserted in water, stirred with a glass rod and the temperature measured. The investigation is completed when the students simply note down that some dissolving processes are endothermic and some are exothermic depending on the salt used. These findings could provoke further questions, such as “Why does the temperature fall when dissolving some salts in water and rise with other salts?” Students could be assigned a task to research this topic and explain their findings in terms of lattice and hydration energy as a basis for endothermic and exothermic dissolving processes.

Two groups of students could perform experiments to determine in which (household) liquids a salt dissolves (M2). Following the tests, they should use their knowledge to explain why, for example, sodium chloride dissolves in water but not in cooking oil. When giving their explanations, they must refer to the details of the process of dissolving (Kennedy, 2014).

After the development phase, students choose a presentation medium (e.g. Powerpoint, poster, blackboard, documents) to share their findings with the rest of the class by means of short presentations. For reasons of time, it may not be possible to allow all groups to make a full presentation but some groups can supplement the presentations of their peers. The presentation phase is particularly important for reinforcing the concepts of the dissolving process and the accompanying energy changes. All of the students receive a worksheet for this purpose (M3).

Table 1. Examples of experiments to investigate cooling packs

Investigation	Preparation
Analysing the contents of the cooling packs	anhydrous copper sulfate for the water / conductivity test for the salt and/or biuret test for urea
Dissolving process	Molecules made of cardboard to help reconstruct the dissolving process (provision of assistance is needed depending on the ability range of the students).
Does dissolving a substance always result in a fall in temperature? Or Can other solid substances be used for the cooling packs?	Provide a range of different salts to dissolve in water.
Can other liquids be used?	Determine how much water is needed to dissolve each substance. The experiment can be repeated using vegetable oil.

This teaching approach is aimed at encouraging students to apply their knowledge of the formation of solutions in an everyday context. The inquiry-based approach helps the teacher to implement differentiation as students work at their own pace. Students who lack skills in the subject of Chemistry may perform the more guided investigations to identify the presence of water and salt.

High-achieving students could be assigned the more conceptually demanding aspects of designing models to explain dissolving and energy changes. Computer software that allows particles to be shown moving (e.g. *ActivInspire*) is an advantage for use in some of the presentations. In Germany a basic knowledge of the dissolving process is important for students in order to better understand interdisciplinary topics, such as agriculture (application of fertilizers, eutrophication, etc.). Many environmental problems which, according to Klafki (2007)

represent typical key epochal problems, must be understood at particle level in order to work out applicable problem solution strategies and meaningful evaluations.

The learning outcomes from the above lesson plan may be summarised as follows:

At the end of this lesson students should be able to:

- Discuss the applications of commercial cooling packs in our everyday lives.
- Describe the energy changes that occur when commercial cooling packs are used.
- Investigate the contents of commercial cooling packs in the school laboratory.
- Explain the processes of solution formation and accompanying energy changes using appropriate models and graphs.

Feedback from classroom implementation in Germany

The lesson plan described above was implemented in two classes (grade 9; age: 14-15 years and grade 11; age: 16-17 years). A questionnaire was issued before and after the lesson plan in order to note any changes in learner motivation (feedback from 50 students). The MoLE (Motivational Learning Environment) questionnaire from Bolte (2006) focuses on students' perception of their chemistry education both before and after the lesson plan is completed. This questionnaire was developed on the basis of different theories of interest and motivation and examines whether this type of teaching unit can contribute to increasing student motivation in chemistry lessons. It also requests information on the student's interest in chemistry for their future chemistry education prior to introducing the new topic (Bolte, Streller & Hofstein, 2013). A pre-questionnaire was used to collect student information on motivation in chemistry lessons prior to teaching the topic (the real situation), including their wishes for an 'ideal' chemistry class (the ideal situation). After introducing the topic, the students submitted feedback regarding their experiences during the lesson plan.

Values between 4 and 7 agree with the assertion while values between 4 and 1 tend to disagree with the assertion.

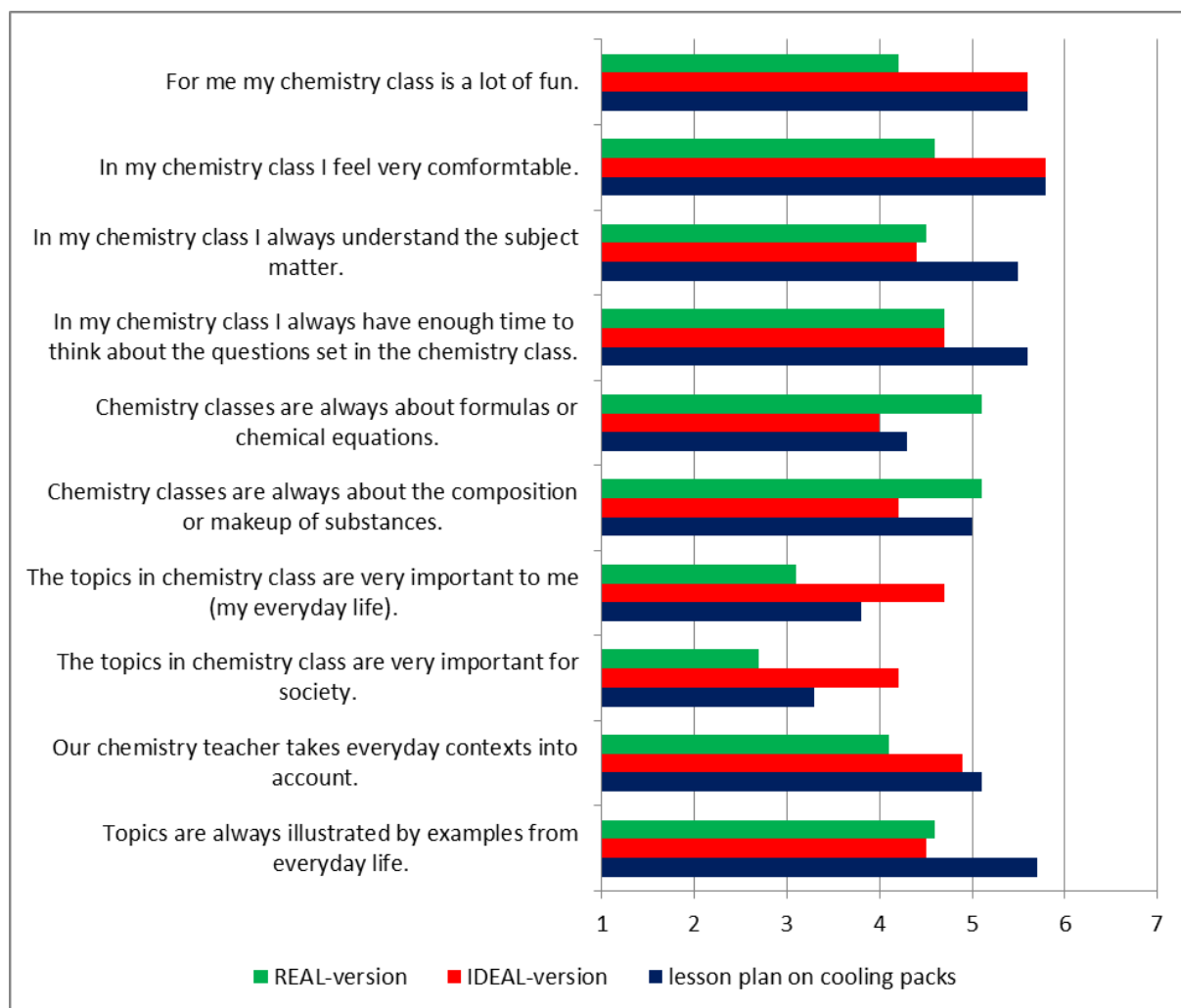


Table 2. Students feedback on the lesson plan

The feedback from the open-ended sections of the questionnaire indicates that the students found the topic appealing and motivating. Students reported that the practical work in particular gave the students a great deal of enjoyment and helped their understanding of the topic. A sample answer received was:

"I thought the lesson was very good because watching the dissolving of the ionic lattice in the example of the instant cooling pack and the practical work we did means I finally understand the process." (Student)

Also, the high degree of self-reliance was seen in a very positive light. The students had to find the appropriate answers to the questions for themselves by completing the investigations:

"I thought the lesson was very good because we had to get the information ourselves through experiments and didn't have to just copy it down." (Student)

The "presentation and discussion phase" too was praised by students and viewed as a successful element.

"I enjoyed the lesson because we did a lot of practical work. I also thought it was good to present our own results" (Student)

References

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-
- Dr Marc Stuckey is a teacher at the Integrierte Gesamtschule Wilhelmshaven (Integrative Comprehensive School in Wilhelmshaven) and co-operative member of the Institute for the Didactics of the Sciences (IDN) - Chemistry Education Research Group, Department of Biology and Chemistry, University of Bremen, Germany*
- Dr Declan Kennedy is Senior Lecturer in Science Education at University College Cork. He taught science in Colaiste Muire secondary school, Cobh, for 23 years prior to taking up a teaching position in UCC.*
- In the following 4 pages Marc Stuckey's worksheets are provided if you wish to use this experiment.**

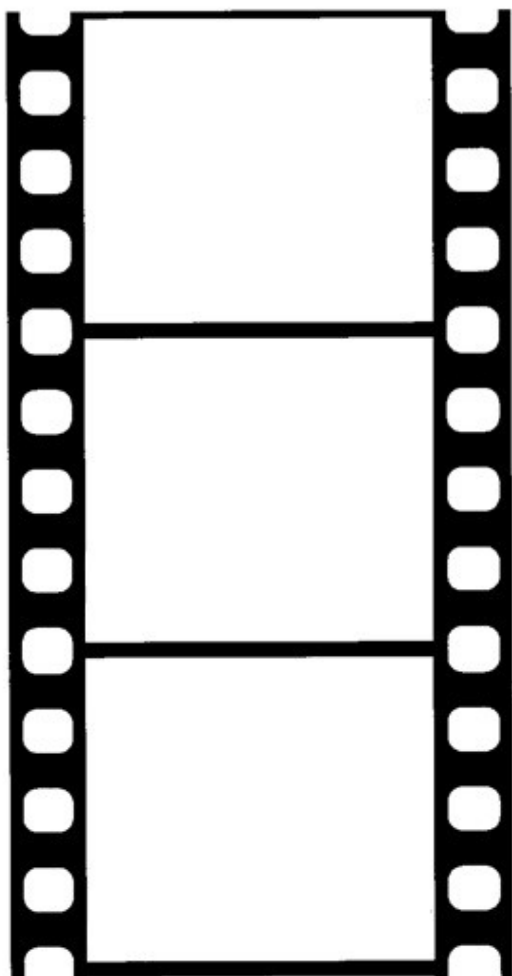
M 1 **What happens in the instant cooling packs ...**

You should observe what happens during the dissolving process! Use the cardboard molecules to explain what you think is happening.

Student experiment: Proof of the contents of instant cooling packs

⌚ Preparation: 5 min Execution: 25 min (standard)

Chemicals / Hazard Warnings	Equipment
☐	☐ Cardboard molecules

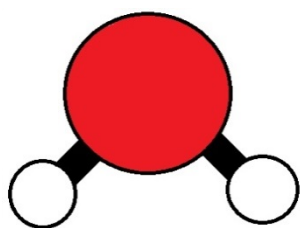
[illegible]

Tasks

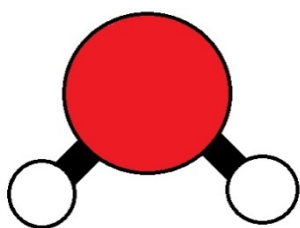
1. *Sketch in the film frames what happens (at particle level) when table salt dissolves in water.*
2. *Use the correct scientific terminology to explain the dissolving process of the table salt in water. (Use terms such as: ionic lattice, water molecules, anions, cations, ionic bond, positive/negative charge).*



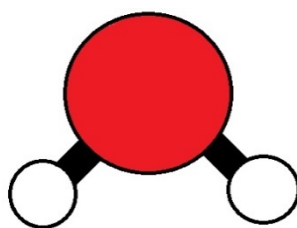
M 2a **Cardboard molecules**



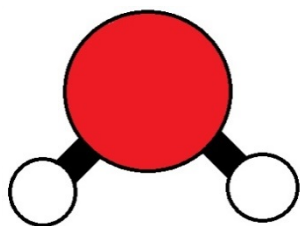
Water molecule



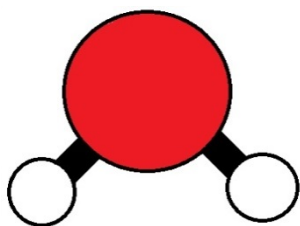
Water molecule



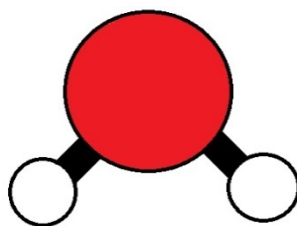
Water molecule



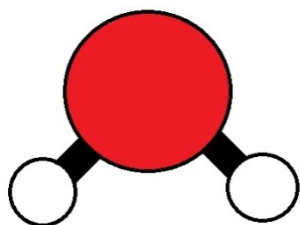
Water molecule



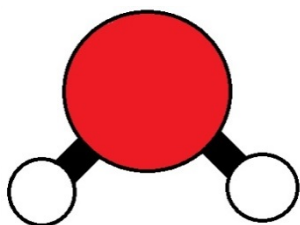
Water molecule



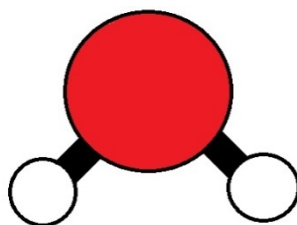
Water molecule



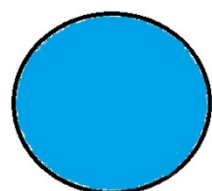
Water molecule



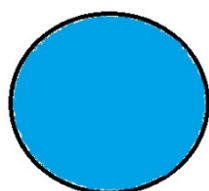
Water molecule



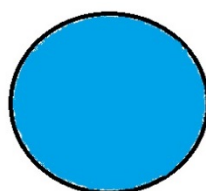
Water molecule



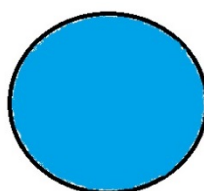
Sodium ion



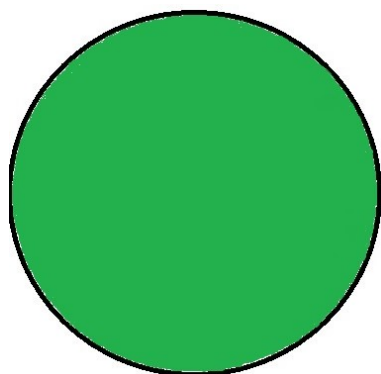
Sodium ion



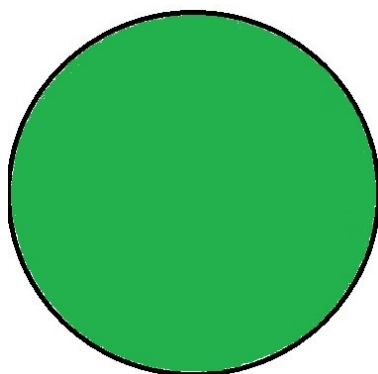
Sodium ion



Sodium ion



Chloride ion



Chloride ion

M 2 Are there any alternative solvents for instant cooling packs?

Injuries can occur during sporting activities. In the case of bruising or sprains in the joints, medical assistance is provided immediately. In addition to applying ice, it is also possible to apply instant cooling packs. Water is contained in these cooling packs.

Student experiment: Different solvents

🕒 Preparation: 5 min Execution: 15 min (standard)

Chemicals / Hazard warnings	Equipment
☐ Salt from the cooling pack (GHS )	☐ Scales
☐ Water	☐ Watch glass
☐ Sunflower oil	☐ Spatula
☐ Acetic acid (GHS  )	☐ 4 glass beakers (50 ml)
☐ Sodium hydroxide solution (GHS )	☐ Glass rod
	☐ (Thermometer)
Attention: Do not let the contents of the instant cooling pack come in contact with your hands.	
Disposal: The solvents can be poured down the drain.	

Experiment execution

1. Portions of the salt, weighing 1 g, must be extracted from the cooling pack (use the spatula, clock glass and scales to do this) and then inserted the portions of salt in the beakers containing water, sunflower oil, acetic acid and a sodium hydroxide solution respectively.
2. Stir the solutions with a glass rod and observe the reactions (measure the temperature, if necessary).

Experiment observations

Evaluations

Tasks

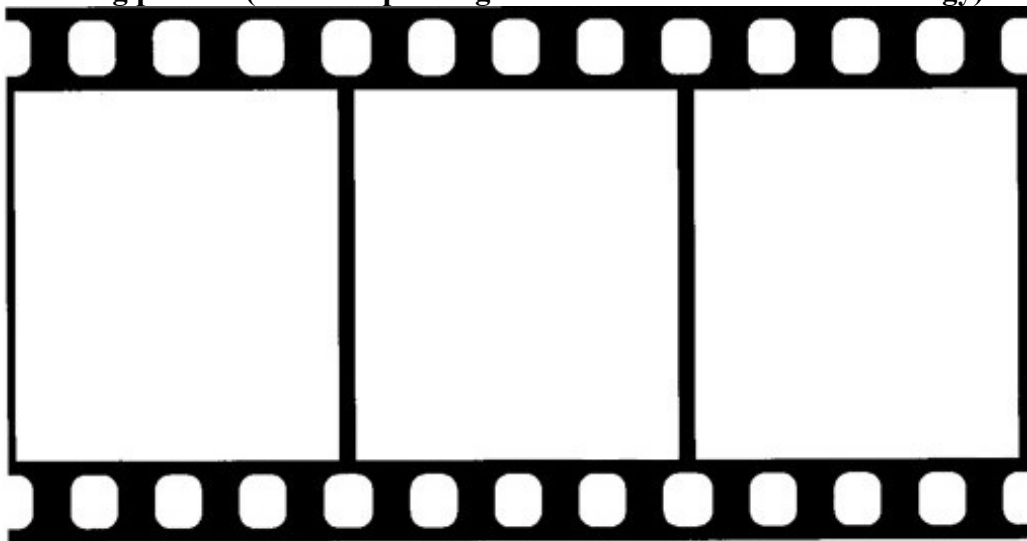
Document your observations and evaluations.

M 3 Overall evaluation of the examination of the instant cooling pack

Record the relevant results of the other groups here in writing.

Water and salt are used in the cooling pack because:

Dissolving process (draw simple diagrams and use scientific terminology)



Show the change in energy using an appropriate graph:



Explain your results

Liquefaction of Air in the Leaving Certificate Chemistry syllabus

Donnacha O'Connell

Department of Chemistry, University College, Cork

(At the 4th Annual BASF Summer School for Chemistry Teachers, Eureka Centre, UCC. June 23rd and June 24th 2015)

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This paper is based on the production of liquid nitrogen from air and the two liquid nitrogen plants in the Chemistry Department in UCC. A tour was given during ChemEd-Ireland 2015. Nitrogen is a diatomic gas with atomic number 7, with a melting point of -210 °C.

The main points of interest to us are that nitrogen comprises 78% of the atmosphere and that it has a boiling point of -196 °C.

The main properties of **gaseous** nitrogen are that it is:

- Colourless
- Odourless
- Tasteless
- Non-toxic
- Non-combustible
- Non flammable
- Relatively inert
- Non corrosive
- An unreactive gas

The properties of **liquid** nitrogen are that it boils at -196°C so it is very cold. It has an expansion ratio of 682, *i.e.* if you spilled 1 L of liquid nitrogen it would give you 682 L of gas. Or if you had 3 mL of liquid nitrogen it could expand to make up over 2 L of gas, a point that is worth noting.

One can demonstrate how cold liquid nitrogen is by placing an ordinary piece of rubber tubing in a container of liquid nitrogen. If you leave the rubber tubing in the liquid nitrogen for a minute or two it loses all its flexibility due to the low temperature. If you then remove it from the liquid Nitrogen and hit it with a hammer it will shatter like glass. If you allow it to return to room temperature it will regain its flexibility property.

Nitrogen was discovered by Daniel Rutherford in Scotland in 1772. Two Polish scientists, Zygmunt Wróblewski and Karol Olszewski were the first to

liquefy Nitrogen in 1883. In 1898 James Dewar invented the first storage container for liquid nitrogen and today the storage containers for liquid nitrogen are called DEWARs.

Charles' law states that gases expand when heated or contract when cooled. This phenomenon was first discovered by Jacques Charles while ballooning over Paris in the 1780s. The higher he went the colder it got and the balloon contracted. Charles' Law may be illustrated by pouring liquid nitrogen on a balloon and observing what happens. These experiments may be seen in the UCC Chemistry Magic show presented by Dr. Declan Kennedy; [UCC Chemistry Magic Show](https://www.youtube.com/watch?v=SL57VvOKWNY) (<https://www.youtube.com/watch?v=SL57VvOKWNY>)

Uses

The main use for liquid nitrogen is in cooling. There are 4 NMR (Nuclear Magnetic Resonance) machines in the Chemistry Department in UCC and the magnets in these machines have to be kept cool with liquid nitrogen.

Liquid nitrogen is extensively used in the food industry and the Food Technology department in UCC is supplied with liquid nitrogen from the Chemistry Department liquid nitrogen plant. It is ideal for quick freezing of food. The fact that the food is frozen so quickly means that bacteria have very little time to multiply and spoil the food.

Also many bacteria need oxygen in order to grow so the presence of nitrogen prevents them from getting the oxygen they need.

Liquid nitrogen may be used in the making of ice cream. This is not a modern development, as it was first used by Mrs. Agnes Marshall in her book "Fancy ices" published in 1890. If liquid nitrogen is used in the making of ice cream, the rapid freezing produces an ice cream with particularly small ice crystals which has a very

smooth texture. (Members of the audience were given a sample of freshly prepared ice cream during the presentation.)

Liquid nitrogen is used in microbiology to freeze samples as well as storage of biological material such as cells, tissue and blood.

The electronics industry also uses liquid nitrogen. It is often used as a coolant for computers.

In medicine liquid nitrogen is used in cryotherapy for wart removal as well as removing unwanted skin and pre-cancerous cells in addition to moles, verrucae and skin tags.

One of the major users of liquid nitrogen in the world is McDonalds. They use it to flash freeze their burgers and also use it for cooling their drinks system and their smoothies.

The UCC Chemistry Department liquid nitrogen plants

In the Chemistry Department at UCC there are two liquid nitrogen plants.

The “old” liquid nitrogen plant is a Philips PLN 106S (Figure 1) and the “new” plant is a Stirling 1 compact liquid nitrogen plant (Figure 2).



Figure 1. Philips PLN 106S liquid nitrogen plant



Figure 2. The Stirling 1 compact Liquid nitrogen plant

The “new” liquid nitrogen plant

The “new” plant is a Stirling 1 compact Liquid nitrogen plant. The principle of operation is that the nitrogen is initially filtered from compressed ambient air which consists of 78 % Nitrogen. Subsequently, the nitrogen is liquefied and stored. The four main steps are:

- Compressing the air.
- Separating the nitrogen from the compressed air.
- Cooling the nitrogen to produce liquid nitrogen.
- Storing the liquid nitrogen

These functions are performed by the main parts of the StirLIN-1 Compact.

The main parts are

1. An air compressor (Figure 3)



Figure 3. The air compressor

Here ambient air enters the compressor which is compressed up to a pressure of approximately 7.2 bar. Next the condensed moisture, oil particles and dust in the air are removed by the drying system.

2. An oxygen-nitrogen separation step, which consists of a Pressure Swing Adsorber (PSA) for separating the nitrogen from the compressed air.



Figure 4. The pressure swing absorber

This step is the difference between the two plants. The ambient air consists of 21 % oxygen, 78 % nitrogen

and 1 % inert gases (for example argon). Producing almost pure nitrogen is therefore simply a matter of filtering the oxygen out of the compressed air. This is accomplished by the Pressure Swing Adsorber, which consists of two oxygen adsorber vessels. These vessels are filled with carbon molecular sieves, which have the capacity to bind oxygen molecules. After adsorbing a certain amount of oxygen the sieves are saturated and must be regenerated. Therefore the vessels are used alternately. When one vessel is adsorbing oxygen, the other vessel is being regenerated. Regeneration is accomplished by de-pressurising the vessel to the ambient pressure, thus blowing off the oxygen.

3. A cryogenerator for liquefying the nitrogen

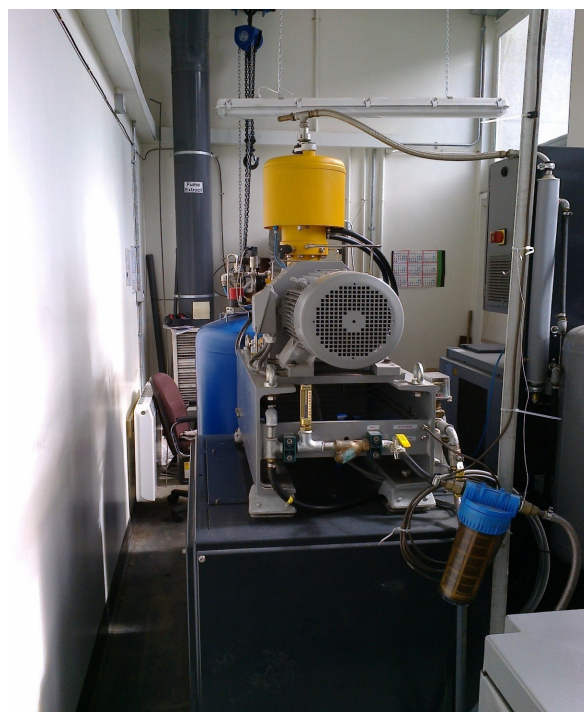


Figure 5. The cryogenerator

In the cryogenerator gaseous nitrogen from the Pressure Swing Adsorber is liquefied. The cold for liquefaction is generated by the “Stirling cycle”, which is basically a compression and expansion of a perfect gas. In our system this gas is helium, which is called the process gas.

A normal helium gas cylinder should be sufficient for an operation period of up to 2 years. The expansion of the process gas cools the cryogenerator’s condenser head, which can be seen on the screen in yellow. The nitrogen flows along the condenser head and is liquefied.

4. A storage tank.



Figure 6. The storage tank

Following condensation the liquid nitrogen is stored in our storage tank which has a capacity of 300 L. Non-condensable gases such as argon are removed from the condenser head.

The “old” liquid nitrogen plant

The “old” liquid nitrogen plant is a Philips PLN 106S which consists of four main parts.

1. A Cryogenerator.

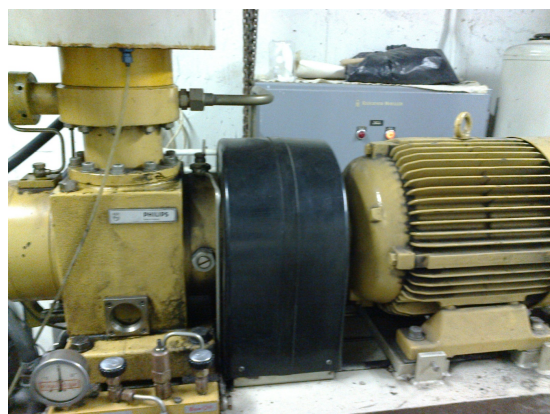


Figure 7. The cryogenerator

The cryogenerator is filled with helium gas under high pressure (25 bar) just like the new plant, which effects the cooling process in a closed cycle, the “Stirling cycle”, just like the new plant. We use helium because we have to use a gas

which does not liquefy at the operating temperature of the cryogenerator.

2. A condenser.



Figure 8. The condenser

The condenser is at the top of the cryogenerator, coloured grey in Figure.

3. A rectification column



Figure 9. The rectification column

The impurities in the air (water vapour, carbon dioxide, etc.) are separated in the column and stored there in the form of snow. After the end of the production period (usually about a week depending on the temperature and the humidity of the air), the plant will stop and the snow must be removed by defrosting it. The defrosting usually takes about a day. In the fractioning column the

stream of air gradually enriches in nitrogen and gives off oxygen until it becomes pure nitrogen vapour at the top of the column. This is the difference between our two plants.

The nitrogen vapour leaves the column and is condensed in the condenser of the cryogenerator. During the starting period (about an hour) the column cools down to the working temperature. The plant then has to be switched over to the working conditions in which the pure liquid nitrogen is produced.

This plant produces about 6 L per hour. The nitrogen is about 99.7% pure.

4. An air inlet.



Figure 10. The air inlet

The column is provided with an inlet opening for the intake of ambient air as shown in the photo above.

In the table below the two plants are compared.

Table 1. Comparison of the two plants

Plant	PLN 106 S	StirLIN-1
	Old Plant	New Plant
Type	Column	Molecular Sieve
Purity	99.7%	99.3%
Drying Out	Weekly	None Required

In comparing the plants it should be noted that the old plant rarely breaks down but requires a lot of regular maintenance.

The new plant uses a lot more electricity but does not require a cooling down time and does not need to be dried out.

However the old plant produces purer nitrogen 99.7% compared to 99.3%. These are the main differences between the plants.

Dangers of liquid nitrogen

The two most common dangers are frostbite or cold burns due to the cold nature of the liquid nitrogen and asphyxiation due to the fact that liquid nitrogen can vaporise and displace the oxygen in the air. That is why you should never travel in an elevator/lift with liquid nitrogen in case it spills and you could very easily be asphyxiated!!

There is also a danger of explosion if liquid nitrogen is stored in a sealed vessel such as a tightly sealed thermos flask!! Remember it can expand up to 700 times its volume. One L of liquid can produce 700 L of gas!!

In researching this talk I came across some terrible accidents involving liquid nitrogen, which are cautionary tales.

As recently as April 2015 a worker in Poland fell into a vat of liquid nitrogen and died.

In 1999 a technician in Scotland died from asphyxiation due to using liquid nitrogen in a poorly ventilated room.

About 8 people every year die from nitrogen asphyxiation in the United States of America.

In 2009 a German chef had an accident with liquid nitrogen and lost both of his hands!!!

It would seem that the chef stored the liquid nitrogen in a sealed container and it exploded all over his hands and he subsequently lost both of his hands.

I also came across the case where a worker was wearing Wellington boots while dispensing liquid nitrogen. The liquid nitrogen spilled and went into the Wellington boot. The worker could not get his foot out and he ended up losing his foot.

There are also many other stories of people losing fingers, hands and toes.

Then there is the famous story of Gaby Scanlon who swallowed two liquid nitrogen cocktails on her 18th birthday in Lancaster in England in October 2012. The minute the second drink hit her stomach she felt excruciating pain. Remember as I said at the start of this paper if only 3 mLs of liquid nitrogen were ingested they could expand to over 2 L in a person's stomach.

Gaby was lucky in the fact that she was rushed to hospital and operated on immediately, but her whole stomach had to be removed as the surgeons said that the liquid nitrogen had "destroyed her stomach beyond repair". Her life will now never be the same again and this is a true story. In June 2015 the bar concerned, Oscar's wine bar in Lancaster was prosecuted under Health and Safety

legislation. They pleaded guilty and the company was fined £100,000 in September 2015.

Under our new Health and Safety policy we only supply outside customers if they have a Dewar transported by a suitable carrier. Unfortunately the days of supplying teachers with a few flasks of liquid nitrogen are over for us!!

Finally I would like to thank Dr. Declan Kennedy for inviting me to give the talk and to Tony Hogan of the Chemistry Department for all his help in preparing the talk.

□

Dr Donnacha O'Connell Is a Senior Technical Officer in the Department of Chemistry, University College, Cork.



On Wednesday the 14th of September, Johnson & Johnson in partnership with the University of Limerick launched the WiSTEM2D Award Program. This is an assisted one year program providing financial support, opportunities to network within peer groups and Johnson & Johnson business leaders, and early career development opportunities including mentoring and day in the life. Five individual awards, for support of studies, each to the value of €4000 are available to female students of Science, Technology, Engineering, Mathematics, Manufacturing and Design (STEM2D) subjects entering their 2nd year of studies 2016/2017 within the University of Limerick. Successful shortlisted candidates will be invited for interview and final selection will be confirmed by 21st Oct 2016. A further three project group awards focused on STEM2D related research will be announced in October.

Professor Sibel Erduran, Chair of STEM Education at UL, Director of EPI-STEM, National Centre for STEM Education said, "*We are delighted to get into this important partnership with Johnson & Johnson, with the mission of enhancing women's participation in science. Our partnership will support UL students in pursuing careers in STEM, provide them with mentorship from industry and potentially lead to more women being employed in STEM jobs in Ireland.*"



National Centre for STEM Education



UNIVERSITY of LIMERICK

OLLSCOIL LUIMNIGH

A Limerick Periodic Table:7 Nitrogen

Created by Peter Davern

Dept. of Chemical and Environmental Sciences, University of Limerick, Limerick

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Nitrogen, N

Oh Haber helps out Mother Earth our N₂ “fix” to sate,
And dynamite explodes (controlled!), while azide bags inflate.
What’s more its oxide giggles...
...as it squirts out whipped-cream squiggles!
In proteins, heme and DNA ... inert, essential mate.

Notes:

Oh Haber helps out Mother Earth our N₂ “fix” to sate,

Mother Earth’s best efforts to “fix” nitrogen using plants, bacteria, etc. are insufficient to provide the ever-increasing world’s population with its essential nutritional supply of nitrogen. The industrial Haber Process helps out by converting atmospheric nitrogen (N₂) to ammonia (NH₃) which is then used to make the nitrogen-rich fertilisers essential for growing our crops, etc.

[sate: verb to satisfy someone fully]

And dynamite explodes (controlled!), while azide bags inflate.

Nitroglycerine (C₃H₅N₃O₉) is explosively unstable in its normal oily liquid form. However, its absorption onto an inert solid support (in the form of sticks of dynamite) confers such a level of stability that it becomes suitable for producing predictable and controlled explosions.

Sodium Azide (NaN₃) is a solid powder found in the mechanism of airbags in cars. Within microseconds of a collision occurring, a small detonation is triggered. This decomposes the azide to liberate nitrogen gas which instantly inflates the airbag.

What’s more its oxide giggles...

...as it squirts out whipped-cream squiggles!

Nitrous oxide (N₂O), a.k.a. “laughing gas”, has long been known for its anaesthetic properties. It is a gas that is reasonably comfortable (i.e. soluble) in both fats and water; hence its use as a propellant for canned whipped-cream.

In proteins, heme and DNA ... inert, essential mate.

Nitrogen atoms are integral to the chemical structure of three of your body’s essential macromolecules:

- *Proteins are comprised of “semi-infinite” combinations of the various naturally occurring, nitrogen-containing, amino acid “building blocks”.*
- *Haemoglobin transports oxygen around your body (via your blood stream) courtesy of heme groups. Each heme contains four nitrogen atoms which “coordinate” the position of an iron atom responsible for binding the oxygen.*
- *DNA is composed of the four nitrogen-containing nucleotides – adenine, guanine, thymine and cytosine.*

As the diatomic molecule, N₂, nitrogen exists as an inert and unreactive gas.



Leiden Conference April, 2016

Reports and reactions to the final TEMI conference in Leiden

Engaging with TEMI in Leiden

Over the weekend of April, nearly 200 teachers, educators and others gathered in Leiden, in the Netherlands, for the final conference of the TEMI project. The last issue of *CinA!* (#107) was a special issue on TEMI and you can read articles about TEMI, ideas for TEMI lessons and reports from the TEMI partners in that issue. The idea of the conference was to round off the project by bringing some of the teachers involved in the partner countries, together with the TEMI teams and other stakeholders in science education in Europe.



The Irish delegation in Leiden

The Irish delegation involved members of the UL TEMI team – Peter Childs, Sarah Hayes, Beulah McManus and Laurie Ryan, teachers involved in the project – Colette Redington, Helen Riordan, James Stephens, Rosaleen Loughman, Siobhan Daly, John Loughlin - and Veronica McCauley (NUIG), Paul McCrory and Conor O'Brien (President, ISTA). Some reactions and ideas from the Irish delegation are given in the articles below.

We should have had more Irish teachers take part and other Irish stakeholders, as the experience of being involved in a wider science education community at the conference seemed to be a very beneficial experience.



The Irish stand at the science fair

The programme was a mix of lectures, workshops, and a 'science fair' session (with wine) for people to show off their TEMI lessons. One of the Irish team, Paul McCrory, gave the first, inspiring talk to engage the audience and launch the conference. Paul was involved in some of the workshops in Limerick in introducing the idea of showmanship. Most of the conference was devoted to various workshops, run by the TEMI, partners and allowing participants to meet teachers from other countries and experience different approaches to TEMI. The UL team ran a workshop on the Circus of Mysteries.



Tilman Andris in action

Tilman Andris (above) mixes magic and science, and he circulated round the tables at the conference banquet doing his amazing card tricks.

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Scratch that itch

Paul McCrory
Learn Differently Ltd

I'm a bit of a curiosity geek. After all, curiosity is the oxygen of science.

So you can imagine my sense of anticipation when I was invited to speak at the TEMI Congress in Leiden - a whole weekend of educators from across Europe sharing their best curiosity-inducing techniques and activities.

One moment that stood out for me during the weekend was the value of deliberately placing yourself in the role of student to help to remind you of some of the feelings they experience in your lessons. In one interesting session Kristine Hjulstad, a magician from Norway, handed out some wooden box puzzles and challenged us to uncover the secret to opening them. (Without breaking them!)

It was fascinating to observe the range of reactions from the audience as we struggled with these deceptively-simple puzzles. We fell along the full spectrum from playful delight to maddening frustration. Like any good educator, Kristine used a range of strategies to try to keep us engaged for as long as possible e.g. acknowledging that she found them difficult too; admitting that some people get frustrated more quickly than others, but that it's important to keep

trying; softening with humour; narrating on our attempts and encouraging us to discuss ideas; being likeable; and giving an escalating series of clues when she read that "the room" was about to give up.

This experience made me reflect more generally - as educators:

- when we try to stimulate curiosity, do we really take the time (and the risk) to let the mystery deepen and the curiosity grow, or do we rush on to supply "the answer"?
- when we do withhold information from students for a prolonged time, how well do we manage the range of frustration levels felt by the students?

If you want to find out more about how I suggested in my presentation that teachers can use curiosity productively in the science classroom, check out these supporting resources <http://learn-differently.com/temi> Please get in touch through the website if you have any questions.

Keep getting them curious.

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Ghost-busters and Gummi bears

Colette Redington
Colaiste Muire, Ennis, Co. Clare

Why does the sea glow a Ghost-Buster green at night, a tin roll uphill, or why do raisins dance? How can you measure the frequency of a cat's purr, the wag of a dog's tail or explain how a Gummy-Bear turns into a ghost?

Questions like these are at the heart of the TEMI Project, based on Inquiry-Based Science Education (IBSE). TEMI hosted a conference in Leiden, Holland earlier this year to share the experiences of nine European universities,

including the University of Limerick, in the training of educators to engage students better through mystery and illusion in the learning of the sciences.

As one of the participating teachers from Ireland I was delighted to go to lovely leafy Leiden, bustling with bicycles and very accessible with canals and walkways through the old town and the university buildings. If you were lucky enough to arrive early (we didn't!) Audrey Korczynska of

Leiden University gave an introductory session on Space Awareness and how to inspire a new generation of space explorers and stimulate young people's interest in science and technology. This was followed by a visit to Leiden Observatory which is beside the university. There were several Astronomy groups present over the week-end, who are involved in educational initiatives like CERN and school visits; these would be useful resources for the teaching of the Space module in the new Junior Certificate syllabus.

Using illusion to capture attention is the preserve of magician-cum-medical student Kristine Hjulsted of the University of South East Norway. Although we were in another workshop at the time, you can look her up on YouTube and see how she uses conjuring and magic to develop perception and critical thinking in children. As in the first level of a TEMI module, engaging through a mystery or observing a strange phenomenon teaches children to observe and then explain, sometimes needing guided questions, to develop their sense of perception. Our minds adjust to the way we expect the world to be and we often leave out information that is not useful to us. Children are better at observing the world, so a little mystery in our teaching gives them more ownership of the concept - they will have tons more explanations for what's going on than most adults.

Yves Bernhardt, who works with the European Commission's Support Group in Science Education was a key-note speaker and presented an overview of the publication '*Science Education for Active Citizenship*'. This offers a 21st century vision of how science education should be, in order to best equip students for active participation in STEM careers. Although primarily aimed at policy makers, the report also offers a frame-work which includes public debate and inputs on what works and what is still needed in science education.

One of the most useful aspects of a workshop called 'Worst Scenarios - an Inquiry into Science Project Nightmares', was the opportunity to meet teachers from other European schools and to share the challenges and experiences of inquiry-based learning in the classroom. We identified what disrupts and derails science initiatives and most challenging - how to perpetuate good practice beyond the lifetime of a funded project.

One of the most encouraging outcomes of participating in the TEMI training in University of Limerick was reading the feed-back from my own students and observing their engagement in a new topic. I have found that generally students who find science challenging are more likely not to participate fully, perhaps because they feel they are never the ones with the right answer. When you introduce them to a topic through a little magic and mystery, or allow them explore through open investigation, these very students will be leaping out of their seats to tell you what they discovered. For example, let them use the torch of their smart-phones and a random collection of reflective and refractive bits and pieces around the lab and they will discover dispersion, spectra, refraction, make their own diffraction grating and make objects disappear all by themselves. Much more fun, and they can still learn the definitions for home-work!

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Getting the figs in the fig rolls

Rosaleen Loughman
Mount Sackville Secondary School,
Chapelizod, Co. Dublin

Is teaching the TEMI way a bit like figuring out how they got the figs into the fig rolls?

The premise of TEMI and the 5E model is this: **Engage** the learner, through an engaging activity which captures the students' imagination, and then through their natural curiosity the student can **explore** the phenomena based on their observations. From here students, through research or further experimentation, will **explain** what is behind the mystery and this explanation will hopefully **extend** beyond the activity to how this might be applied to other situations. The students peer **evaluate** the work done, checking for understanding, discussing alternative methods, and the validity of their conclusions through a guided discussion, for example.

In April this year, a group of policy makers, educators, educator educators and scientists came together in Leiden, in the Netherlands, to discuss, review and apply this method of teaching as a way

of raising engagement, developing the key competencies for Science and improving scientific literacy.

Recreate the wonder

Nanoscience: How small is small?

Researchers from the Charles University of Prague introduced the world of nanoscience to us, initially by having us put images of mitochondria, mites, and molecules into order from the smallest to the biggest, assigning a size in terms of cm, mm, nm etc and then making a comparative assessment based on their scale. It was hard work, and getting consensus between the group (of teachers) meant that there was good (and at times robust) discussion about the various items that we were sorting. The aim of the activity was to get an idea of how small, small can be. Looking at a high quality image of, for example, the mitochondria and discussing how many of them might fit into a muscle cell, recreates the wonder of in this instance, the human body.

Nanoscience: Cell theory

Using a block of cheese, we cut it first into half, quarter and so on and measured the increase in surface area and compared it to its overall volume. It is an easy way to both incorporate some numeracy into a lesson, but also explain cell theory, optimum cell size and the concept of surface area to volume ratio.

Activity 2: How to prepare nano?

2. Nanocheese

Reduce the size of a cube of cheese two times and fill in the table.

Division	Number of cubes	A length of edge (one cube) cm	Surface of one cube cm ²	Surface of all cubes cm ²	Volume of one cube cm ³	Volume of all cubes cm ³
0.	1	2	24	24	8	8
1.	8	1	6	48	1	8
2.	64	0,5	1,5	96	0,125	8

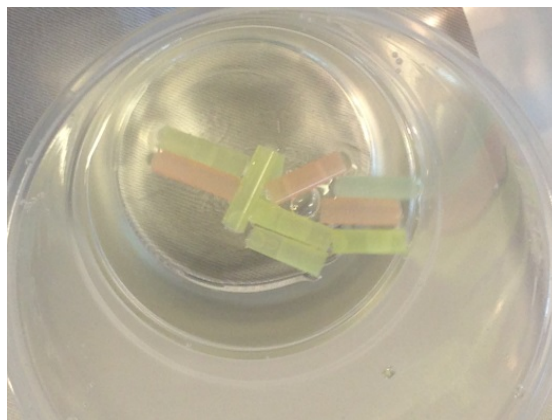
Nanoscience: Making the invisible, visible

Shining a laser through various solutions, for example tea, egg white and milk and comparing the pattern observed and explaining why the light is scattered differently, presents opportunities to discuss not only the phenomena of light, the concept of solutions, but also the molecular size of the constituent parts etc. It also makes for some pretty nice photos for students to record their results. Using lasers to demonstrate the 'invisible' nanoparticles provides endless teaching opportunities across the disciplines of chemistry, physics and biology.



Nanoscience: Building blocks

The final activity was observing how nanoparticles assemble. Swirling some cut up plastic straws in a glass of water leads to the straws forming an aggregate. This is useful for explaining self-assembly in nature, weak bonds, quaternary structure of proteins (for example), non-covalent bonding etc.



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Implementing Changes towards Inquiry-based learning

Brigid Corrigan

Resources for inquiry-based learning

The new Junior Sert science course is based on what was once termed the *inductive approach* in education, which has been *re-branded* today as **Inquiry-based learning (IBL)**. Regarding inquiry-based learning (IBL) and how to introduce it into your practice, the following is a list of the many courses and workshops available to teachers in Ireland, which offer excellent CPD and inclusion in communities of practice, to support transitioning to this way of thinking. Ireland has been involved in a number of IBL projects funded by the EU. (The links were organised by Pat Dundon, science teacher in Castletroy College, Limerick)

EPI*STEM, National Centre for STEM Education <http://epistem.ie/>

Chain Reaction Project (UL is the Irish partner)

<http://www.ul.ie/chainreaction/node/2>

TEMI Project (UL is the Irish partner)

<http://www.ul.ie/news-centre/news/workshop-for-teachers-brings-science-to-life>

[http://www.pdst.ie/sites/default/files/TEMI%20PP_18OCT%20\(1\).pdf](http://www.pdst.ie/sites/default/files/TEMI%20PP_18OCT%20(1).pdf)

The CASTEL Group in DCU have produced lots of useful material regarding assessment in IBSE via their SAILS Project, and previously the ESTABLISH project.

SAILS Project

<http://www.sails-project.eu/portal/workpackages>

ESTABLISH project

www.establish-fp7.eu/

Declan Kennedy at UCC led the Irish team who were partners in **PROFILES**.

PROFILES project at UCC

chemweb.ucc.ie/Pro2/PROFILES-ucc.htm

Furthermore, the materials available from The School of Education NUI Galway 'Science Hook' series and Science on Stage may be readily tweaked to form the basis of many IBL activities.

The School of Education NUI Galway 'Science Hook'

<http://www.sciencehooks.scoilnet.ie/>

Science on Stage (Ireland)

[http://www.science-on-](http://www.science-on-stage.eu/page/display/5/28/0/teaching-materials-2)

[stage.eu/page/display/5/28/0/teaching-materials-2](http://www.scienceonstage.ie)

<http://www.scienceonstage.ie>

From a European point of view, the **Go-Lab Portal** is worth a look for simulated experiments where hypotheses may be framed, variables can be adjusted and data collected through their Online Labs and Inquiry Spaces.

The Go-Lab Portal

<http://www.go-lab-project.eu/online-labs>

<http://www.go-lab-project.eu/inquiry-learning-spaces>

My own experience of IBL

I took the leap into inquiry a number of years ago via some of the courses mentioned and, based on my experience, I feel the biggest effect comes from the **change in your mindset**. It is **how you see IBL** and its potential to change the teaching, learning and assessment experience of both teacher and student.

It is 'one step at a time', and 'small changes' in your own practice, related to your own school setting, which allows you to become the architect of the landscape of your classroom. Embedding inquiry into your classroom practice can be as simple as a thoughtful sequence of questions, which have many possible solutions but have engaged the student's minds, that *they* want to find a solution. It becomes a classroom

environment that is inclusive and provides an entry level for all abilities.

It can involve IT, as much or as little as you the educator can/is able to provide, as IBL is more about the *creativity of the mind* and the *purposeful use of IT* to support it. Embedding IBL in your teaching is a journey in itself, but it's also about what is happening on the journey and it has many destinations.

I continue to be on that journey and am changing and learning all the time. IBL has allowed my students and me, to become more involved in the teaching and learning process than before, and I have started to reflect on my practice in a more focused way than before. All of these small changes I believe are making me a better educator but it takes time to develop and embed and to have the confidence to try it in the first place. This has been my experience so far.

I was involved with other teachers from my school in the TEMI project, whose aim was to introduce inquiry by using mysteries to engage students (see the special issue, *Chemistry in Action!*, #107, Spring 2016.)

My involvement in TEMI helped me to understand the significance of 'engaging students first' to enable a richer learning experience. This was evident from the level of participation and vibrant conversations that took place when I used an engaging activity to introduce a topic.

The following are **brief excerpts of lessons** that I have used in class, to cover the topics **Measurement and Density in Physics**.

Density Challenge

Sink or swim

Question: How many marbles can float in the boat?

Equipment provided: Water baths, marbles, boat, weigh balance, graduated cylinder.

Extended learning: How to calculate density using the formula, and showing the relationship between density, mass and volume

Inquiry Activities

Measurement 1

Question: How many different ways can you measure a marble?

Equipment provided: Piece of string, weigh balance, graduated cylinder, water, overflow can, Vernier callipers, and ruler. Data recording worksheet and science activity sheet.

Extended learning: Density

Sample Data Recording Sheet

1.

Inquiry Activity Worksheet

Activity name:	
What did you see?	Draw a picture
What did you learn?	

Activity name:	
What did you see?	Draw a picture
What did you learn?	

Inquiry Activities

Measurement 2

Task: Measure the distance around and the distance across the circular object.

An effective method for measuring the circumference is to wrap a string around the object and then measure the string.

Do this for a number of circular objects.

Record the information described below, on the data recording sheet

- Description of each object
- Distance around the outside of each object
- Distance across the middle of each object
- Distance around divided by distance across

Were there any patterns in your data?

Apple Pi Recording Chart

NAME _____

Using string and rulers, measure the distance around several round objects, as well as the distance across the middle of those objects. Record your measurements below.

OBJECT	DISTANCE AROUND THE OUTSIDE OF THE OBJECT	DISTANCE ACROSS THE MIDDLE OF THE OBJECT	DISTANCE AROUND DIVIDED BY DISTANCE ACROSS

Remember: Include appropriate labels on all measurements!

1. What do you notice about the numbers in the last column?

2. What is the average of all values in the last column?

The following lesson plan was inspired by teachers Stephen Phillips, Ed Carew-Robinson, and Ed McLaughlin from Wilson's School in the UK.

Cookie Mining

To develop inquiry and group work skills

Task: Identify your cookie:

- Discuss possible ways to do this
- Implement one of them
- Put the cookie back

Task: Cookie Mining:

- You need to mine your cookie for chocolate.
- How could you do it?
- Implement your chosen method.

Equipment: Paper plate, cookies, water, beakers, tweezers, spoon, weigh balance, inquiry activity sheet.
The *inquiry activity worksheet* is shown here below.

Cookie Mining	
You need to mine your cookie for chocolate.	
Questions	Answers
How could you do it? Describe your chosen method.	
How well did you do?	
How do you know?	
Did your method of separation produce any data?	
If time was a factor would you have changed your method?	
If you had to 'rent' equipment would you have decided on a different method?	

Specific Gravity: The 'Ryder' Method

Adrian J. Ryder
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In the usual method to find the specific gravity by apparent loss of mass the stone is suspended from a balance and allowed to enter the water below with the masses recorded for free hang and immersed. It is somewhat tedious to set up the apparatus in this manner. The 'Ryder' method makes a remarkable use of the law of conservation of energy to provide a result in a much easier manner as detailed below.

The Apparatus



The necessary apparatus for this method is as follows, from the left in the photograph above.....

- Container of water
- Stand through which a knitting needle is fitted to hold the
- Stone support , (a shaped two penny coin with four lengths of fine silver chain attached)
- Balance
- Test stone (a round quartz here)
- A specific gravity bottle. (pycnometer)

Method

Step 1.



The container of water is placed on the balance and the stone support is freely immersed in the water. The mass is 106.87 g.

Step 2.



The stone is now also placed on the weighing pan giving a mass of 108.53 g in total. Thus the mass of the stone is $108.53 - 106.87$ g, i.e. 1.66 g.

Step 3.



The stone is now placed on the stone support making sure it is wholly immersed. The total mass is now 107.52 g which shows a gain of $107.52 - 106.87$ g, i.e. 0.65 g.

This gain, by the principle of conservation of energy has to be the loss of mass of the stone when immersed in the water.

Thus the specific gravity of the stone is $1.66 / 0.65$ which works out to be 2.56.

The correction ...

A correction needs to be made since the water used was tap water and one of the advantages of this method is that pure distilled water is not necessary at all. The specific gravity of the water being used needs only to be worked out once for each fill of the container being used. The specific gravity of the water is now found as follows

Step 1.

A 25 mL specific gravity bottle is weighed, see below, 19.00 g



Step 2.

The bottle is now filled with the water and reweighed, see below, 44.80 g.



The specific gravity of the water is thus $(44.80 - 19.00) / 25$ which comes to $25.80/25$ which is 1.03.

This number now needs to multiply the 2.56 which was worked out earlier and this gives the true specific gravity of the stone to be 2.64.

The book figure for quartz is 2.65 so allowing for experimental error this is a remarkably close result.

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THE MYSTERY OF MATTER
SEARCH FOR THE ELEMENTS

A PBS three-part series on the discovery of the elements was shown in 2015.

You can access video clips from the website.

Episode 1: 'Out of thin air' (1754-1806) Priestley and Lavoisier

Episode 2: 'Unruly elements' (1859-1902) Mendeleev and the Curies

Episode 3: 'Into the atom' (1910-1960) Moseley and Seaborg

The DVD can be purchased from PBS and as a Region 1 DVD from Amazon UK.

For more background and resources see <http://www.mysteryofmatter.net/>.

In June IUPAC announced the provisional names for elements 113, 115, 117 and 118, which were temporarily named Ununtrium, Ununpentium, Ununseptium, and Ununoctium. The new names are:

- 113: Nihonium (Nh), after Japan
- 115: Moscovium (Mc), after Moscow
- 117: Tennessine (Ts), after Tennessee (specifically Oak Ridge National Laboratory, Vanderbilt University, and the University of Tennessee at Knoxville)
- 118: Oganesson (Og), after Yuri Tsolakovich Oganessian

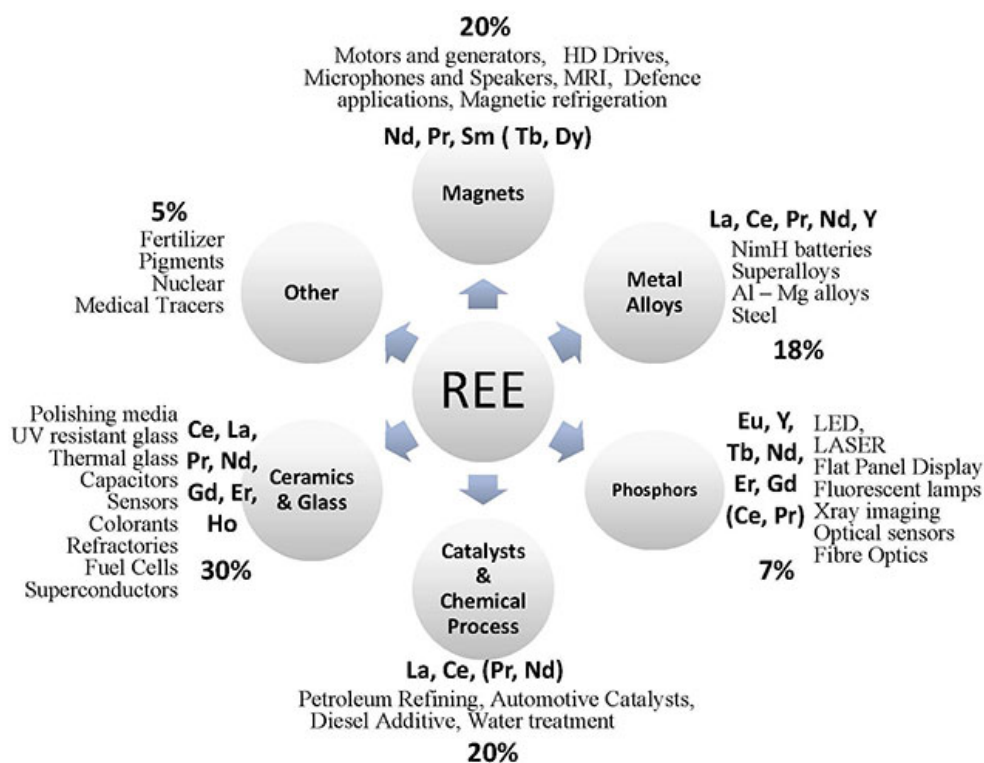
The Periodic Table of Elements

scientificgems.wordpress.com

1 H Hydrogen																	2 He Helium						
3 Li Lithium	4 Be Beryllium																	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium																	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton						
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon						
55 Cs Cesium	56 Ba Barium	57-71 La-Lu Lanthanides	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon						
87 Fr Francium	88 Ra Radium	89-103 Ac-Lr Actinides	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson						
57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium									
89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium									

Note that 113 and 115 have the ending -ium; 117 has the -ine ending as it is in group 17, the halogens, and 118 ends in -on as it is in group 18.0, a rare gas. (A free poster of the Periodic Table with the new elements is supplied with this issue.)

See <http://www.namibiarearearths.com/rare-earths-industry.asp> for a list of uses. The EU funded a project to look into the long-term supply of rare earth elements (REE) as a major strategic resource. (<http://www.eurare.eu/RareEarthElements.html>)



Uses of rare earth elements (<http://www.eurare.eu/RareEarthElements.html>)

PERIOD	1																	2						
	H																	He						
	3	4																	5	6	7	8	9	10
	Li	Be																	B	C	N	O	F	Ne
	11	12																	13	14	15	16	17	18
	Na	Mg																	Al	Si	P	S	Cl	Ar
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36						
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr							
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54							
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe							
55	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86							
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn							
87	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118							
Fr	Ra	Ac-Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo							
LANTHANIDE																								
6	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71									
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu									
ACTINIDE																								
7	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103									
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr									

Periodic table highlighting the **Light Rare Earth Elements** and **Heavy Rare Earth Elements**.

Periodic Table highlighting the rare earth elements

(<http://www.eurare.eu/RareEarthElements.html>)

Chemical Education in the Republic of Ireland 2015-2016

Peter E. Childs

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(An annual report prepared for the EuCheMS Division of Chemical Education and the IUPAC Committee on Chemical Education.)

Summary

The new Junior Science course is due to start in September 2016. This has reduced content (200 versus 240 hours) and no mention of chemical bonding. Six new textbooks for the new course were launched this year but its implementation, featuring more in-school assessment by teachers, is being hindered by opposition from the main second-level teacher's union. They will not cooperate with the new course and members are not allowed to attend in-service courses. This will affect 2/3 of the schools. In addition, the same union is in an industrial dispute with the government that threatens school closures in the coming year. Work is ongoing on new senior cycle science courses to provide more information to teachers on what the specified outcomes actually mean. Science teachers have been unhappy about the level of detail in the new courses. These are due to start in 3 years' time when the new junior cycle science courses have completed their first cycle. It is still an issue as to whether the new junior science course in chemistry will provide an adequate foundation for the existing or new leaving certificate chemistry course. The report of the STEM Review Group is still not published. This year is the last year of the CAO points system for university entry and from next year it will be simplified. Student numbers are increasing in the education system due to an increased birth rate, and this will have major implications for primary, secondary and tertiary levels in provision of new schools and new teachers.

(See

<http://www.education.ie/en/Publications/Statistics/Key-Statistics/Key-Statistics-2015-2016.pdf> for education statistics.)

Introduction

The main items of interest in the last year in relation to chemical education in Ireland education in general are:

1. Introduction of a new junior cycle science course from September 2016, against a backdrop of opposition from the main secondary teacher's union (ASTI).
2. Increasing numbers in education at all levels due to an increased birth rate in the last decade. See <http://www.education.ie/en/Publications/Statistics/Key-Statistics/Key-Statistics-2015-2016.pdf> for the latest statistics. This will require more investment in new schools and hiring new teachers. Third level has been badly hit with reduced funding, more students, loss of staff and a higher staff:student ratio.
3. In the 2016 there was an increased demand for third-level places, and a continued shift to vocational and STEM-related courses. Nearly 60% of the LC cohort stay on to third level and Ireland has the highest proportion of young people in Europe with third level qualifications.
4. Chemistry at LC level remains the 2nd most popular science after Biology, with a small increase in numbers. Agricultural Science has displaced Physics as the third most popular science. The unusual feature in Ireland is the dominance of Biology. (See Figure 1 below.) Every LC student takes English, Irish and Mathematics and Biology is the most popular optional subject. Science is not compulsory in Ireland at second level and ~90% take the Junior Science course. The % of the LC cohort in 2016 (55,708) taking each science subject is as follows:

Ag. Science 14.2% Biology 61.2%
Chemistry 16.3% Physics 13.9%

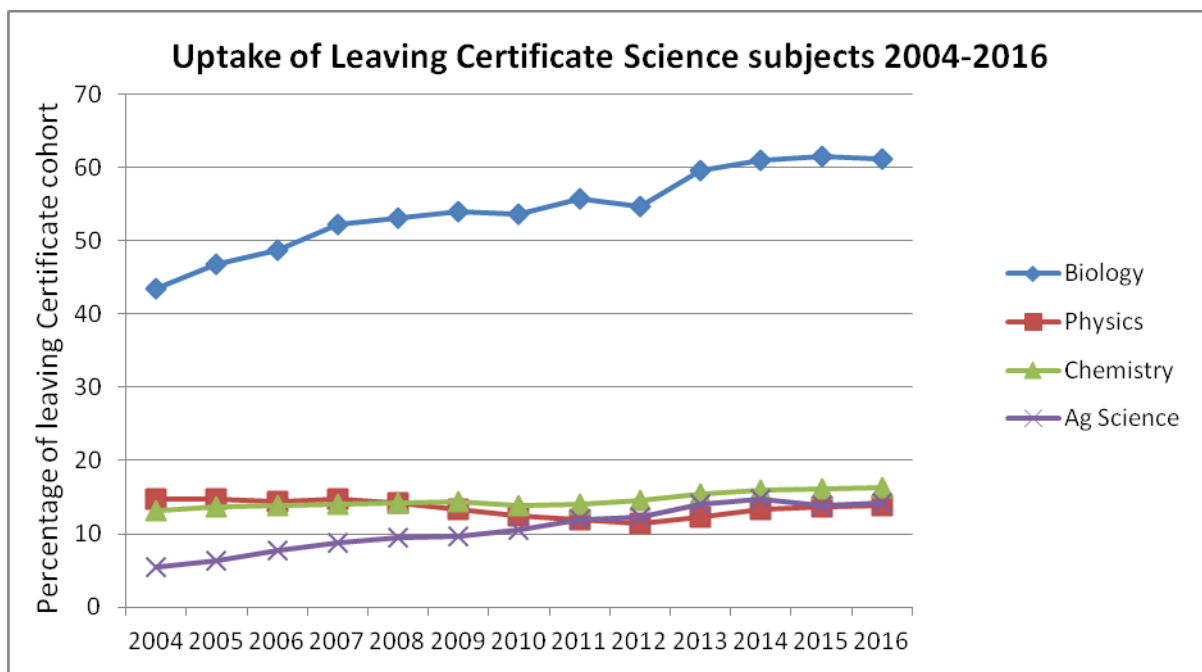


Figure 1: LC Science Statistics 2004-2016

5. Ireland's first full Professor STEM Education, Sibel Erduran, is leaving the University of Limerick at the end of 2016 for a professorship at the University of Oxford, having been in Ireland since 2014.

Curriculum developments

a) Junior cycle

The whole junior cycle programme is being revised and the new Science courses starts in 2016. This is a 3 year course. The specification is available at: <http://curriculumonline.ie/Junior-cycle/Junior-Cycle-Subjects/Science>

New features of this specification include learning outcomes across the unifying strand, **Nature of science**, and the four contextual strands: **Physical world, Chemical world, Biological world and Earth and space**. This is the first time there has been a significant emphasis on the Nature of Science and Earth and Space is a new addition. In April 2016, 6 new textbooks for the new courses were launched. The new course is due to be examined for the first time in 2019.

b) Senior cycle

The existing Chemistry syllabus was introduced in 2000 and is under revision. (Details can be found at

<http://www.curriculumonline.ie/Senior-cycle/Senior-Cycle-Subjects/Chemistry>)

A new Chemistry specification has been approved and for the first time it is intended to include assessment of practical work. (http://ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Senior_Cycle/What-s-New/Science/Scientific-Practices/ChemLC.pdf) (This also applies to the new Physics and Biology courses). A Science in Practice group has been set up to develop materials for teachers, expanding on the specification, which only includes learning outcomes.

(http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Senior_Cycle/What-s-New/Science/Science.html)

It would make sense to introduce the new courses at the end of the first cycle of the new junior science course i.e. 2019.

Courses, conferences, workshops

Chemistry teachers in Ireland are well-served by courses, workshops and conferences, in addition to CPD workshops provided by the PDST, the government body responsible for CPD. Special CPD courses for the new junior science course are being provided.

- October 2015 – the annual one-day ChemEd-Ireland 2015 was held in University College, Cork. The 2016 conference will be held in Dublin City University, Dublin. This is the only conference specifically for chemistry teachers and it was started in 1982 by Dr Peter Childs.
- April 2016 – ISTA weekend conference was held in Limerick in 2016 at Limerick Institute of Technology.
- June 2016 – the biannual SMEC research conference was held in Dublin in St. Patrick's College, Drumcondra.
- July – 10th Chemistry Demonstration Workshop was run in the University of Limerick and the BASF Summer School featuring Organic Chemistry was run in University College Cork.
- July – the Boyle Summer School was run in Lismore, birthplace of Robert Boyle. (www.robertboyle.ie/)

In August 2017 the ESERA conference will be held in Dublin in Dublin City University.

Science teacher publications

Irish science/chemistry teachers have access to a number of publications:

Chemistry in Action! Magazine – 2/3 times a year (free of charge). The Spring 2016 issue (#107) was a special issue on the TEMI FP7 project.

SCIENCE magazine – for ISTA Members, 3 times a year.

Science SPIN – a popular science magazine.

Science Education Research

Considering the size of the country and the science education community, Ireland is very active in science research and has a good international profile. There are science education research groups in Dublin City University (CASTEL), the University of Limerick (EPI*STEM), Dublin Institute of Technology, Trinity College, Dublin and University College Cork. There is a science and maths centre in Waterford Institute of Technology (CALMAST) with a focus on primary maths and science. Ireland has increased its activity in science education research in recent years as evidenced by: research awards (Masters and PhDs), publications, papers given at national and international conferences, and participation in EU projects.

In recent years Irish institutions have been the coordinator (ESTABISH, SAILS) or partners (ENGAGE, FIBONACCI, SALIS, TEMI, ChainReaction, Chemistry is all around us etc.) in European projects and the emphasis on IBSE has had an impact on those Irish teachers and schools involved in the various projects. The Irish Research Council has funded science education research studentships for several years, although these are highly competitive.

Science Teacher Education

There are several routes to becoming a science/chemistry teacher in Ireland:

- The concurrent route – with either a 4 years or 5 years (to Master's level) duration.
- The consecutive route – post bachelor degree and now 2 years and leading to a Master's qualification.
- An on-line course based on distance learning.

Two institutions have started to offer a 5 year course leading to a Master's qualification and there is pressure for all the concurrent courses to move to 5 years, in line with European practice. At present it is possible for a school leaver to be qualified to teach a science subject at second level by following either a 4 year, 5 year or 6 year course, with nominally the same qualification. Government grants for fees only cover 4 years of full-time study.

The Teaching Council of Ireland has changed its requirements for teacher accreditation and several courses have had to be modified to take account of this.

(<http://www.teachingcouncil.ie/en/Publications/Registration/Documents/Curricular-Subject-Requirments-after-January-2017.pdf>). Apart from the broad guidelines, there is considerable variation in the various courses offered by different institutions in how these are interpreted. There are very few permanent jobs in teaching and many teachers are on short-term contracts. There is a significant over-supply of science teachers in Ireland and at present there no quotas in place to limit the number of teachers produced. Many new Irish science teachers go abroad to find work.

Science is part of the primary school curriculum from year 1 to year 6 and all primary teachers have courses in science education, although of limited duration.

Informal and non-formal science education

One of the great successes of the Irish system is the focus on non-formal science education through the BT Young Scientists Exhibition, an all-Ireland event, which started in 1963 (<http://btyoungscientist.com/>). The winners of the Irish event have had great success in international competitions.

The SciFest events reach even more students around the country and involve one-day regional fairs and a national fair. This gives every school an opportunity to participate and to encourage science project work in their science teaching. (www.scifest.ie)

Science Week Ireland is an annual event in November (www.science.ie) run by Science Foundation Ireland (SFI). SFI is also responsible for the Discover Science and Engineering Education and Outreach programme (<http://www.sfi.ie/discover-science-engineering-dse/>), with a special emphasis on primary schools. SFI also sponsors Smart Futures (www.smartfutures.ie/), which encourages STEM personnel in industry to visit schools and talk about their work and career opportunities.

Chemical Education Committees

The RSC Education Division Ireland Region continues to be active and covers the whole island of Ireland, North and South. The RSC has appointed an Education Coordinator for the Republic, based in Trinity College, Dublin, and working with a coordinator and administrator based in N. Ireland. The Spectroscopy in a Suitcase (SIAS) project is being expanded with centres in Dublin, Cork and Limerick/Galway. Postgraduate students visit schools with a kit of spectroscopic instruments, to introduce senior cycle chemistry students to modern spectroscopic techniques. (<http://www.rsc.org/learn-chemistry/resource/res00001239/spectroscopy-in-a-suitcase?cmpid=CMF00002351>)

The Institute of Chemistry of Ireland (ICI) has revived its Education Committee, chaired by Dr Odilla Finlayson (DCU) and ICI is affiliated with EuCheMS, ECTN and IUPAC.

The Irish Association of Science Education Lecturers (IASSEL), which was started in 2000, was revived this year to provide a forum for those involved in science teacher education and science

education research. The convenor is Mary Mullaghy (TCD).

Irish Science Teachers Association (ISTA)

The ISTA is an active body representing science teachers with a membership of over 1000. It is a solely voluntary body with no full-time officers. (www.ista.ie) The main activities include:

1. SCIENCE magazine – 3 times a year. (<http://www.ista.ie/publications/science-journal>)
2. An annual weekend conference – in 2016 it was held in Limerick and in 2017 in NUI Maynooth.
3. A national schools science quiz with regional heats and a final in Dublin.
4. Regional monthly branch events around the country.

Institute of Chemistry of Ireland activities

The Institute of Chemistry of Ireland (www.chemistryireland.org) is the professional body for chemists in Ireland. It publishes an electronic magazine (*Irish Chemical News*, <http://www.chemistryireland.org/html/ichemnews.html>) and has an annual Congress, together with a number of specifically education-focused activities. The Institute also works closely with the Royal Society of Chemistry Ireland Region and the Society for Chemical Industry in organising events. ICI is the recognised professional body representing chemists in Ireland and is affiliated with EuCheMS, ECTN and IUPAC.

Some educational activities:

1. Schools Newsletter Competition 2015-2016 was on the theme of 'Chemistry & Light', as 2015 was The International Year of Light.

The 2016-2017 ICI Schools' Chemistry Newsletter competition is now open to all second level students. This year's theme is 'The Chemistry of Climate Change'.

2. The Institute sponsored prizes in the 2015 ISTA Senior Science Quiz.
3. The Institute presented medals to the SIX candidates who tied for top marks in last year's Leaving Cert Chemistry paper (Honours).
4. As is customary, ICI provided a sum of money in sponsorship to the organisers of the Research Colloquium, hosted by

UCC: <https://www.ucc.ie/en/chemistry/chemistry-colloquium-2016/> This is an annual event for chemistry postgraduates to present their research to their peers, which is hosted by each University chemistry Department in turn.

5. The Institute were also pleased to sponsor prizes in the Eurachem Analytical Measurement Competition, which was hosted by Athlone Institute of Technology this year.

6. Finally, the Institute's Education Committee have been working on a response to the new Leaving Certificate Chemistry Syllabus.

Chemical and biopharmaceutical industry

Ireland continues to punch above its weight in the biopharmaceutical sector, which has weathered the recession and provided a valuable backbone for the Irish economy since 2008. There has been a shift to biopharmaceuticals and the industry body is now called Biopharmaceutical Ireland (<http://www.biopharmaceuticalireland.ie/>) and although international mergers in the industry have resulted in some plant closures, these have been offset by new plants coming on stream. There is a big demand for chemical engineers, chemists and biochemists in the industry.

A report has just been published (8/8/16) on Future skills needs in the Biopharma Industry and forecast 8,400 new jobs in 2020. The industry currently employs 28,200 people (Of these, 21,500 were engaged in Pharma manufacturing and related services, while 6,700 were employed in Biologics) and is responsible for €30.2 billion in exports (2015). (<http://www.skillsireland.ie/Publications/2016/Biopharma-Skills-Report-FINAL-WEB-VERSION.pdf>)

This quotation indicates the importance of the chemical and pharmaceutical industry to Ireland's economic growth. In 2015 Ireland experienced the biggest growth in GDP in the EU.

Of the €89.2 billion goods exported [in 2014], chemicals and related products, which include pharmaceuticals, accounted for 58 per cent or €51.5 billion of the total.

Within this category, exports of medical and pharmaceutical products increased by €973 million (+5 per cent) to €22.2 billion in 2014, as

new drug lines began replacing the ones that have come off patent.

Irish Times 22/5/15

<http://www.irishtimes.com/business/economy/exports-the-primary-driver-of-economic-turnaround-1.2221285>)

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This report was prepared by Dr Peter Childs, the Irish representative to EuCheMS Division of Chemical Education and the IUPAC Committee for Chemical Education. The content is the best available but depends on people sending in news of activities. If items or events have been omitted please let the author know. Past reports are available on the EuCheMS Division of Chemical Education website.

If you wish to have items included in the 2016-2017 issue please send them to peter.childs@ul.ie by the end of June 2017.

Organic Acids (1)

On p. 65 you will find the structures and sources of some common organic acids. A free A3 poster of this is supplied with this issue. You might like to use this as the basis of a class project for LC Chemistry.

You could get the students to research the following:

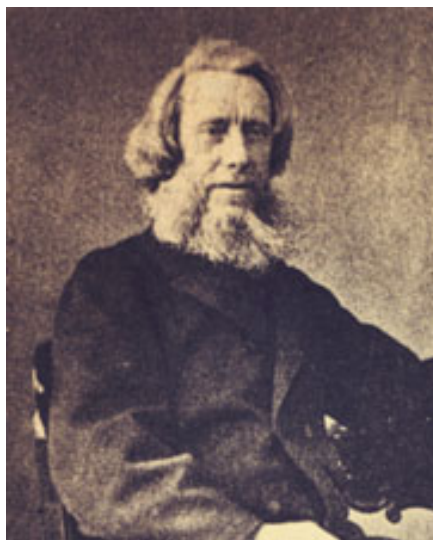
- **Some sources of the acids are pictured but how are the acids made/obtained industrially?**
- **What are they used for?**
- **Look up their acid dissociation constants and decide which is the strongest/weakest acid. Rank them in acidity.**
- **How many are carboxylic acids?**
- **How many end-points would you find in an acid-base titration of these acids?**
- **What is their state of matter (s or l) at room temperature?**
- **One of them is not a carboxylic acid. Where does its acidity come from?**

□

The Instrument Makers No. :10

John Joseph Griffin 22/Jun/1802 – 9/Jun/1877

Adrian Ryder tutorajr@gmail.com



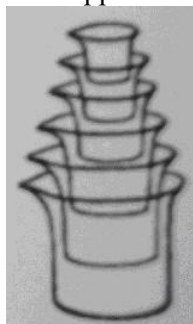
John Joseph Griffin

John Joseph Griffin's father was Joseph Griffin, a prosperous Glasgow merchant. Joseph Griffin's "House of Griffin", set up about 1795, dealt with the sale of books and imported scientific apparatus. On the 22th June 1802 John Joseph was born in Shoreditch, London. The family moving to Glasgow shortly afterwards. John's eldest brother Richard Thomas had been born in 1790 and mention is made of other unnamed children, none of whom has a bearing on this essay. Richard Thomas (1790 – 1832) began work in his father's business in 1805, aged about fifteen, the usual age for a boy to be apprenticed

into a family business, and John Joseph joined them in 1817.

Apart from 'learning the trade', John also studied at Glasgow's Andersonian Institute, which had a strong scientific emphasis. After this he was apprenticed to Thomas Tegg and Co., booksellers, of Cheapside, London, in order to further his interest in the family firm. He was also to spend time abroad studying chemistry in Paris and, for a time in 1832, worked with Leopold Gmelin in Heidelberg, in order to be effective in the apparatus side of the business, while Richard concentrated on the book side. John made a number of visits to Germany making arrangements to acquire apparatus for sale and obtaining permission to manufacture others.

Joseph died in 1820 and Richard took over the running of the company, under the name Richard Griffin & Co. where he very quickly inaugurated changes. Not content with merely selling books he set up a publishing side of the business. In order to popularize reading, and so, no doubt, to boost the sale of books, a public library was opened at the firm's premises in Hutcheson Street. John's interest in the scientific side saw the brothers manufacturing their own scientific apparatus for sale by 1826, to augment the firm's dealings with those made abroad and imported.



Above left, the Berzelius 'German' beaker of the 1820's, Middle, the set of 6 'Griffin's beakers, costing four shillings in their 1877 2nd edition catalogue, and today's 'Griffin' graduated beaker with its distinctive spout.

One simple result was their production of round filter paper of various sizes in bulk about 1837.

This totally replaced the previous filter paper in use, which was square and had to be cut by hand

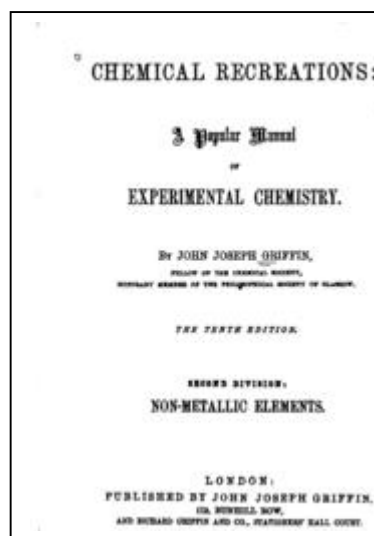
for use. They also prepared books of test strips, which still remain in general use. Not satisfied with the composition of the glass beakers coming from Germany, John spent much time in finding the right composition of glass for use and designed the squat form of beaker, the Griffin beaker, that generations of students and scientists have taken for granted.

John's company not only made and sold individual pieces of scientific equipment but also sold mineralogical cabinets filled with various categories of specimens and also sets of apparatus for home and laboratory usage. I detail one such set from the 1838 edition of the 'Recreations', which is priced at one guinea, (one pound and one shilling) as follows:

Set 1. for small preparations, elementary testing etc.,

*Berlin Porcelain pestle and mortar,
Two glass solution flasks
Lamp furnace
Tube holder
2 sets of six different size test tubes
2 conical test glasses
Small tube frame
Three glass stirrers
Two test books
Three precipitating bars
Test spoon and spatula
Set of four cylindrical jars
Filtering funnel
100 circular filters
Stone washing bottles
Porcelain capsule
Three stoneware capsules
Berlin porcelain crucible
Berlin porcelain cup
Japanned blowpipe
Flint glass retort
Stoneware gas bottle
Three feet of gas delivery tube
Small cork borer.*

Quite a lot for a such a reasonable sum one must agree. Various other more complex sets were also available. One was also permitted to mix and match where one already had sufficient of a particular piece of equipment.



Title page of Chemical Recreations

John's interest in science, especially chemistry, was to remain with him throughout his life. In 1823 the firm published his book "*Chemical Recreations: a popular manual of experimental chemistry*", which was highly successful and went through several revised editions, some eight by 1838. This was the first scheme of practical work designed for the student of chemistry and showed a great deal of innovative thought with regard to method and apparatus. The popularity of the various editions was enhanced by a 24 page section detailing apparatus available from the firm.

John's reason for writing '*Chemical Recreations*' is best given in his own words from the preface "...I have been induced to adopt this course by a desire that my readers should be taught to think as well as to experiment, and thus be qualified at an early part of their study to discriminate between the true and the false, and acquire the facts of the science without being mystified by its fictions." He also believed that "One experiment, well conducted, and carefully observed by the student, from first to last, will afford more knowledge than the mere perusal of a whole volume."



Title page of an early catalogue

John was at times outspoken and again in *'Chemical Recreations'*, commenting on a report from a professor about the great breakage of glassware by students without any great deal of scientific advancement, he gives what must often go through the science teachers' minds: "*this proves very clearly that test glasses are never broken in large quantities but by stupid people. It would be proper to dismiss students of this kind from a laboratory on the same ground that incurable patients are dismissed from a hospital – to make room for others that are not incapable of improvement.*"

John's other works were *'A Treatise on the Blowpipe'* 1827, A translation of Heinrich Rose's *'Handbuch der analytischen Chemie'* 1831, *'System of Crystallography'* 1841, *'The Radical Theory in Chemistry'* 1856, *'Centigrade Testing as applied to the arts'* 1860, *'The chemical testing of Wines and Spirits'* 1866 and 1872, *'Chemical Handcraft'* 1866 and 1877, with all books being published by the firm.

Between 1840 and 1860 nine of his papers appeared in various scientific periodicals. John was also involved in the editing of the *Encyclopaedia Metropolitana*, which was published by the company in 59 parts between the years 1817 and 1845.

Richard died in 1832 and John was left with the entire care of the business, as Richard's son Charles, (1820 – 1862), was only twelve years of age.

In this same year (1832) John married Mary Ann Holder, and between them they produced twelve children, among whom were William (FCS) and Charles (FSA), who both entered John's company and made their own additions to the chemical apparatus being produced by the company.

John's deep interest in chemistry saw him actively encouraging the subject's development in both schools and advanced institutions of education. He was a prime mover in the revival of the Glasgow Philosophical Society and the foundation of the Chemical Society in 1840, which has its headquarters in London, being incorporated by Royal Charter in 1848, and John became a Fellow of the Society.

Glasgow's influence in the publishing trade was fading, whilst that of London was becoming dominant, and so John decided to move the business to London in 1848. Charles, Richard's son, once of age, had joined the firm and had shown a growing interest in the publishing and book sales side of the firm and so in 1852 John and his nephew Charles dissolved the partnership. Charles taking the bookselling and publishing part of the business, becoming Charles Griffin & Co. John, at last, was able to indulge his prime interest in the scientific side of the manufacture and sale of instruments, trading as J.J. Griffin & Sons. By 1860 John's company had a shop on Bunhill Row, moving later to Long Acre in London. The firm sold not only imported apparatus but also sold self-designed and self-made apparatus and equipment. In later years J.J. Griffin & Sons developed, through a series of mergers, into the major scientific supplier Griffin & George.

John died at his residence, Park Road, Haverstock Hill, on the 9th June 1877.

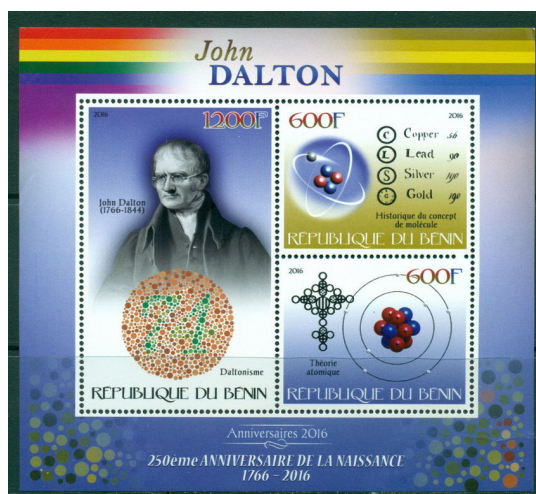
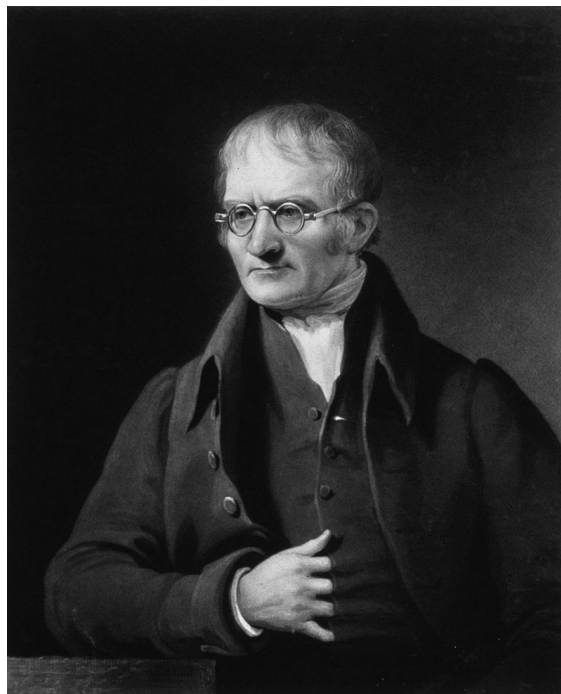
References...

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books.google.ie/books?id=1eE4AAAAAAAJ
<https://archive.org/details/chemicalrecreat04grifgoog>
books.google.ie/books?id=9QJLAAAAYAAJ

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Chemical Quotations: #7

John Dalton (1766-1844)



“Matter, though divisible in an extreme degree, is nevertheless not infinitely divisible. That is, there must be some point beyond which we cannot go in the division of matter ... I have chosen the word ‘atom’ to signify these ultimate particles.”

Dalton’s Manuscript Notes, Royal Institution Lecture 18 (30 Jan 1810)

Places to visit: Allihies, West Cork



Allihies, Beara, West Cork, Ireland
ALLIHIES COPPER MINE MUSEUM



A view looking over Ballydonegan Bay to Allihies, with the remains of the mines on the hillside beyond. The unusual white sand of the bay is quartz, a residue of mining.

Allihies, lying at the tip of the Beara Peninsula in West Cork is one of the most beautiful places in Ireland to visit. In the 19th century it was a hot spot of industrial activities with over 1500 people involved in mining and processing copper ore. The landscape still bears the signs of this intense industrial activity and the Allihies Copper Mine Museum (www.acmm.ie), housed in the old Methodist Chapel (built in 1845 for the

mineworkers), gives an excellent introduction to the local copper mining industry. Several copper mining trails have been marked out in the district, so you can visit some of the mine sites. (See <http://www.bearatourism.com/loopallihies.html>)

This a quiet, peaceful place today but 150 years ago the air would be filled with the smoke from the engine houses and the noise from the hammers

crushing rock to release the ore and the noise of hundreds of workers.



This map of the walks shows the main mine sites at Doonenn, Mountain Mine, Coom, Caminches and Kealogue.

The mines were started by ‘Copper’ John Puxley in 1812, and the Puxley family made a fortune from them. Their story was fictionalised by Daphne du Maurier in her novel *Hungry Hill*, named from a nearby mountain overlooking Castletownbear. The Puxley’s built their own ‘castle’ nearby at Dunboy, overlooking the quay and the Copper House, where copper ore was stored before shipping to Swansea for smelting. There are several walking trails over the mountain, visiting the various mining sites. There are many shafts, which are fenced off and one can see traces of copper staining on exposed rocks.



A mine working showing copper staining

The various sites are littered with waste rock, much of it quartz, and you can easily find pieces with small inclusions of gold-coloured

chalcopyrite (CuFeS_2), the main ore mined here. When exposed to the air this is weathered to give carbonates. (See <http://www.acmm.ie/geology/> for a discussion of the geology and photos of the rocks.)

History of mining

The mining at Allihies goes back to 1810 when outcrops of copper at Dooneen were pointed out to John Puxley. He started mining at Dooneen in 1812. Mining stopped here in 1838 and was resumed again at the Dooneen mine from 1872-78. Over the years 4 other mines were opened (and closed) depending on the quality and quantity of the ore. At their peak they were very lucrative for the owners. Each mine had one or more engine houses for steam pumping engines, and steam engines were also used to power ore crushers. Water wheels, driven from reservoirs higher up the mountains, were also used to power ore crushers.



The location of the first mine at Dooneen on the coast

Caminches Mine opened in 1818 and closed in 1850, peaking in 1835, and little remains to be seen.



The remains of the engine house at the Coom mine

The Coom Mine was the last mine to open in 1870 and closed in 1882. It was not very productive but the remaining engine house is in a spectacular location high on a bluff (see above).



The remaining engine house of the Kealogue mine

Kealogue Mine opened in 1842 and 18 shafts were sunk (several of which remain to be seen), and 4 engine houses one of which remains to be seen. The quartz sand left after the rock had been crushed and the ore removed, was washed downhill and forms the white sand of Ballydonegan beach. The mine closed in 1882.



**The Mountain Mine engine house at Allihies, looking out over Ballydonegan bay.
(see also cover photo)**

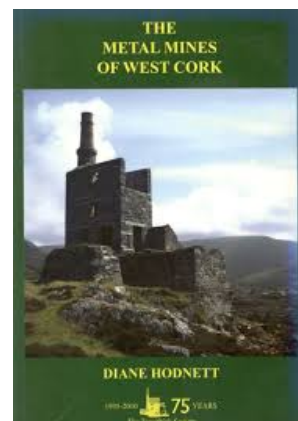
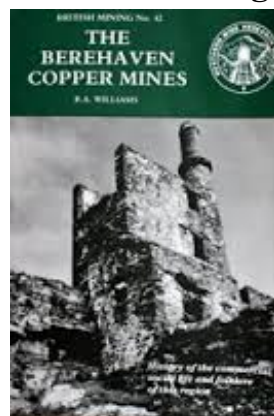
The most impressive remains are those of the Mountain Mine, high on the mountain overlooking Allihies. The copper vein was discovered in 1813 and originally worked as an opencast mine. The conserved engine house is known as the Man Engine House (erected 1862) as it powered a moving step-on, step-off lift or escalator that carried men down into the mine and up again. The Mountain Mine was the most productive mine and reached a depth of 421 m, 280 m below sea level, which required continuous pumping. The mine remained in production to 1882.

I hope you can see from this short tour that there is a lot of interest to see at Allihies and it is well worth a visit. Start with the museum in the restored Methodist Church (many of the Cornish miners brought in to do the skilled work would have been Methodists).

Estimates of how much ore was raised over the 70 years or so of production range from 962,000 to 1,219,000 tonnes. Between 1813 and 1913 290,170 tonnes of concentrate were produced from the mines at Allihies, yielding 28,615 tonnes of copper. The copper ore was shipped by sea from Dunboy (over the mountain from Allihies), where it was stockpiled, to Swansea where it was smelted into copper metal. In 1836 the exported ore was sold for nearly £75,000 in Swansea, which would be worth ~£8,616,000 today. The Bearhaven copper mines made the Puxley family very wealthy. When the mines closed many of the workers emigrated to work in mines overseas, for example, in Butte, Montana.

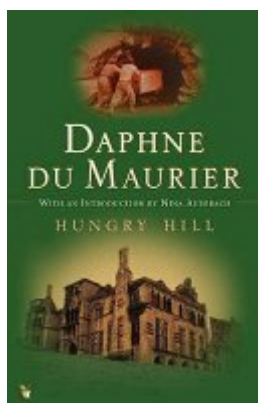
Various attempts have been made to reopen the mines, none of them successfully, the latest from 1956-62 by the Emerald Isle Mining Company. There is currently interest again in Allihies and the latest is the European Metals Corporation (formerly Gondwana Oil Corporation) (see <http://www.europeanmetalscorp.com/index.html>), which mining licences in the Allihies area and their website has useful information on the mines and their potential. There is some talk of looking for gold, often associated with copper and quartz. (All the photos in this article were taken by P. E. Childs on visits to Allihies in August 2016.)

Further reading



A history *The Berehaven Copper Mines* was written in 1991 by R.A. Williams, later reprinted in 1993 by the Kenmare Bookshop, but is now of

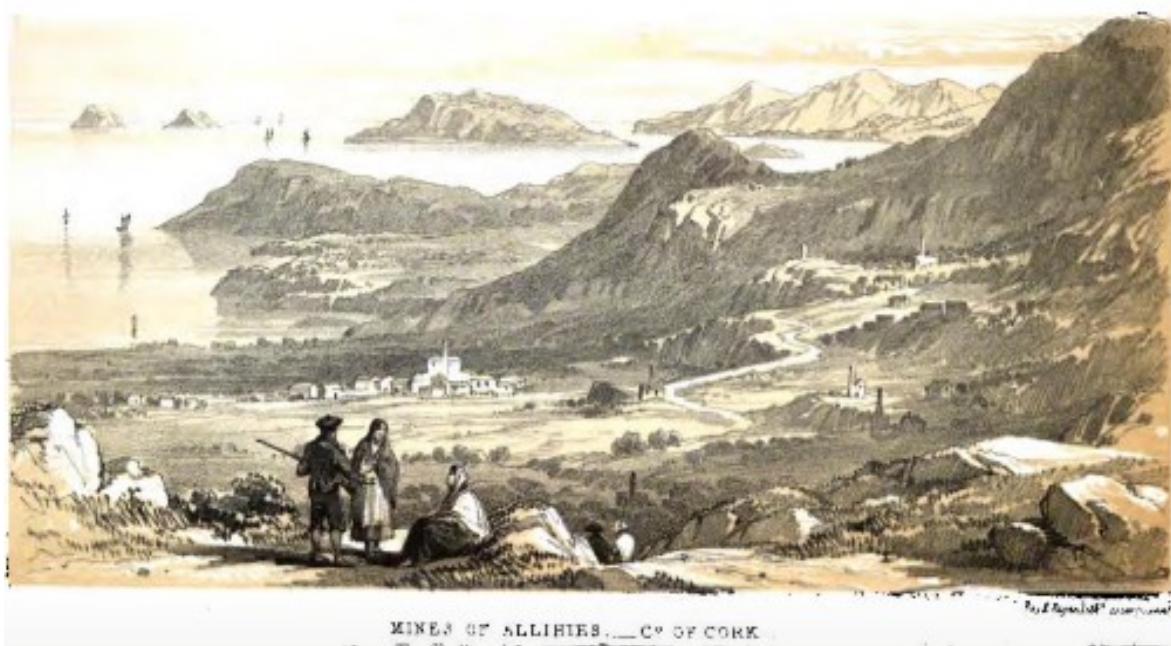
print and hard to obtain. A later book by Daphne Hodnett, *The Metal Mines of West Cork* (2010), has a chapter on The Beara Peninsula Mines, but is also out of print.



The novelist Daphne du Maurier was a friend of the Puxley family and stayed at their house in Dunboy (shown here on the cover). There she wrote the book *Hungry Hill* in 1943, a fictionalised retelling of the history of the mines and the Puxley family (called Broderick in the

Some contemporary accounts:

1. **Lady Chatterton, Rambles in Southern Ireland, 1838 (published 1839)**
(this may be downloaded at <https://archive.org/details/ramblesinsouthi02chatgoog>)
It is a rare contemporary account of the mines, especially the illustration below.



An illustration from the book done by Lady Chatterton of the mines, showing many engine houses at this time, which coincided with peak production.

book), which is still in print. She located the mines at Hungry Hill, several miles from Allihies. It is well worth a read and was made into a film in 1947.



The poster from the 1947 film of Hungry Hill

“Then, nearer, Cooleagh bay, which is the summer harbour of the mines. On the side of the rocky eminence before us were the works of the mines the engines and cottages of the miners scattered irregularly about. Of this extended view, which gives a map-like idea of the south west of Ireland, the annexed sketch (above) will convey some, but I fear an imperfect notion.

We had a note of introduction to the Protestant chaplain of the mines, and we found him most civil and attentive to us. The mines are now far from being so productive as formerly. The Company by which they are worked is at present going to great expense in a search, hitherto unavailing, after a new vein and if the assertion of one of the Captains be correct, they are now losing money. This account, however, is at variance with the stated produce; formerly it amounted to 600 tons a month; now it averages 350 tons. Copper ore is worth £9 a ton; but the purchasers always take off 2% per cent a ton, to cover their risk: consequently the real price is £7. 10s. a ton; this, at the former rate of production, would give £54,300 a year; and at the reduced supply, would still give £31,500 a year. An eighth goes amongst the owners of the fee - four, I think, in number; formerly the principal one received £4000 a year. The Company's shares amount to 64, which are divided, I was told, between five proprietors, of whom Mr Puxley, whose place we passed to-day [Puxley Castle], is the chief. The works, it is said, employ one thousand people. Girls, who attend the washing of the ore, get 34d. a day; boys, 6d.; men, from 1s. to 1s. 4d.

Miners work by task-work; a gang undertakes a piece of work at so much per ton, the price being fixed by a master, the ore to produce 10 per cent., to ascertain which an assay office is established. There are four captains; the men are paid monthly, and the calculation is made so as to give the men who handle powder about 1s. 4d. a day, the others about 1s. Many Cornish miners and their families are established here, and the English and Irish, notwithstanding a difference of religion, agree perfectly well together. It is said that for ten years there has not been a quarrel among the workmen, owing to a rule, which is strictly enforced, that whoever quarrels is immediately dismissed.

We visited the school, where the children looked very comfortable; the girls with their hair very coquettishly braided and arranged. As we ascended afterwards, we met two little Cornish

children, one of whom answered “Tolerably well” to every question. “How do you get on at school?” “Tolerably well.” “How do you like work?” “Tolerably well.” “Can you read?” “Tolerably well.” “This road is intolerably steep?” “Tolerably well.” And so on, still the same answer.

The mine is now about 110 fathoms deep, and they are working it deeper, the vein occupying a narrow space. Five steam engines are employed: the first we visited works the crushing machines and pounders. Over the pounded ore water is passed, the ore is then sifted, and after a number of successive washings, the dross is separated. The situation of the head Captain, as the principal miner is termed, is worth about £300 a year, which includes his house and perquisites. Our reverend guide was extremely polite, but I thought rather too fond of steam-engines, of the construction of which I must confess myself very ignorant, although I cannot help seeing the revolution they are effecting everywhere and in every thing. After having inspected the first works, we ascended to another engine, which is much higher up the mountain: and on our way we saw some curious clefts in the rock, which had been made by former excavations, and travelled over heaps of ore the refuse of former works. The Captain observed that as far as his experience went, in Irish mines the richest part of the vein is near the surface.

The upper engine is used for pumping water out of the excavation; near it is the vent for the escape of the smoke from another engine, which is at work in the mine, about 160 feet below the surface. To pay this engine a visit, and thus to see something of the interior, was our next object; for which purpose we re-descended. The passage by which we entered has a rail for bringing out the ore, and it also serves as a channel for the exit of the water pumped up. We had a wet and dirty walk. Stooping low, and creeping along the side, to avoid the water, we advanced to the steam engine; we then diverged into a side gallery, to see the men at work. By means of ladders, the lower levels are attained; but as we were not properly equipped, none of my party attempted to descend.

On our return, we visited some of the cottages, and with all my partiality for Irish peasants, I could not but see the striking superiority in point of cleanliness of the cottages belonging to the English miners. After leaving the mines, we

proceeded by a short cut to the top of the pass, as the road was too steep to allow of our remaining in the carriage we were accompanied by a poor fellow, who just before our arrival had lost his thumb, from an accident with a steam engine; he however will receive pay until he is able to return

to his work; this is done by an arrangement, under which a small deduction is made from the pay of those employed. “ (Volume 1, Pp 75-76)

□

2 Robert Kane, The Industrial Resources of Ireland, 1845, p. 185-6

<http://www.ucc.ie/celt/published/E840001-001/text005.html>

The most important mine in this district is that conducted by **Captain Read**, near **Ballydonegan Bay** on the west side of the promontory of **Bere**. The existence of mineral deposits in this locality was first recognized by **Colonel Hall**, and pointed out by him to the proprietor, **Mr. Puxley**. The following particulars as to its actual state were communicated to me by its very skilful manager.

This mine was commenced about thirty-three years ago, under the name of the **Allihies** mine, but as the workings are now removed from the land of **Allihies**, the name of the **Berehaven** mine has been adopted for it. In the space of three or four miles are several veins, most of which run east and west, and dip to the north. Some of these were found on trial unproductive and were abandoned, but two veins, one called the **Mountain**, being situated 450 feet above the level of the sea, on a large east and west lode, the other, the **Caminche** vein, which runs north-east, have furnished the principal workings.

In the **Mountain**, a great quantity of copper ore has been raised; there is still obtained about 200 tons per month, of about 10 per cent. produce. The principal working is about 760 feet in length and 852 feet in depth. The lode is sixty feet wide in one place, but branches and narrows in other places to three or four feet. It consists of quartz and copper pyrites. It is all blasted with gunpowder. The deepest levels had been hitherto rather unproductive, but just now, ore of excellent promise has been raised from them.

The **Caminche** vein is worked for about 570 feet in length and 912 in depth. The engine shaft sinks sixty feet more. The vein runs north-east and dips south-east. It has been very productive; the ore is cleaner than in the **Mountain** vein; the breadth of the lode is from one to twelve feet. There are employed in these mines about 1000 persons, as follows:

Miners . . .	400
Smiths and joiners . . .	30
Helpers . . .	25
Labourers . . .	245
Boys . . .	170
Girls . . .	130

Mr. John Read, who is engaged in this mine under the direction of his father, kindly furnished me with the following analysis of the usual quality of ore: he found it composed of:

Copper:	10.2
Iron:	10.8
Sulphur:	14.8
Quartz:	63.9
Loss:	0.3
Total:	100

A short distance from these copper veins, is a vein of lead, which was worked some years ago, and some ore raised, but as it did not promise very well, the workings were not proceeded with.

Owing to the conformation of the surrounding country, there is no command of water power at **Allihies**, and all the machinery for crushing and dressing the ore is driven by steam engines, of which there are five at work. The ore raised in this mine is about the same quality as at **Knockmahon**, varying from 10 to 15 per cent. of copper. In the return made to the **Railway Commissioners** in 1837, the average annual produce is given at from 6000 to 7000 tons, valued at £9 per ton. I find by the returns of sales at **Swansea**, that the produce was in:

Year	Tons	Value (£ s.d.)
1836	6,418	£74,879 18s 0d
1840	4,808	£40,981 2s 6d
1843	4,446	£36,348 6s 0d

The produce has, therefore, diminished considerably in amount, and still more in richness, but it is to be hoped that this may not continue.

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Chemical Anniversaries

John Dalton (1766-1844)

Peter E. Childs

Early life and education

John Dalton was born 250 years ago on September 6th, 1766. He was one of the founding figures of modern chemistry, putting the ancient Greek idea that matter was made up of small, indivisible particles (atoms) on a firmer scientific footing. The fundamental idea of modern chemistry is that matter is made up of a limited number of atoms of various sorts, building blocks, which can be combined and rearranged to produce different substance, just as plastic building blocks can be used to make a wealth of models. The idea that everything is made up of atoms has been described as “this master-concept of our age” (Greenaway, 1966, p.227) was due to John Dalton. He applied Newton’s idea of small, indivisible atoms, which originated with the Greek philosopher Democritus, to the understanding of gases in the atmosphere, and then extended the idea to a quantitative explanation of chemical composition. His contemporary, the Swedish chemist, Berzelius, said: “*If one takes away from Dalton everything but the atomic idea, that will make his name immortal.*” Fulsome praise for a humble, colour-blind, Quaker school master living in the provinces.

John Dalton was born around September 6, 1766, to Quaker parents, in Eaglesfield, near Cockermouth, a remote village in Cumberland (now Cumbria), in N-W England. He was largely self-educated, and learnt most of his mathematics and sciences by teaching others. He learned some mathematics in a local school until the age of 11, started his own school at the age of 12 and at 15 he joined his brother Jonathan, and they taught at and later ran a Quaker school in Kendal, Cumbria. The Quakers were a small, but influential Christian group, and Dalton was thus labelled in the England of his day as a non-conformist or dissenter, like Joseph Priestley and Michael Faraday. As a result of this Dalton moved in restricted educational and social circles, growing up in the countryside, and then spending most of his life in relative obscurity in Manchester, then a provincial backwater. The Quakers were a tight-

knit social group, who valued education, and were very successful in business and industry, and were active in philanthropy. However, they were excluded from the universities and so had to set up their own influential and very innovative schools and colleges. Dalton was taught and influenced from 1781 by John Gough, a blind polymath from Kendal, who taught the young Dalton Latin, Greek, French, Mathematics and Science. In return Dalton read to him from books and newspapers. Gough encouraged Dalton to study natural phenomena and to keep a meteorological journal, which Dalton started on March 24, 1787 and kept up methodically for the rest of his life, making his last observations on his deathbed, nearly 60 years later. He made over 200,000 measurements over 57 years. These observations started Dalton’s scientific career and provided the material for his first book (*Meteorological Observations*, 1793). His observations set him thinking about gas mixtures in the atmosphere, and this led him to formulate his Law of Partial Pressures, which formed the foundation of his views on the particulate nature of matter and the atomic theory.

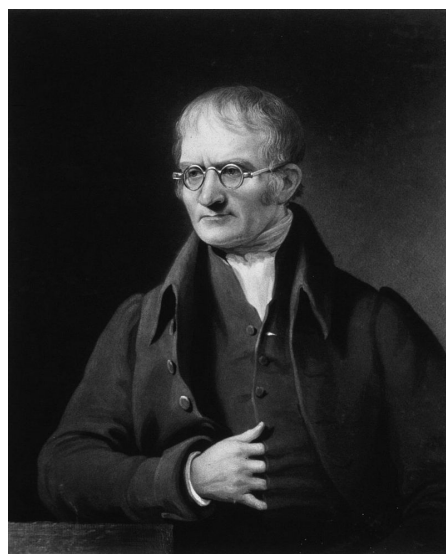


Figure 1 John Dalton by Charles Turner in 1834

Manchester and the atomic theory

In 1793 he moved to Manchester, then a growing industrial town, as a Professor of Mathematics and Natural Philosophy at New College, a dissenting academy. He stayed there until 1799, only resigning to devote himself fully to scientific research. He taught private pupils to earn a living and stayed in Manchester for the rest of his life, where he did all his important work, most of it published in the *Memoirs* of the Manchester Literary and Philosophical Society (MLPS), the obscure journal of an obscure society in a minor provincial town. Dalton joined this society in 1794 and was first Secretary from 1800, and then President from 1817 until his death in 1844. His first scientific paper was published by the MLPS in 1798, where he described his own red-green colour blindness. He was the first to describe this type of colour blindness, which is now known as Daltonism, and it is more common in males than females. He published 116 essays in the *Memoirs* of the MLPS.

His study of the air, initiated by his weather measurements, led him in 1803 first to the Law of Partial Pressures, and later to study the combining masses of elements, leading to the Law of Multiple Proportions. He compared marsh gas (methane, CH_4), with olefiant gas (ethene, C_2H_4), and found that ethene contained double the mass of carbon for the same mass of hydrogen. Dalton drew up the first list of relative atomic weights. This led him to make the conceptual leap to an atomic model, in order to explain chemical composition, whereby one atom of an element could only combine with one or two atoms of a second element, forming different compounds of different composition. Dalton visualised atoms as small, hard balls and he made small wooden models to explain how atoms combined. These were the first atomic and molecular models and he invented a set of rational symbols for writing chemical formulae (Figure 2). These ideas were first aired in public in 1803 at a meeting of the MLPS, mentioned in Thomson's *System of Chemistry* (1807), and finally published by Dalton in his most important book, *New System of Chemical Philosophy* (Part 1, 1808, see Figure 3).

"Matter, though divisible in an extreme degree, is nevertheless not infinitely divisible. That is, there must be some point beyond which we cannot go in

the division of matter ... I have chosen the word 'atom' to signify these ultimate particles."

Dalton's Manuscript Notes, Royal Institution
Lecture 18 (30 Jan 1810)

ELEMENTS			
Hydrogen	1	Stentian	46
Azote	5	Barytes	68
Carbon	5	Iron	50
Oxygen	7	Zinc	56
Phosphorus	9	Copper	56
Sulphur	13	Lead	90
Magnesia	20	Silver	190
Limbe	24	Gold	190
Soda	28	Platina	190
Potash	42	Mercury	167

Figure 2 Dalton's chemical symbols

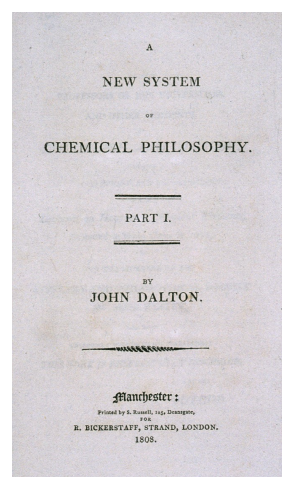


Figure 3 Cover page of Dalton's *New System of Chemical Philosophy*

He did his most significant work between the years 1795 and 1805, but he only became famous much later when the importance of the atomic theory was realised. He became a member of the Royal Society in 1822, received its first Royal Medal (1826) and was honoured with a State Pension in 1833, amongst many other honours. Born in obscurity, he died on the July 27, 1844 a famous man of world renown, and forty thousand people came to his funeral in Manchester. John Dalton was a modest and unassuming man; he never married and remained plain John Dalton to the end of his life.

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Conference Reports

This year has been a rich year for science education and chemical education conferences. In chronological order through the year, some of them are: New Perspectives in Science Education (NPSE), Florence, 17-19 March; ISTA Conference in Limerick, 8-10 April; the TEMI Conference in Leiden, 15-17 April; the Dortmund Symposium on Chemical Education, Dortmund, 25-27 May; SMEC, Dublin, June; the Biennial Conference on Chemical Education (BCCE), Greeley, USA, 31 July – 4 August; the International Conference on Chemical Education (ICCE), Malaysia, 15-20 August; ECRICE, Barcelona, 7-10 September. In many of these conferences Ireland has had a good representation of science education faculty and postgraduate students, several of them teachers doing part-time research degrees. The two main science education groups represented at the conferences are Castel from Dublin City University and EPI*STEM from the University of Limerick, with a sprinkle of researchers from other institutions. You will find a short report on the TEMI final conference in Leiden on p.25.

Springtime in Florence: 5th New Perspectives in Science Education (NPSE)

Florence, Italy 17-19 March

This year's conference was the 5th in the annual series held in Florence. The conferences attract 100+ science education researchers from Europe and beyond, with a mix of oral and poster papers. The papers are published in a conference Proceedings, available at the conference, and also on-line, so they are easy to access. This conference is a good opportunity for young researchers to present their work because it is small, and at most there are 3 parallel sessions, but all within the same building. The Proceedings may be accessed at: www.conference.pixel-online.net

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ISTA Conference, Limerick, 8-10 April

The annual ISTA weekend conference was held in Limerick this year, based in the Limerick Institute of Technology (LIT). The conferences held in Limerick have a good track record for good organisation, convenient venue and a good academic programme and social events. This year's conference was no exception and the committee, chaired by Maria Sheehan, did an excellent job. There were some very good speakers and the venue in LIT is ideal, with the long atrium for exhibitors and coffee. There was some problem with plenary lectures overlapping with the shorter talks, but the workshops proved to be accessible and successful, attracting large numbers. There was a large and well attended exhibition, and one attractive feature was that the publishers were giving away free copies of the new JC Science nooks – if you were lucky you could pick up 6 titles, and put them in the capacious conference bag. The last session on Sunday morning had a good attendance and David Katz's session was excellent, as was the hands-on animal and bird session.

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23rd Dortmund Symposium in Chemical Education, 'Chemical Education Research and Practical Work'

Dortmund, Germany 25-27 May

These 2 ½ day Dortmund symposia on chemical education (DSCE) have been held for many years focusing on a single topic in chemical education. Originally they were in German but soon became international with all talks in English. They were started in Dortmund by the late Hans-Jürgen Schmidt, but in recent years they have alternated between Dortmund (organised by Bernd Ralle) and Bremen (organised by Ingo Eilks). The DSCE have several unique features: all the speakers are invited by the organisers to speak on the theme of the conference; there is a specific theme; the conference is free but participants must pay their own travel and subsistence expenses; there is also an opportunity to present posters related to the theme; the conferences are quite small and intimate (up to 100 people); they are held every

two years and the next one will be in Bremen in 2018. This year's conference was dedicated to Professor Bernd Ralle from Dortmund, who is retiring next year. The meeting involved members of the chemical education research community from Israel, Germany, Australia, Georgia, the United Kingdom, Malaysia, the United States of America, Finland, Turkey, Switzerland, Bosnia and Herzegovina, Croatia, Japan, Czech Republic and last but not least, Ireland! The focus of the symposium was dedicated to uncovering and addressing the dearth in research on the chemistry laboratory in teaching and learning. While it was unanimously acknowledged that the laboratory is an essential element of science curricula, there were explicit calls and demands for more research into the influence of the laboratory in nurturing holistic learning experiences for students. All the papers were related to research on practical work in science/chemical education. The papers of the invited talks are published very rapidly in the Proceedings, which sells for ~€30. This year Peter Childs and Aishling Flaherty from UL gave one of the talks on: "From the laboratory to the e-laboratory: a history of practical work in school science." The full programme and abstracts can be accessed at:

<https://www.dcu.ie/smec/smec2016-conference-programme.shtml>

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SMEC 2016

St. Patrick's College, DCU, 16-17 June

The biennial Science and Mathematics Education Conference hosted by CASTeL was held in June in St. Patrick's College, Dublin, now part of the Institute of Education at Dublin City University. The last of these conferences, in 2012 and 2014, had large attendances due to the involvement of teachers and partners involved in the EU FP7 projects ESTABISH and SAILS, both of which have now finished. The numbers attending were thus much smaller and thus there was a higher proportion of Irish attendees.

Many of the papers appear in on-line Proceedings, although these are not always easy to track down on the website. The prize for the best paper by a postgraduate went to Louise Lehane from UL. The programme can be accessed at:

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Engaging students with exciting demos

10th Chemistry Demonstration Workshop, 27th June to 1st July 2016

The 10th Chemistry Demonstration Workshop was held at the University of Limerick from 27th June to 1st July 2016. 12 teachers from around the country attended the workshop. The workshop is residential on the UL campus and last 4 days. It is a chance for teachers to learn new skills and try out new demonstrations and develop their confidence and competence. At the end of the workshop the teachers had to work in pairs to devise and present a short Science Magic Show to their peers. The workshop also included a session of low-cost physics demos run by Paul Nugent and David Keenahan from the IOP and also an introduction to the Spectroscopy in a Suitcase kit (see p.) by Dr John O'Donoghue, the RSC Education Coordinator for the Republic, and copies of RSC education resources available online.



A group photo at the workshop

This year one of the emphases was on using simple demonstrations to engage students in inquiry, using the approach developed by the Teaching Enquiry with Mysteries Incorporated (TEMI) EU project (www.teachingmysteries.eu). Presenting an interesting and eye-catching demonstration as a mystery to engage students and get them asking questions, can be an effective way to develop inquiry in the classroom and make for more meaningful learning. (See CinA! #107 for a special issue on TEMI.)



Fascinating flame tests

The workshop was jointly organised by SSPC and the Department of Chemical and Environmental Sciences, and coordinated by Dr Sarah Hayes of SSPC with the help of Laurie Ryan and Dr Peter Childs. The Workshops were started 10 years ago by Dr Peter Childs and over the years well over 100 teachers have taken part. The workshop was supported financially by Biopharmaceutical Ireland (thanks to Siobhan Dean) and PDST. For a nominal cost (€100) teachers get 4 days B&B and all meals plus the workshops and materials, which is a good deal by any standard and a great start to the summer.



Colourful flame tests engage students and teachers

Thanks to our sponsors, the workshops are really good value for money and a great break at the end of a long school year. We plan to hold a workshop again next year at the end of June and if you are interested and want more details contact Dr Sarah Hayes at sarah.hayes@ul.ie

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BCCE, Greeley, Colorado, USA

31 July – 4 August

Aishling Flaherty

The Biennial Conference on Chemical Education (BCCE) that was held at the University of Northern Colorado, Greeley, USA in early

August. Given that the previous BCCE in 2014 took place a mere few weeks before I began my own PhD research, I was looking forward to this year's BCCE with great anticipation. More than 1,600 chemistry researchers and teachers from all over the world were about to gather and discuss all things chemistry education. The conference attendees were most certainly spoilt for choice by an extensive conference programme, with research into all types of chemistry education research and practice. A process of elimination lasting almost two hours was sufficient for deciding upon which talks that I wished to attend each day of the conference!

Commemorating a Very Special Birthday!

Tuesday, the third day of the conference, was to be the most insightful and exciting for me as it featured a day-long symposium devoted to the celebration of George Bodner's 70th birthday. Often referred to as the '*Father of Chemistry Education*', George Bodner is credited as being one of the first to apply the constructivist theory of learning throughout the field of chemistry education. In a 1986 article published in the *Journal of Chemical Education*, he claimed "*Knowledge is constructed in the mind of the learner*". The symposium featured talks Tina Overton (Monash University, formerly University of Hull), Melanie M. Cooper (Michigan State University), Norbert J. Pienta (University of Georgia), Roy Tasker (Purdue), Rainer Glaser (University of Missouri), Thomas J. Greenbowe (University of Oregon), Vicente Talanquer (University of Arizona) and three of his own former PhD students: MaryKay Orgill (University of Nevada-Las Vegas), Marcy H. Towns (Purdue University) and Gautam Bhattacharyya (Missouri State University). Along with extended birthday tributes, the symposium's presentations featured an eclectic mix of chemistry education research, with insights into areas such as ethics and communication, assessing chemical knowledge construction over time, faculty's perceptions of discovery, inquiry and science-writing heuristic laboratory pedagogies, eye-tracking studies of molecular representations, scaffolding molecular level visualisations, scaffolding mechanistic reasoning in chemistry, cognitive influences in problem solving and research in eliciting students' prior knowledge to design effective research instruments.



Aishling Flaherty, George Bodner and Tina Overton at BCCE

George Bodner gave an insightful talk on evaluating approaches to teaching chemistry that attempt to deviate from traditional methods. In emphasising the inefficacy of conducting comparison tests of control and experimental groups, who have been subjected to traditional and novel teaching approaches respectively, George proposed a five dimensional model to “evaluate” as opposed to “assess” such novel teaching approaches. The five dimensions took into consideration evaluating the following aspects of any novel approach to teaching chemistry:

1. The cognitive load experienced by students,
2. Students’ feelings about certain aspects of the novel approach,
3. Students’ extent of knowledge retention ,
4. Students’ ability to transfer knowledge,
5. Students’ acculturation into the field of chemistry.

As a PhD student, I found it particularly useful having spent the past 18 months trying to comprehend and develop a research strategy to collect and evaluate data that was of sound underpinning epistemological and ontological basis. At the end of the talk George made an announcement that was warmly welcomed by the audience informing that the book, *Theoretical Frameworks for Research in Chemistry & Science Education*, co-authored with MaryKay Orgill, is to become available again to buy in the near future – testament to its excellence. The day was a deserving tribute to the significance of both the work and character of George Bodner.

“We Introduce the Chemical Scale That Even We Have No Feel Of!”

Another highlight of the conference was my participation in a workshop on ‘*The VisChem Approach*’ by Roy Tasker of Purdue University. The workshop was on the use of software available on www.vischem.com.au, which features simulations of chemistry’s molecular world. Simulations involve accurate and calculated portrayals of the molecular world, as opposed to animations which just feature the positioning and visualisation of molecular interactions. Roy emphasised the necessity of simulations in promoting students’ sense of scale of molecular-level chemistry, claiming that “*Chemistry is not mindless calculations, having a robust understanding on a sub-micro level is chemistry*”. Throughout the workshop the audience were provided with insights into possible areas of difficulty which students could encounter when interpreting depictions of the molecular world, which we as teachers present to them. In the context of our efforts to develop students’ interpretation of the molecular level of chemistry, we must understand that what students see in chemical diagrams, animations and simulations is not the molecular level of chemistry. Students will make individual perceptions and meanings of the molecular level of chemistry based on their interpretations of such representations. As teachers we must understand that individual students’ interpretations will be inherently unique, whether accurate or inaccurate.

Overall, my first BCCE was enriching as I felt as if I was welcomed into community with open arms by both researchers and teachers. While I gained lots of insights into various avenues of chemistry education, there was more to my week than just research. The conference programme included an array of different social events, which gave the opportunity to get to know the people behind the names of authors on books and papers. Ice-Cream socials, 5km runs at dawn and evening BBQs in the orange-tinged Colorado sunshine, were just some of the social events on offer, before concluding the social calendar with an unforgettable performance from the most aptly named conference band: *Al D. Hyde and the Keytones!* And so the longing to go to BCCE 2018 which will take place at the University of

Notre Dame du Lac in South Bend, Indiana begins now!

<http://www.unco.edu/bcce2016/>

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13th ECRICE

Barcelona, Spain, 7-10 September

The 13th ECRICE, European Conference on Research in Chemical Education, was held in Barcelona 7-10 September 2016. These biannual conferences alternate with the Eurovariety conferences and are sponsored by the EuCheMS Division of Chemical Education. The ECRICE was hosted by the Catalan Chemical Society and organised by Fina Guitart and Carles Bo. What a great location for a conference! A beautiful city on the sea, with hot, sunny weather in September.

The conference had a full programme of 5 plenary lectures, 10 keynote talks, 4 demonstration sessions, 92 oral papers, including 4 symposia, and 58 posters, with just over 200 participants. The daily programme was long and packed, running from 8.30 am to nearly 7 pm, enough to test the strongest conferee, especially in really hot, humid weather. The conference was in the city centre in the historic Institute of Catalan Studies and everything was under one roof and easily accessible. The refreshments and lunch were held in the open air cloister.



The conference setting

The ECRICE conferences focus on research in chemical education and cover all levels of education from primary to graduate level. The conference was well organised and ran smoothly, with an excellent social programme. The programme had a good mix of contributions and the emphasis on chemical demonstration sessions was especially interesting, giving an alternative to more theoretical sessions. The symposia dealt

with relevance, language in chemistry teaching, and two on the Irresistible project on Responsible Research & Innovation. The ECRICE conferences are quite small and give plenty of opportunity to meet old friends and make new ones and the focus on chemical education means a community of shared interests, speaking the same language. Most of the participants come from Europe but there were a number of Americans. The small, informal nature of these conferences makes them an ideal venue for postgraduate students to present their work and they were well represented on the programme.

Ireland was well represented on the programme with a plenary lecture by Odilla Finlayson (DCU), a keynote lecture by Sarah Hayes (UL) and 5 oral papers and 1 poster from UL, 3 oral papers and 1 poster from DCU. Four Irish postgrad students made presentations. It is important that postgrads get the opportunity to travel and present at international conferences, but this is difficult for those teachers doing part-time research degrees to get time off. Just attending such conferences would be beneficial for chemistry teachers and it would be nice to see more being able to attend.

The quality of the plenary and keynote talks was very good and the inclusion of several demonstration lectures was a great idea. The ones by David Katz (seen at this year's ISTA conference) and Bob Worley (CLEAPPS, UK) were especially good and Bob will be presenting at ChemEd-Ireland in DCU on Saturday October 22nd.

The Council meeting of the EuCheMS Division of Chemical Education is always held in conjunction with ECRICE or Eurovariety, and at the meeting it was decided that the next ECRICE will be held in Greece in 2018, venue and dates to be decided. It is hoped to hold a joint ECRICE-ICCE conference in 2020 in Germany, following the example of the joint meeting in 2012 in Rome. The timing of such conferences is important – they should not clash with similar conferences in other countries and ideally they should fall within the school and university summer vacation, so that teachers and academics can come. This ECRICE in Barcelona was a bit late in the year for schools, although many universities in Europe do not start back until later.

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E-learning from Nature: An Erasmus+ Project

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The E-Learning from Nature project is funded by the European Commission and the Italian National Agency for the Erasmus+ Programme and aims to promote a proactive students' approach to learning science and to develop innovative teaching methodologies for science teachers.



The two-year project started in December 2016 and has eight partners from seven countries, with Limerick Institute of Technology representing Ireland in the partnership. Each country has a network of five schools taking part in the project. The Irish schools are: St Caimin's Community School, Shannon; St Joseph's School, Borrisoleigh; St Mary's Holy Faith Convent, Glasnevin; Glenstal Abbey School and Tallaght Community School. Science and English teachers from each school have become part of the partnership. So far there are two Associated partners – EPI-STEM in the University of Limerick and Mary Immaculate College Limerick.

The first phase of the project involved each of the schools visiting an 'Area of Natural Interest' where the teachers and students studied the geographical area and recorded their findings in various media – from photos and videos to poetry and drawings. The areas chosen by the Irish partners are: Devil's Bit and North Tipperary, Glenstal Abbey Estate, Malahide and Portmarnock in Dublin Bay, and the Tolka River and adjacent banks at Glasnevin Dublin. A collection of information sheets, direct sources about the flora, the fauna, the natural elements and any other human intervention of scientific

interest in a specific environmental area has been built up.



The photograph show students from St Mary's in Glasnevin during one of their surveys of an intervention area near the banks of the River Tolka. The intervention resulted from an incident in Summer 2014 where Dublin City Council and Inland Fisheries Ireland had to carry out an emergency response following an "extensive fish kill" along the Tolka River. Locals in the area reported seeing 'hundreds' of dead fish following what looked like a detergent dump in the waterway. The students were comparing the effects of the intervention on the flora and fauna, with nearby lands where no intervention had taken place.

In the current phase the teachers are using the media as triggers for short video lessons. These can be on any aspect of Biology, Earth and Space, Nature of Science, Chemistry or Physics inspired by the study of the geographical area. For example, St Joseph's College have found micrometeorites on the Devil's Bit and one of their lessons will focus on them.

By the end of November 2016 each country will have produced fifteen short video lessons. Every output from the project will be accessible through the project portal at <http://enature.pixel-online.org/> and there is also a Facebook page for sharing of ideas among the project community

and the wider science teaching community at <https://www.facebook.com/enatureproject/>
The second year of the project will involve a *multiplier* meeting of teachers in each country, which will include a conference call with a similar meeting in one of the other partner countries. The managers and researchers will bring all of the materials and discussions from each phase of the project together to produce a Teachers' Guide. The guide for science teachers will focus on innovative methods to enhance students' motivation to study of science subjects and improve their basic skills in science. The guide will be organized in 4 chapters: Teaching

scientific subjects through problem based and real life case scenarios; Enhancing students' basic science skills through their active involvement in the learning process; Effective use of new technologies to promote the scientific knowledge and Transnational cooperation to promote scientific knowledge in school education.

If you want to find out more about the project and follow how it develops please visit the webpage. If you want to be kept informed about – and perhaps participate in - the multiplier event in Spring 2017 please contact Marie.Walsh@lit.ie

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Diary

24th ICCE

15- 20 August

<http://www.icce2016.org.my/>

Kuching, Sarawak, Malaysia

13th ECRICE

7-10 September

Barcelona, Spain

<http://ecrice2016.com/>

ChemEd-Ireland

22 October

Dublin City University, Dublin

Odilla.finlayson@dcu.ie

Nature of Science and Science Education Symposium

26-29 October

EPI*STEM, University of

Limerick, Limerick

Helen.fitzgerald@ul.ie

ICASE World Science and Technology Education

Conference

1-5 November

Antalya, Turkey

<http://www.icas2016.org/>

Science Week Ireland

13-20 November

www.science.ie/

2017

ASE Meeting

4-7 January

University of reading, Reading,

UK

<http://www.ase.org.uk/conference/s/annual-conference/>

6th New Perspectives in Science Education

16-17 March

Florence, Italy

www.conference.pixel-online.net

Eurovariety in University Chemistry Education

27-29 June

Belgrade, Serbia

dtrivic@chem.bg.ac.rs

ChemEd 2017

23-27 July

South Dakota State U.,

Brookings, SD, USA

www.sdstate.edu

ESERA

21-25 August

Dublin City University, Dublin

www.esera2017.org/

ChemEd-Ireland

21 October

University of Limerick

If you know of any relevant conferences or events of interest to chemistry teachers, please send in details to: peter.childs@ul.ie

Reading maketh a full man; conference a ready man; and writing an exact man.
Francis Bacon

"In science one tries to tell people, in such a way as to be understood by everyone, something that no one ever knew before. But in poetry, it's the exact opposite."

Paul Dirac

Chemlingo: what's in a name - nitre or natron?

Peter E. Childs

When I was growing up and first studying chemistry at school, I always thought the name Chile saltpetre (saltpeter in American English) was a funny name. Saltpetre is the old name for potassium nitrate, KNO_3 , also known as nitre (niter). Chile saltpetre is sodium nitrate, NaNO_3 , and is also known as soda nitre or nitratine. The crude mixture of salts from which sodium nitrate is obtained is known in Chile, where there are large deposits, as *caliche*. You can still find the name used on commercial products.

Where does the name saltpetre come from? One derivation is from the Latin *sal petrae*, meaning the salt of rock. (1) An alternative etymology is the salt of Petra, the “*rose-red city, half as old as time*”(2) in the Jordan desert.(3) Petra was a major trading centre on the camel trains across the Arabian desert into the Roman Empire and accumulated heaps of camel dung, which in turn yielded on fermentation potassium nitrate efflorescence. Potassium nitrate was often found as an encrustation of soluble salt on rock. It was important because it was a key constituent of gunpowder, the first explosive. The men who went around collecting saltpetre from dunghills and cattle sheds were known as saltpetre men (in 1643 known as salt-petre-men) and were authorised to collect human and animal wastes from wherever they could be found (4). The place where salt petre was extracted was also known as a nitrary.



A typical nitrary (Germany, circa 1580)

Confusingly in much earlier times sodium carbonate was known as natron (also as nitre), from which we get the symbol Na for sodium.

In the Old Testament in Proverbs 25:20 we read:

Like one who takes away a garment on a cold day, or like vinegar poured on soda, is one who sings songs to a heavy heart.

The word soda here is translated from the Hebrew *neter* (in older English translations nitre). However, the chemical context tells us that the biblical nitre is in fact soda, sodium carbonate. Both potassium and sodium carbonates were known as nitre or natron. Natron became restricted to sodium carbonate and thus became the etymological origin of Berzelius' *natrium* (sodium), symbol Na. Humphrey Davy called the new element he found by electrolysis in soda, sodium. Nitre came much later to be used for both sodium and potassium nitrates, and then just for potassium nitrate, which then gives us both nitrogen and nitric acid.

Imagine how confusing chemistry was before the names of elements and compounds were standardised and its nomenclature systematised. As you can see above, the same name was used for different substances and the same substance had different names.

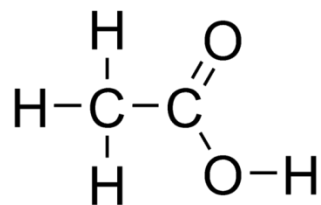
References

- (1) J.F. Partington, 1998, 'Saltpetre', ch. VII in *A History of Greek Fire and Gunpowder*, John Hopkins University Press
- (2) From the poem "Petra", John William Burgon, 1845 (see http://en.wikipedia.org/wiki/John_William_Burgon, accessed 10/7/09)
- (3) David Bloch, origin of saltpetre at http://www.salt.org.il/frame_saltpet.html, accessed 10/7/09
- (4) For the 1646 ordinance authorising the collection of saltpetre see <http://www.british-history.ac.uk/report.aspx?compid=56118>, accessed 10/7/09

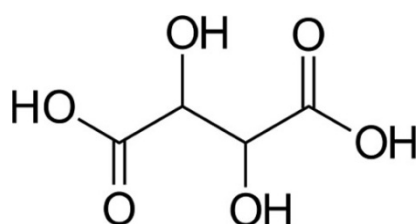
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Common organic acids (1) (* optically active) (see p.43)

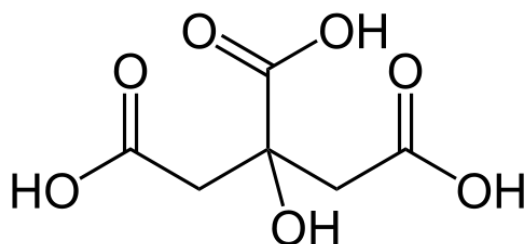
Ethanoic (acetic) acid CH_3COOH



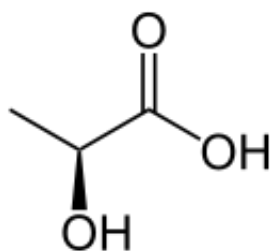
*Tartaric acid $\text{HOOC}.\text{CHOH}.\text{CHOH}.\text{COOH}$ 2,3-Dihydroxybutanedioic acid



Citric acid $\text{C}_3\text{H}_5\text{O}(\text{COOH})_3$ 2-Hydroxypropane-1,2,3-tricarboxylic acid



*Lactic acid $\text{CH}_3\text{CH}(\text{OH})\text{COOH}$ 2-Hydroxypropanoic acid



*Ascorbic acid (vitamin C) $\text{C}_6\text{H}_8\text{O}_6$ (5R)-[(1S)-1,2-Dihydroxyethyl]-3,4-dihydroxyfuran-2(5H)-one

