Contents

1. **Contents**
2. **Editorial**
3. **Editorial from issue #1, May 1980**
5. **Musings on the 100th edition** — Marie Walsh
5. **Education News and Views**
7. **Adjustments to the Leaving Certificate Chemistry Syllabus**
11. **Oxidation of Phenylmethanol** — Michael Seery
13. **Elementary, my dear Watson?** — Marten J. ten Hoor
14. **Ideas for teaching Isotopes in Leaving Certificate Chemistry** — Maria Sheehan
18. **The Instrument Makers No. 4 Peter Woulfe (1727 – 1803)** — Adrian J. Ryder
21. **TY Science: Ardscoil Rís – London TY Science Tour 2013** — Phil Harte
23. **Laboratory Accidents # 3** — Sarah Hayes
26. **Chemistry for non-specialists** — John Daly and Maria Sheehan
30. **Classical Chemical Quotes #6**
    William Lawrence Bragg (31 March 1890 – 1 July 1971)
31. **Chemlingo: Greek fire and other hot topics**
32. **Elementary Chemistry: New elements; Best books on the Periodic Table; Periodic Table cool stuff**
38. **Salt making in Bad Sooden-Allendorf, Germany** — Peter E. Childs
40. **CheMiscellany**
41. **Lactic acid: no longer a sour taste**
43. **Optical isomerism**
44. **Simple Inquiry Science (SIS) 1: Self-inflating balloons**
45. **TEMI – Teaching Enquiry with Mysteries Incorporated**
46. **Conference reports: Science on Stage 2013**
49. **2013 Centenaries: Bohr and the Braggs**
51. **Thomas Andrews plaque unveiled in Belfast**
52. **A Periodic Table of Limericks~ 1 Hydrogen** — Peter Davern
53. **Diary**
54. **Information Page**

For subscription details etc. see inside back cover.
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Editorial #100

100 not out

We made it! This issue marks a major milestone in the history of *Chemistry in Action!* magazine – the 100th issue and 33 years of production. The magazine started in a small way in May 1980 and since then over 5,000 pages have been printed. This year *Education in Chemistry*, the RSCs chemistry education magazine, celebrates its 50th anniversary. It is always easy to start things and it is much harder to keep them up. Something like this is a labour of love as it is not a commercial production and it is a low-budget publication, dependent on voluntary effort and spomsorship. I am hoping I will be able to find the right sort of person or people to keep the magazine going.

One of its distinctive has been the fact that it is sent free-of-charge to all Irish chemistry teachers who request it from their school address. The aim here was to make sure it got into the hands of individual teachers. Too often, when materials are sent to schools, they disappear into an educational black hole and are never seen by the teachers they were intended for. Many teachers have retired since the magazine started – it was launched in May 1980 at the Institute of Chemistry's annual congress in Sligo.

All things change …

The title of a lecture I gave at SMEC 2006 in St. Patrick's College, Drumcondra was *The problems in science education: 'All things change and all things stay the same.'* (available at http://main.spd.dcu.ie/main/academic/mathematics/smec2006proceedings.html). When I read the editorial from issue #1 of *Chemistry in Action!* (p. 3), I wondered what has changed in 33 years? The same concerns expressed then are the ones we have now. The editorial raised questions about the relevance of the LC chemistry syllabus (which was revised in 1983 and in 2000) and the problem of rote-learning of predictable questions; issues relating to practical work and laboratory resources; questions about the relevance of what was taught and the links to the real world and applied chemistry; the problem of low numbers taking the physical sciences – even though will note that in 1978 19.0% of the LC cohort were doing chemistry; it has only just climbed back to just under 15%. I thought it made interesting reading and I hope you do too. A generation of chemistry teachers has passed through the system (if not on) since 1980. As the bumper sticker says:

Old chemists never die – they merely fail to react

I notice too I was more verbose in 1980, although I am always tempted to extend the editorial beyond a page. The first ssue was 20 pages and now CinA! averages 54 pages. I have also included the list of original sponsors, none of whom, I am sad to say, have lasted the course as sponsors of the magazine (then called a newsletter). One of the challenges in producing *CinA!*, apart from keeping a regular publication schedule, has been raising enough money from the sponsors to allow it to be sent free-of-charge to any Irish chemistry teacher who requests it. This is one of its unique features and I know, from several attempts at raising funds from readers, that it would close tomorrow if I depended on subscriptions. I hope I can continue to persuade old and new sponsors to continue supporting the magazine.

One has to think of the future and sustainability (one of today's buzz words) and I can't go on forever. I have successfully handed over the ChemEd-Ireland conferences, and I hope to hand *CinA!* over in due course. The appointment of assistant editors from our Chemistry Education Research Group at UL is part of this plan. However, I haven't run out of steam or ideas yet!

Something old, something new

I have tried out lots of ideas over the years in *CinA!*, including the 4-page student supplement *Action Chemistry!*, which ran for 20 issues. I have tried to include some of these ideas in this issue: Elementary Chemistry, CheMiscellany, ChemData, teaching ideas, historical items, news of applied chemistry etc.

Peter E. Childs
Hon. Editor

Editorial from Issue #1 May 1980

Change for the better?

Matter at the submicroscopic level is in a state of molecular chaos, of rapid, continual change. There are many parallels with the state of the world in 1980, where an increasing rate of change is a common feature of different countries. Chemical education in Ireland in the 1980s is no exception and cannot escape the pressures to change Many dissatisfactions have been expressed about the teaching of science and maths in Irish schools – from pupils, teachers third-level institutions, professional bodies and employers. They are signs of the winds of change blowing through the educational system, and for chemists and chemistry teachers our main concern is the teaching of chemistry in schools. Chemistry, along with physics, is one of the most useful subjects at school in relation to the development of the Irish economy and the needs of industry, both in its own right and as basis for other careers in science and technology. This is just where the jobs of the 1980s will be found and commonsense alone would dictate that schools should be encouraging pupils to take the physical sciences at leaving certificate level. This should be evidenced by increasing numbers of boys and girls taking chemistry and physics at school, but the actual situation is rather discouraging.

1978 Leaving Certificate numbers as % total LC cohort (1972 in brackets; D of E statistics)

	Chemistry	Biology	**Physics**
1978	19.0	48.5	13.0
(1972)	(20.5)	(22.0)	(13.1)

Chemistry and physics are barely managing to hold their own, despite a steady increase in the total numbers doing the leaving certificate, whereas biology has shown a dramatic growth. The more people who do some science at school the better, but we should all be concerned at the small numbers doing the physical sciences, given the changes in the Irish economy over the past decade.

What is wrong?

What can be done to improve the image and enhance the status of chemistry in Irish schools? This question should concern all of us involved in chemical education and we should remember that the choice is made after the intermediate certificate and that in some schools there is no choice! The present syllabus and the examination are usually cited as the main problem areas, followed by the inadequacy of the teacher-training process and the lack of facilities in schools. The syllabus and the examination are imposed from above and teachers have traditionally had little or no say in them, although all teachers are constrained by them.

The present syllabus is widely agreed to be overloaded with material, to be too academic and conceptual, to require no practical work, and to contain very little applied chemistry. The examination, on the other hand, favours rote-learning, it is predictable (encouraging 'question spotting'), it tests mainly recall, and high marks can be obtained without ever doing any practical work. These are all major indictments and it is good to be able to record that the Department of Education has set up a syllabus revision committee for leaving certificate chemistry, which is to start meeting about now. Submissions have been made by the Irish Science Teacher's Association (ISTA) and the Institute of Chemistry of Ireland (ICI). However, it will be at least 1982 (or later) before the new syllabus is introduced in schools, and many would argue that changes are needed NOW!

The role of '*Chemistry in Action!*'

Chemistry is first and foremost a practical subject, which cannot be taught properly without providing the pupils with experiences in a laboratory. There is no real learning without doing. In too many Irish schools it appears that chemistry (and other sciences) is taught mainly, if not exclusively, from the textbook and in the classroom. In this, Ireland is out of step with most of the world in regards to science education at second level. Grants are available for equipment and chemicals, but all of them are not taken up. A wealth of modern and appropriate equipment, apparatus, visual aids etc. is available from Irish suppliers, as witnessed by the exhibition displays at the ISTA conferences. It is common to put the blame on the syllabus and the examination, which must take their share, but many Irish teachers manage to include substantial amounts of practical work at leaving certificate (and inter-certificate) level and still get good results. There needs to be a change of attitude and approach on the part of many science teachers (not all by any means) and a change of Emphasis from the department in its requirements, and perhaps also from the universities. Many teachers teach "as they were themselves taught" and lack the necessary confidence and expertise to tackle practical work at school, often because this aspect was omitted from their own training and in their schooling. This is an area where the need for regular, comprehensive and perhaps compulsory In-Service Education for all science teachers is most glaringly obvious. *Chemistry in Action!* will stress a practical approach to the teaching of chemistry and it is hoped that this will be a help to many teachers.

Applied chemistry is essential

The second major area of concern, which *Chemistry in Action!* will try to tackle, is the importance of the role of chemistry in everyday life, in society, in industry and in the Irish economy of the 1980s. The usefulness of chemistry when applied to solve problems e.g. in agriculture, medicine, and industry in general, is one of the main reasons for including chemistry on the school curriculum, It has been said that we live in a chemical world and the applications of chemistry are all around us, and indeed, we depend on chemistry every day in many ways. The importance of applied chemistry could not be gathered by studying the present L.C. syllabus or the way chemistry is taught in most schools, or indeed at third-level institutions. Chemistry, which is unrelated either to personal experience in a laboratory or to its applications in everyday life, can only be a superficial part of a child's education. Knowledge which is crammed for regurgitation in a short examination usually evaporates overnight, leaving little trace in later life. Education in and through chemistry should surely be more than this! *Chemistry in Action!* will be trying to make us all more aware of the applied nature of chemistry in the real world, and this must surely enrich our teaching.

Everyone's support is needed

Chemistry in Action! is a new venture and will ned all the support it can get. It is hoped to produce the newsletter 2 or 3 times a year, with free circulation to at least all second-level schools in the Republic, and eventually to all individual teachers of chemistry. The size of the newsletter, the frequency and the free circulation will be critically dependent on the level of financial support from the chemical related industries in Ireland, who are interested in improving chemical education. In order to make sure every teacher sees the newsletter (making you read it is a different matter!) it has to go to every school. We want to reach the whole set of chemistry teachers not just those in the ISTA or the few in the ICI, and this requires a subsidised publication. So far the response of Irish industry has been very encouraging (see list of sponsors below) and I hope that many other firms will follow suit once the newsletter is launched.

We also need the contributions of practising teachers to make *Chemistry in Action!* successful and useful: not in money but in kind – articles, experiments, ideas for teaching, your personal views etc. I hope you will feel that this is your newsletter and that it contains something of interest and of use to you in your teaching. Your comments on *Chemistry in Action!* as well as your contributions will be welcome. Please make sure all your science/chemistry colleagues see this issue and get them to send in their names for their own copies.

P. E. Childs
Hon. Editor

Sponsors for 1980:
De Beers, Irish Cement, Aer Lingus, Foss Electric, ChemLabs, Alkem Chemicals, NET, Organon, Bayer, Bord Na Mona, Alumina Contractors (later AAL)

Musings for the 100th edition of Chemistry *in action!*

Marie Walsh
Limerick Institute of Technology, Moylish, Limerick marie.walsh@lit.ie

I have been associated with *Chemistry in Action!* and other activities that Peter has carried out including SICICI and ChemEd conferences since 1989. In fact it's twenty five years ago this week since I called to his office in Thomond College to pay my subscription for *Chemistry in Action!* and he asked if I would be interested in applying for a part-time job for which he had acquired some funding. I had started subscribing to the magazine and to *Action Chemistry!* when I was teaching in St Columb's College in Derry. The job of research assistant was a step back to chemistry education that I was delighted to take.
When I returned to teaching the job became ever more part-time but I am happy to have been a small part of what has been achieved under Peter's direction to help Chemistry and Science teaching in Ireland and beyond through all the different initiatives.
We moved on from the old electronic 'golf ball' typewriter to one of the first Amstrad word processors in the country. We experimented with Minitel, and embraced the technological changes that followed. The University provided new accommodation after the merger with Thomond College. Yet, the *Chemistry in Action!* product is still in print format and that's the way people seem to like it.
Other things have changed: we have a new base in the University of Limerick Foundation Building, the Chemistry Education Research Group has expanded, and interactions and involvements as partners with European projects have increased. However, one thing hasn't changed: Peter's enthusiasm for Chemistry and Chemistry education. I am sure all of the others involved in the past or currently with his work will join me in congratulating him on 100 issues of *Chemistry in Action!* and wishing him all the best for future issues too.

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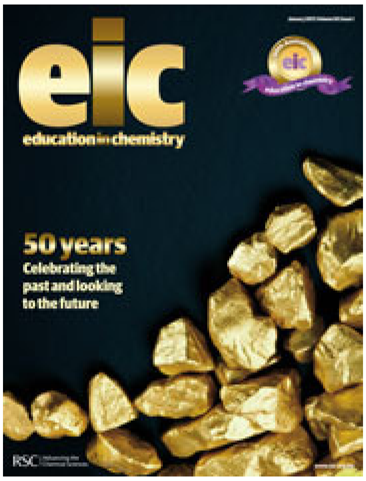
Education News and Views

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

Education in Chemistry turns 50



The RSCs magazine on chemical education, *Education in Chemistry*, started publication in 1963 and thus 2013 marks its 50th birthday. It is produced 6 times a year and is sent free of charge to UK and Irish schools. This milestone will be marked by a reception in London on November 14th.
http://www.rsc.org/Education/EiC/Anniversary/

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SMEC 2012 Proceedings

The full Proceedings of the SMEC 2012 conference held at DCU in June 2012 are now available on line at:
www4.dcu.ie/sites/default/files/**smec**/pdfs/**SMEC** 2012_complete.pdf
The theme of the conference was: Teaching at the heart of Learning. The next SMEC conference is due in June 2014, in conjunction with the SAiLS project.

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SCORE Conference 2013

SCORE is the Science Community Representing Education and consists of UK learned societies. In Feb. 2013 the SCORE group organised its annual conference on the theme 'Assessing the sciences: exploring ways assessment can help to promote an authentic experience of the sciences in 11-19 education'. The conference brought together 150 people from the science and science education community in the UK to discuss assessment. You can access the summary of this and previous conferences at:
http://www.score-education.org/publications/publications-score-events-and-conferences

'More than any other single factor in the system, it is assessment that determines what is taught, when it is taught and how it is taught'.
Charles Tracy, Institute of Physics

One topic that was considered was the assessment of practical work in science at second level and 8 exemplar methods were discussed:

1. *Students write a report on an investigation using their own data, but their practical skills are not observed nor assessed.*
2. *Students write a report on an investigation using data provided.*
3. *Students do a written exam that asks questions about practical work.*
4. *Students do a practical examination and write up their apparatus, method, results and evaluation.*
5. *Students are given an oral exam in which they are asked questions about a project they have done.*
6. *A teacher, or external examiner, observes students doing practical work.*
7. *An examiner listens to an audio or video recording of the students doing some aspect of practical work.*
8. *An examiner views an 'artefact' produced by the student in the same way they would for an art or Design & Technology student.*

This is of interest in Ireland in the light of the discussion on assessment of practical work in the new LC science syllabi.

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OECD Literacy and Numeracy Report

The OECD published a report on literacy and numeracy in 24 countries, including Ireland, in October 2013. The report on *Literacy in the Information Age* can be accessed in full at *www.**oecd**.org/edu/skills-beyond-school/41529765.pdf*

I have just included the results for age 16-24, as this range overlaps senior second level and third level education and also represents a recent cohort of young people and thus the effect of the current education system. Ireland is performing averagely or below average in both literacy and numeracy and these data support the results of the 2009 PISA Report. Overall Ireland does a bit better from age 16-64, but the worrying thing is the poor performance of young people and the implications this has for further education and employability.4

Literacy for people aged 16-24

1 Finland
2 Japan
3 South Korea
4 Netherlands
5 Estonia
6 Australia
7 Sweden
8 Poland
9 Czech Republic
10 Germany
11 Austria
12 Slovak Republic
13 Denmark
14 France
15 Canada
16 Norway
17 Ireland
18 Spain
19 England/N Ireland
20 United States
21 Italy
22 Cyprus

Numeracy for people aged 16-24

1 Netherlands

2 Finland
3 Japan
4 Flanders (Belgium)
5 South Korea
6 Austria
7 Estonia
8 Sweden
9 Czech Republic
10 Slovak Republic
11 Germany
12 Denmark
13 Norway
14 Australia
15 Poland
16 Canada
17 Cyprus
18 Northern Ireland
19 France
20 Ireland
21 England
22 Spain
23 Italy
24 United States

□

Changes to the LC Chemistry syllabus from 9/13

Circular0047/2013 at www.education.ie has modified the LC Chemistry syllabus from September 2013 to take account of the banned substances listed in circular 0014/2011. The circular is given below (see also p.)and it is followed by a description of one of the new experiments, the alkaline oxidation of phenylmethanol by potassium permanganate (replacing the dichromate oxidation of alcohols.)

□

CIRCULAR LETTER 0047/2013

To the Principals and Boards of Management of Second Level Schools

Adjustments to the Leaving Certificate Chemistry Syllabus

Introduction

Circular 0014/2011 (Discontinued Use of Chemicals – Substances of Very High Concern) informed schools of a number of substances which have been designated as Substances of Very High Concern by the European Chemicals Agency.

As a result of the ban on the continued use of these substances, three of the mandatory practical activities on the Leaving Certificate chemistry syllabus could no longer be carried out by students. Since 2011, the theoretical knowledge of the experimental procedure and outcomes of the mandatory experiments listed in the circular remained as part of the syllabus, but students were not required to carry out the procedure.

The Leaving Certificate chemistry syllabus is now being adjusted so that all of the mandatory practical activities can be carried out safely by students. The theoretical content of the syllabus is not being changed. Four of the mandatory experiments are being adjusted. Three are being adjusted to accommodate removal of banned substances and one that did not require the use of a banned substances is being extended to ensure that the overall amount of practical work in the syllabus does not change.

Teaching guidelines for each of the adjusted practical activities will be published online at www.curriculumonline.ie/

Leaving Certificate Chemistry Syllabus adjustments

Full details of the changes are provided in the appendix but in summary:

In section 7.3 of the syllabus (Organic Chemical Reaction Types), students will continue to test the properties of an aldehyde and a carboxylic acid as previously specified, but will not prepare them as both experiments involve oxidation using a chromium(VI) solution. The two organic oxidations involving a chromium(VI) solution are being replaced by the preparation of benzoic acid from phenylmethanol by oxidation using potassium manganate(VII) in alkaline conditions.
This is being introduced as a new experiment.

In section 7.4 of the syllabus (Organic Natural Products), the steam distillation of an organic substance is being adjusted to specify the extraction of clove oil and to include the liquid-liquid extraction of eugenol from the emulsion produced using cyclohexane. This does not introduce any new theory. The extension of this experiment will make up for the reductions in the mandatory experiments in sections 7.3 and 8.2.

In section 8.2 of the syllabus (Le Chatelier's Principle), investigations of three aqueous equilibrium mixtures are being replaced by an investigation of one aqueous equilibrium mixture. The two aqueous equilibria that are being discontinued involved chromium (VI) and cobalt (II) salts.

These adjustments are effective from September 2013 for all students who will sit the Leaving Certificate Chemistry examination in 2015 and thereafter.

General

Please bring this Circular and Circular 0014/2011 (Discontinued Use of Chemicals - Substances of Very High Concern) to the attention of teachers of science in the school and also provide a copy to members of the school board of management. Note that any activity which involves substances whose use should be discontinued such as the demonstration of the oxidation of potassium sodium tartrate by hydrogen peroxide, catalysed by cobalt(II) salts (page 18 Ordinary level Chemistry syllabus / page 53 Higher level Chemistry syllabus) or using cobalt chloride paper to test for water (OC14, page 19 Junior Certificate Science syllabus) should no longer be conducted.

This Circular and Circular 0014/2011 may also be accessed at http://www.education.ie

Breda Naughton
Principal Officer
16th September 2013

Appendix: Details of adjustments to the Leaving Certificate Chemistry Syllabus

Ordinary Level Syllabus - Page 18 - Current Content

Activity

Demonstration of the oxidation of potassium sodium tartrate by hydrogen peroxide, catalysed by cobalt(II) salts.

Ordinary Level Syllabus – Page 18 - Adjusted Content – effective from September 2013 for all students who will sit the Leaving Certificate Chemistry examination in 2015 and thereafter.

Activity

Observation of the oxidation of potassium sodium tartrate by hydrogen peroxide, catalysed by cobalt(II) salts (This should be shown using an appropriate video clip).

Ordinary Level Syllabus - Page 23 - Current Content

Mandatory Experiment 7.4

Preparation and properties of ethanal [properties limited to reactions with (i) acidified potassium manganate(VII) solution, (ii) Fehling's reagent and (iii) ammoniacal silver nitrate].

Mandatory Experiment 7.5

Preparation and properties of ethanoic acid [properties limited to reactions with sodium carbonate and magnesium].

Mandatory Experiment 7.6

Extraction of clove oil from cloves (or similar alternative) by steam distillation.

Ordinary Level Syllabus – Page 23 - Adjusted Content – effective from September 2013 for all students who will sit the Leaving Certificate Chemistry examination in 2015 and thereafter.

Mandatory Experiment 7.4

Properties of;

(a) ethanal [properties limited to reactions with (i) acidified potassium manganate(VII) solution, (ii) Fehling's reagent, and (iii) ammoniacal silver nitrate]

(b) ethanoic acid [properties limited to reactions with sodium carbonate and magnesium].

Mandatory Experiment 7.5

The oxidation of phenylmethanol (benzyl alcohol) to benzoic acid with potassium manganate (VII) solution in alkaline conditions.

Mandatory Experiment 7.6

Extraction of clove oil from cloves by steam distillation and liquid-liquid extraction of eugenol from the emulsion produced using cyclohexane (structure of eugenol not required).

Ordinary Level Syllabus - Page 24 – Current Content

Mandatory Experiment 8.1

Simple experiments to illustrate Le Chatelier's principle:

(i) $CoCl_4^{2-} + 6H_20 \rightleftharpoons Co(H_20)_6^{2+} + 4Cl^-$

(to demonstrate the effects of both temperature changes and concentration changes on an equilibrium mixture).

(ii) $Cr_2O_7^{2-} + H_2O \rightleftharpoons 2CrO_4^{2-} + 2H^+$

(iii) $Fe^{3+} + CNS^- \rightleftharpoons Fe(CNS)^{2+}$

(to demonstrate the effects of concentration changes on an equilibrium mixture).

Ordinary Level Syllabus – Page 24 - Adjusted Content – effective from September 2013 for all students who will sit the Leaving Certificate Chemistry examination in 2015 and thereafter.

Mandatory Experiment 8.1

Simple experiments to illustrate Le Chatelier's principle:

$Fe^{3+} + CNS^- \rightleftharpoons Fe(CNS)^{2+}$

(to demonstrate the effects of both temperature changes and concentration changes on an equilibrium mixture)

Higher Level Syllabus - Page 53 - Current Content

Activity

Demonstration of the oxidation of potassium sodium tartrate by hydrogen peroxide, catalysed by cobalt(II) salts.

Higher Level Syllabus – Page 53 - Adjusted Content – effective from September 2013 for all students who will sit the Leaving Certificate Chemistry examination in 2015 and thereafter.

Activity

Observation of the oxidation of potassium sodium tartrate by hydrogen peroxide, catalysed by cobalt(II) salts (This should be shown using an appropriate video clip).

Higher Level Syllabus - Page 60 - Current Content

Mandatory Experiment 7.4

Preparation and properties of ethanal [properties limited to reactions with (i) acidified potassium manganate(VII) solution, (ii) Fehling's reagent and (iii) ammoniacal silver nitrate].

Mandatory Experiment 7.5
Preparation and properties of ethanoic acid [properties limited to reactions with sodium carbonate, magnesium and ethanol].

Mandatory Experiment 7.6
Extraction of clove oil from cloves (or similar alternative) by steam distillation.

Higher Level Syllabus – Page 60 - Adjusted Content – effective from September 2013 for all students who will sit the Leaving Certificate Chemistry examination in 2015 and thereafter.

Mandatory Experiment 7.4
Properties of;
(a) ethanal [properties limited to reactions with (i) acidified potassium manganate(VII) solution, (ii) Fehling's reagent, and (iii) ammoniacal silver nitrate]
(b) ethanoic acid [properties limited to reactions with sodium carbonate, magnesium and ethanol].

Mandatory Experiment 7.5
The oxidation of phenylmethanol (benzyl alcohol) to benzoic acid with potassium manganate (VII) solution in alkaline conditions. Calculation of percentage yield (the balanced equation will be given).

Mandatory Experiment 7.6
Extraction of clove oil from cloves by steam distillation and liquid-liquid extraction of eugenol from the emulsion produced using cyclohexane (structure of eugenol required).

Higher Level Syllabus - Page 61 – Current Content
Mandatory Experiment 8.1
Simple experiments to illustrate Le Chatelier's principle:
(i) $CoCl_4^{2-} + 6H_20 \rightleftharpoons Co(H_20)_6^{2+} + 4Cl^-$
(to demonstrate the effects of both temperature changes and concentration changes on an equilibrium mixture).
(ii) $Cr_2O_7^{2-} + H_2O \rightleftharpoons 2CrO_4^{2-} + 2H^+$
(iii) $Fe^{3+} + CNS^- \rightleftharpoons Fe(CNS)^{2+}$
(to demonstrate the effects of concentration changes on an equilibrium mixture).

Higher Level Syllabus – Page 61 - Adjusted Content – effective from September 2013 for all students who will sit the Leaving Certificate Chemistry examination in 2015 and thereafter.

Mandatory Experiment 8.1
Simple experiments to illustrate Le Chatelier's principle:
$Fe^{3+} + CNS^- \rightleftharpoons Fe(CNS)^{2+}$
(to demonstrate the effects of both temperature changes and concentration changes on an equilibrium mixture).

New LC experiment:
On the following pages you can find detail of the new experiment on the oxidation of phenylmethanol using alkaline potassium permanganate, which is a replacement for the dichromate oxidation of ethanol.

Oxidation of Phenylmethanol

Michael Seery
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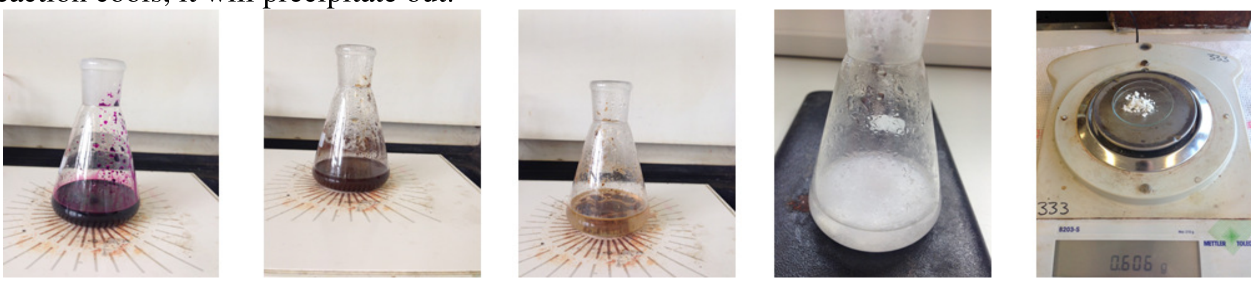
Procedure:

Phenylmethanol (1 mL) is added to a 50 mL conical flask. A solution of potassium permanganate (25 mL, 0.2 M) and sodium carbonate (0.5 g) are added and the solution heated at about 60 °C for 20 minutes on a water bath. The solution turns brown on heating. After cooling slightly, a few drops of conc. HCl are added until the solution was acidified; i.e. until no more fizzing is apparent. The solution clarifies leaving a brown residue of manganese dioxide. Finally, sodium sulfite (a few drops of saturated solution) is added until the solution cleared. Benzoic acid precipitates as the solution cooled. This is filtered off using a Hirsch funnel and weighed when dry (0.6g, 50%).

About the reaction:

The reaction involves oxidation with MnO_4^-. The mechanism is not well understood, but the permanganate provides the oxygen atoms necessary for the oxidation. The oxidation state of Mn changes over the course of the reaction from +7 to +4. The initial solution of permanganate will be dark purple. As it oxidises the phenylmethanol, it itself will be reduced to Mn^{4+}, precipitating out as MnO_2 – the brown powder is visible as the reaction progresses. In order to complete the reaction under necessary alkaline conditions, sodium carbonate is added. The Mn^{4+} is again reduced at the end to soluble Mn^{2+}, using sodium sulfite, which allows for all solid product to be easily isolated by filtration, and safe disposal of the filtrate. Benzoic acid is sparingly soluble in water, and as the reaction cools, it will precipitate out.

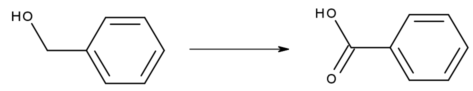


Sequence of reaction from left to right: (i) addition of permanganate and sodium carbonate; (ii) solution cooled slightly after twenty minutes; (iii) addition of conc. HCl; (iv) precipitation of product; (v) isolation and weighing.

Purpose of each reagent:

- **$KMnO_4$**: This is the oxidising agent, which will oxidise phenylmethanol to benzoic acid. In the process, it is itself reduced.
- **Na_2CO_3**: This increases the pH of solution, so that it is alkaline. This is necessary for the reaction to proceed as indicated.
- **HCl**: This is used to acidify the solution. In doing so it neutralises the sodium carbonate. HCl also protonates the benzoate anion, forming benzoic acid, so that it will precipitate out of solution when the reaction cools.
- **Na_2SO_3**: This is used to reduce the MnO_2 precipitate so that it can be solubilised as Mn^{2+}(aq).

Analysis:



$C_6H_5CH_2OH$ — 1 mole $\qquad$ C_6H_5COOH — 1 mole

The density of phenylmethanol is 1.05 g/mL. Therefore the mass used in the reaction is 1.05 g. As the molecular mass of phenylmethanol is 108.1 g/mol, this means that 9.7×10^{-3} mol of reactant were used, and hence 9.7×10^{-3} mol of product (molecular mass 122.1 g/mol) expected. This corresponds to a theoretical yield of 1.19 g. Using the above conditions, a yield of 0.6 g (50% was obtained). Melting point of benzoic acid: 122 °C.

Balanced Equation:

$$3\ C_6H_5CH_2OH + 4\ KMnO_4 \longrightarrow 3\ C_6H_5COOH + 4\ MnO_2 + H_2O + 4\ KOH$$

Editor's note:
The interesting thing about this reaction is why it is done in alkaline conditions, since MnO_4^- is a weaker oxidising agent under these conditions and produces a solid by-product, MnO_2, which has to be dealt with in a separate step. This is why permanganate titrations are done under acidic conditions. However, in this case it appears that the reaction is faster under alkaline conditions than acidic conditions, although it will still take place in acidic solutions. This is presumably linked to the specific mechanism of the reaction.

The use of sodium sulphite in acid solution to dissolve solid MnO_2 and convert it to soluble and colourless Mn^{2+} can also be used to make sure that burettes do not develop a brown stain when used in $KMnO_4$ titrations or to remove the stain from glassware stained with $KMnO_4$.

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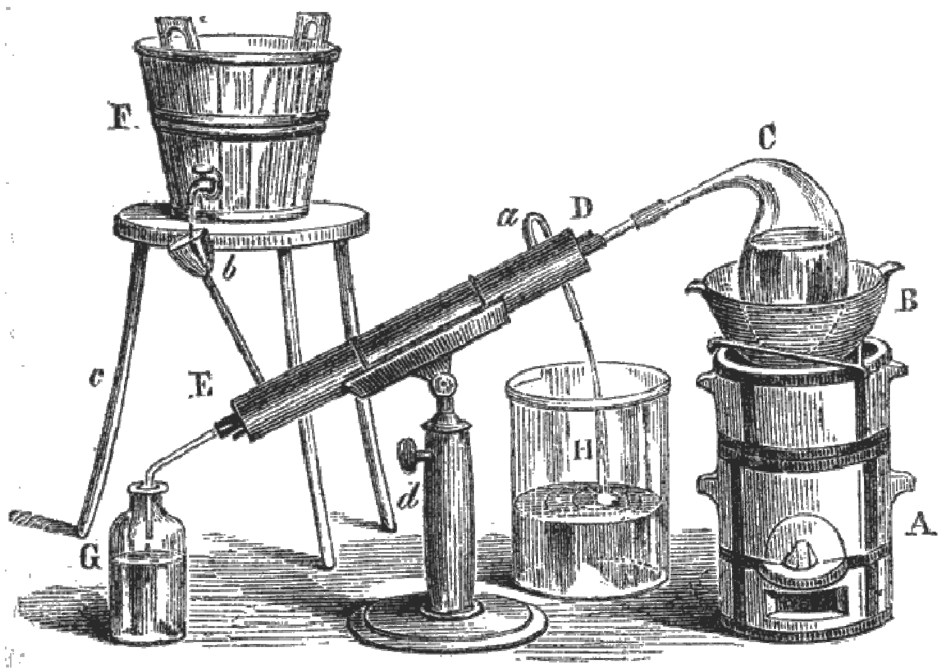
The distillation of ether in the 19th century
http://albumen.conservation-us.org/library/monographs/monckh/chap02.html



Elementary, my dear Watson?

Marten J. ten Hoor
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A recent article[1] in the *Journal of Chemical Education* induced me to write this note.

During the course of time different definitions of the term *chemical element* have been given. According to the classical definition due to Boyle[2] and Lavoisier[3] an element is a pure substance that cannot be decomposed by chemical means. The recent IUPAC definition[4] describes an element (or an elementary substance) as matter, the atoms of which are alike in having the same positive charge on the nucleus. However, the occurrence of allotropes and isotopes poses problems that this definition can hardly cope with. To see this, I take the element oxygen as an example. Apparently, the pure substances O_2 and O_3 should be viewed as different material forms of that element: but what about the mixture of O_2 and O_3 that is formed if pure O_2 is passed through an ozoniser? It certainly is matter consisting of oxygen atoms only, so by the IUPAC definition it should be considered an element. As this mixture can be decomposed by various physical or chemical methods, it is not an element by the classical definition of Boyle and Lavoisier. Moreover, it does not seem right that an element could be a *mixture* of different pure substances. Atoms with the same nuclear charge have the same number of extranuclear electrons, and for this reason are believed to have the same chemical properties. But the decompositions of pure $^{16}O^{17}O^{18}O$ and $^{17}O^{16}O^{18}O$ by irradiation yield different products[5]. Clearly, the oxygen isotopes of ozone, at least in the arrangements given above, do not have the same chemical properties. In other words: different arrangements of isotopes lead to different chemistries[5].

An almost forgotten proposal concerning the meaning of the term chemical element was advocated by Mendeleyev[6]. It amounts to the view that an element is something that is conserved in chemical reactions. Consider a reaction between two pure substances in the sense of the Boyle-Lavoisier definition of an element: if red-brown pure copper is heated in a stream of pure oxygen, the black solid CuO is formed at first, but at temperatures above 1050 degrees Celsius[7], CuO is completely decomposed to yield the red solid Cu_2O. The different colors of these three substances indicate that they are quite different from each other. The absence of electric conductivity shows that both CuO and Cu_2O do not contain the conductive pure substance Cu as such. But both must contain *something copper-like*, for if they are heated in a stream of pure hydrogen gas, copper is formed. What is this something copper-like? It must be common to CuO and Cu_2O. If it is assumed that these substances contain Cu^{2+} and Cu^{+} ions, respectively, then the something copper-like cannot be one of these ions, nor any other conceivable copper ion. The particle that copper atoms and all possible copper ions have in common is the nucleus of the copper atom. Hence, the conclusion must be that the something copper-like, or the *element* copper, is the nucleus of the copper atom. This conclusion can immediately be generalized[8]:

The chemical element X is the nucleus of an atom of X

As in chemical reactions the nuclei of the reacting particles remain unchanged, the above definition of an element results in a general chemical law[8]:
In all chemical reactions each partaking element is conserved

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Ideas for teaching Isotopes in Leaving Certificate Chemistry

Maria Sheehan*

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Introduction:

This article is the first in a series of short articles taken from the 'ITS Chemistry' teaching resource. 'ITS Chemistry' aims to increase thinking skills in Chemistry and provide pupils with tangible hands-on activities for concepts that are abstract and sometimes difficult for pupils to visualise.

The Leaving Certificate Chemistry (DES 1999) requires pupils to understand:

- Atomic number (Z), mass number (A), isotopes; hydrogen and carbon as examples of isotopes.
- Relative atomic mass (A r). The 12C scale for relative atomic masses.
- Calculation of approximate relative atomic masses from abundance of isotopes of given mass number (e.g. calculation of approximate relative atomic mass of chlorine).
- Distinction between chemical reaction and nuclear reaction (simple equations required – confine examples to alpha and beta emissions). Radioisotopes.
- Uses of radioisotopes (three examples).

Equipment and Chemicals needed:

- 10 polystyrene balls (it helps to colour them). These can be sourced at: www.evansartsupplies.ie (alternatively you could use the plastic inside of a Kinder Egg or around Easter you can buy plastic eggs, which can be taken apart for filling.)
- Dried peas
- Pasta
- Coloured card,
- Black Marker
- Blue-tack

N.B. we use dried pieces and pasta but you could use any two different objects – coloured marbles or beads, nuts and bolts etc.

Preparation Required:

Use the polystyrene spheres (or plastic eggs) to make the nucleus of the atom Eggium (Eg).

Each nucleus will contain 5 protons (peas) and a variable amount of neutrons (pastas), depending on the colour of the egg. Here is one possibility:

- Make 2 eggs = 5 peas & 4 pastas (Blue Eggs)
- Make 5 eggs = 5 peas & 6 pastas (Yellow Eggs)
- Make 3 eggs = 5 peas & 5 pastas (Green Eggs)

Have coloured cards available, 2 blue, 5 yellow and 3 green

The Lesson

Introduction

Introduce the concept of relative atomic mass. Pupils will work in small groups to answer the questions in their workbook (see pupil exercise sheets at the end of this article).

Development

Hand out the different polystyrene balls (or eggs) to the different groups (one per group).

Explain that it is an atom of the element Eggium (this is a fictitious element). Distribute 10 balls, as this will make calculating the percentages later on in the lesson a little easier. Once pupils have answered the first three questions as a group, one representative from each group should put their isotopic notation for their atom on the board (the symbol for the element is Eg ~ the mass number should be on the bottom and atomic number on the top).

Figure 1 is an example of what the board may look like:

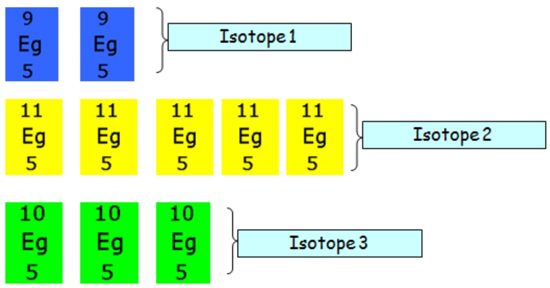


Figure 1: Illustration of what the board may look like during the activity

Discuss the following questions as a class:
(The answers are provided below.)

1. Are all of the eggs the same element? How do you know? (Yes, the all have the same number of protons)
2. What do you call atoms that have the same number of protons but different numbers of neutrons? (isotopes)
3. Other than having more or less numbers of neutrons, name one other thing that is different between isotopes? (the have different atomic masses)
4. Do all isotopes occur naturally with the same frequency? (No, there are more of the yellow isotopes than the others.)
5. Next help students calculate the percentage of each isotope. If you have 10 eggs and 2 of them are a certain isotope, then your percentage for that isotope would be 20%. The students have just calculated the natural abundance of the isotopes for your Eggium element. Introduce students to the term natural abundance. Natural abundance describes how often a certain isotope occurs in nature, usually in percentage form.
6. How would one calculate the average mass of one atom of the element Eggium? Someone will suggest that they add up the masses of each egg and divide by ten.
7. The next step requires students to calculate the average mass of one atom of Eggium. This can be done two different ways, explain both methods and do the example to show students that they get the same answer. As you demonstrate this be sure to group the elements of similar mass together. For example, your calculation may look like:

9+9+10+10+10+11+11+11+11+11=103
103/10 = 10.3
The atomic mass of Eggium is 10.3.

8. Next, show students that they may take the percent natural abundance and multiply it by the mass of each isotope. If these are added together they will give the same result for atomic mass. The calculation would look like this:
(20%x9)+ (30%x10) + (50%x11) =10.3

You may need to discuss why the second method is more efficient. Be sure that students understand that:
-It would be impossible to count every atom of an isotope, so we take representative samples.
-Atoms are present in such large quantities that it is much easier to use percentages than actual quantities of atoms.
-They are calculating the atomic mass for an element, and this is the number that is reported on the Periodic Table of elements. Some pupils may mix this up with the mass number, which is not on the Periodic Table but which gives the number of protons and neutrons in an atom.

Conclusion (10 minutes)
To finish this class, it is important for pupils to practice these calculations. They should complete the exercises given in the workbook and then practice some for homework out of their own text book.

Ideas for this lesson came from: http://www.brighthub.com/education/k-12/articles/11042.aspx

ITS Chemistry: This is a teaching package on the particulate nature of matter and the mole developed, trialled and evaluated by Maria Sheehan as part of her PhD work at the University of Limerick. The package took into account the findings of chemistry education research on misconceptions and cognitive development

Pupil Worksheet:

Equipment needed:

- Polystyrene sphere or egg (supplied by your teacher)
- Black marker
- Coloured card
- Blue-tack

Method:

1. In your group, take the polystyrene spheres supplied by your teacher and open it.
2. The container is a model of an atom. It is an atom of the element ***Eggium*** (note: this is a made up element).
3. Inside the container you will find some dried peas and some pasta.
4. The peas represent the number of protons and the pasta represent then number of neutrons in the atom of Eggium.
5. Examine the contents and answer the following questions.

Questions:

1. What is the atomic number of this atom? ____________
2. What is the mass number of the atom? ____________
3. Write down the isotopic notation for this atom in the box provided? (The chemical symbol for Eggium is Eg, place the mass number on the top).

It is now time to share your data with the rest of the class. A representative from your group should write the isotopic notation for your atom of Eggnium on the board.

As a class discuss the following questions:

1. Are all of the atoms, atoms of the same element? How do you know?

____
____
____
____

2. What do you call atoms that have the same number of protons but different numbers of neutrons?

____
____
____
____

3. Other than having more or less numbers of neutrons, name one other thing that is different between isotopes?

____
____
____
____

4. Do all isotopes occur naturally with the same frequency? Do some occur more than others?

____
____
____
____

5. What percentage of each isotope occurred?

Isotopic notation of atom	Percentage abundance of isotope

6.How would one calculate the average mass of one atom of the element Eggnium?

____
____
____

7.In your group calculate the average mass of one of the atoms of Eggnium:

Calculation space:

8.Your teacher will show you an alternative way to calculate the average mass of an atom of Eggniu

Use the space below to record this method:

Calculation space:

The Instrument Makers No. 4

Peter Woulfe (1727 – 1803)

Adrian J. Ryder tutorajr@gmail.com

Peter Woulfe was born in 1727 in the village of Teermaclane (often corrupted to Tircullane), some six miles south of Ennis, County Clare. No record exists of his parents and only one brother is mentioned in records. The Woulfe family home, see photo below, has been a ruin from the 1840's and there is no record of Peter ever returning to the area of his birth.

The Woulfe house in Teermaclane, Co. Clare

Peter received his early education in the neighbourhood but, for some unknown reason, when aged fifteen he moved to Madrid in Spain to be with his brother, Estevan, a prominent merchant there. Later he moved to Paris in order to work under the French chemist Rouelle, on the recommendation of the Limerick surgeon, Sylvester O'Halloran (1728 – 1807). (Guillaume Francois Rouelle, 1703 – 1770, had started a public course in his laboratory in 1738 and helped many notable chemists in developing their skills. He introduced the concept of a base into chemistry in 1754.)

In 1752, at the age of only twenty-five, he was working under Doctor Charles Lucas of Dublin in London and was then appointed Surgeon General on Guadeloupe in the Caribbean Leeward Islands, an island of some 629 square miles.

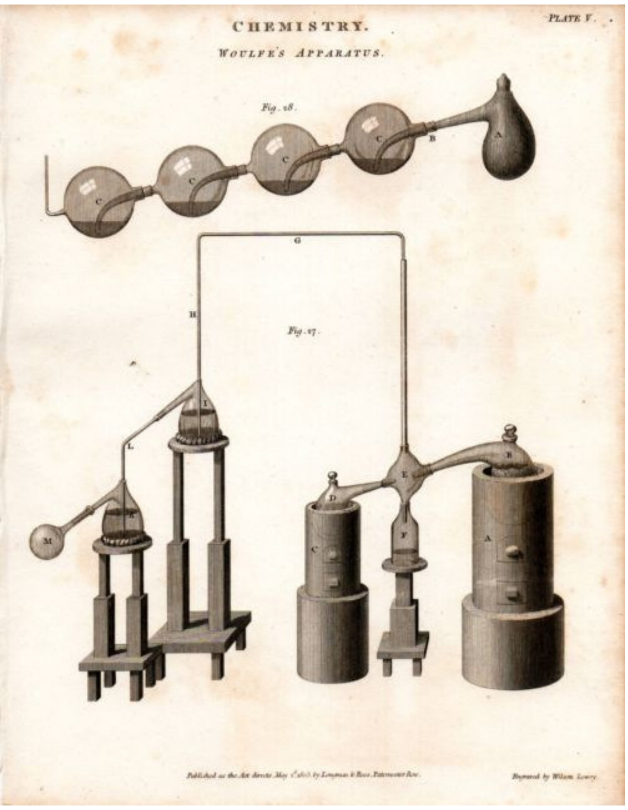
On his return he spent a time studying the mines in Germany and France and was employed by Lord Bute (1713 – 1792) and other rich people to advise on and arrange their collections of natural curiosities. At this time John Ferrar, the Limerick historian, (1743 – 1785), says he was the acknowledged first chemist in Europe.

He was the first modern chemist to examine and exploit the tin deposits in Cornwall, in 1766, and in the following year he was elected a Fellow of the Royal Society for his paper on "Experiments on the distillation of acids and volatile alkalis", in which he described an apparatus which is still known as Woulfe's bottle. He received the Copley Medal, the highest award of the Royal Society, in 1768.

Below are shown early forms of the Woulfe bottle, which were used for washing gases or saturating liquids therewith.

Early Woulfe's Bottles

The new bottle provided a convenient method for obtaining concentrated solutions of soluble gases or for purifying insoluble gases from soluble impurities. When one looks at the plate of Woulfe's apparatus below, one can well see the difficulties in setting up the apparatus previously available prior to this.



1803 print of Woulfe's apparatus

In 1776 Woulfe reported on the production of hydrochloric ether (chloroethane, C_2H_5Cl) by the passing of gaseous HCl into ethanol (ethyl alcohol). He had previously, 1767, reported on a preparation of the substance, as well as the preparation of ethyl nitrate by the distillation of alcohol with nitric acid. He was later, 1784, to report on an improved yield of ethyl nitrate by the use of nitre (potassium nitrate) and sulphuric acid instead of nitric acid itself.

In 1771 Woulfe reported on his investigations into 'Mosaic Gold' (stannic sulphide, SnS_2). Also in this year he reported on experimental work he had been engaged on, where he found a yellow dye produced on treating indigo with nitric acid. He had discovered picric acid, (2,4,6 trinitro phenol), the first synthetic dye, which is also used as an explosive and burn treatment. As a treatment for burns it is used as a 1% solution. Other medical uses are for the treatments of malaria, herpes, trichinosis, smallpox and antiseptics.

(Indigo has been extracted from the plant indigofera tinctoria and related species from earliest times with the word appearing in English from at least 1289. It is used to stain wool and silk a yellow colour.)

As an explosive picric acid began to be tested in Lydd, England about 1885 and it was adopted under the name Lyddite in 1888. During World War One it was extensively used in grenades and bombs. It did need a primer in order to explode.

In 1776 Woulfe reported on his investigations into the analysis of the ore, hornsilver (AgCl, chloroargyrite) in which he claimed it contained not only the 'acid of salt' (HCl) but also the 'acid of vitriol' (H_2SO_4). This year was also to see him deliver the first Bakerian lecture for the Royal Society on the 20^{th} of June. This lecture was funded by a bequest of one hundred pounds made by the naturalist Henry Baker (1698 – 1774), which was to be used annually for this purpose.

In 1779 Woulfe reported the existence of a previously unknown element in the mineral wolframite, iron manganese tungstate, $(Fe,Mn)WO_4$, but failed to isolate it in its pure form. This was later worked on by Carl W. Scheele in 1781 who produced tungstic oxide (WO_3) and it's final isolation was due to Fausto (1755 – 1833) and Juan Jose (1754 – 1796) de Elhuyar who, in 1783, produced the pure element tungsten by the reduction of the acidified wolframite with charcoal.

Woulfe was now wintering in London, while spending the summers in Paris and from 1784 most of his publications were to appear in Rozier's '*Journal de Physique'*. (Jean-Baptiste Francois Rozier 1734 -1793) Four such papers appeared in 1784, 1787, 1788 and 1789 but none were of great importance. In a way Woulfe's scientific career was over.

In later life Woulfe became erratic and is said to have had strange religious and alchemical ideas. He now spent much time in the search for the elixir of life and was to attribute his failure to find it as due to a want in him of due preparation by pious and charitable acts. John Timbs (1803 – 1875) claimed Woulfe to be the last alchemist and the rumour of his madness in late life may well be due to his alchemical notions.

In his lodgings in Bernard's Inn, 22, Holborn (London, EC 1) his rooms, filled with chemical apparatus, would only be gained by persons having the secret signal. He breakfasted at four each morning with select friends. He had no faith in the medical profession and would not permit anyone of them near him. His treatment of any illness was a stagecoach trip to Edinburgh. The jolting and swaying was sufficient to relieve any symptoms. It was after such a 'cure' in 1803 that he remained ill, and refusing to be treated by a doctor, died, alone and unattended at his lodgings.

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http://en.wikipedia.org/wiki/Indigo

(http://en.wikipedia.org/wiki/Peter_Woulfe)

http://en.wikisource.org/wiki/Woulfe,_Peter_(DNB00)

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The Essential Chemical Industry – now online!

This was the title of a resource book, now in its 5th edition and produced by the Chemical Industry Education Centre at the University of York and edited by Professor David Waddington. This is now available as a web-based resource, which allows it to be updated more often. This is a one-stop site for information on the chemical industry (with particular reference to the UK). This will save the busy teacher time in tracking down relevant information. It covers industrial processes, materials, basic chemicals, metals, polymers. The coverage is designed for the UK A levels, so it contains more than is needed for the Irish LC Chemistry syllabus. It is an essential stop for the chemistry teacher, so make sure you benchmark it.
www.essentialchemicalindustry.org

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The search for simplicity

"I believe all complicated phenomena can be explained by simpler scientific principles."

Linus Pauling

"You do not really understand something unless you can explain it to your grandmother."

and

"If you can't explain it to a six year old, you don't understand it yourself."

Albert Einstein

TY Science:

Ardscoil Rís – London TY Science Tour 2013

Phil Harte
Ardscoil Rís, South Circular Road, Limerick

During the first week of Easter Holidays in March of this year, 48 transition year students and 5 teachers appeared in Shannon Airport at 4:15am, destined for London. This apparition was the first Science tour group from Ardscoil Rís in Limerick.

How the tour came about

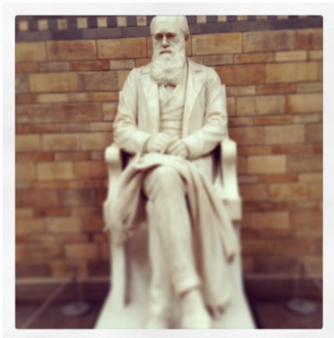
As with many schools around the country, the popularity of Science subjects at senior cycle had been declining in previous years. The tour was conceived and lead by Ms. Diane Condon and Mr. Jack Corrigan as a way of bringing Science back into the limelight in the school. This wasn't the only goal for the tour, with events and visits planned carefully to give a real quality learning experience to students.

Once the idea was floated it quickly got traction in the school, and the work began. Tour operators were researched by Jack and Diane as were destinations. Being so close and with so much to see and do, London became the destination of choice. The students were consulted and responded extremely positively, with the tour being oversubscribed! All of the other Science teachers; Ms. Rose Lawlor, Ms. Catherine Casey and Mr. Phil Harte came on board and detailed planning began. Diane and Jack then took the proposal to our principal Ms. Bríd de Brún and the board of management who gave great support to the project.

The tour schedule was then decided. Tasks, such as collecting passports, money, and documentation were divided between the teachers. Students had to have European health insurance. The tour cost each student €350 – which included the flights, hotel with breakfast included, our very own bus for the entire tour, dinner two nights and admissions to the various Museums and Parks.
The five teachers held a mandatory meeting with parents and students two weeks before the trip, where our expectations were presented clearly and emphatically. Doing this in advance of the trip made it substantially easier to run. It also allowed parents to communicate with us and gave a chance to collect Passports, Health Insurance cards, emergency contact details etc. These details were all copied and a file left in the school and brought with us as precautions.

Details of the tour

Day 1 began with our flight to London Stansted with Ryanair at 6:15am in the morning. Once there, we met our bus and tour guide who would took the group on a tour of London. After this it was the Science Museum (www.Sciencemuseum.org.uk) for a couple of hours, where we also had lunch. The museum itself is a wonderful place.



There were interactive exhibitions on nearly anything you can imagine, from space exploration to holograms, from Darwin to Watson and Crick and even Alan Turing. The students were allowed to explore the museum and its exhibitions themselves and met the teachers at a specified time and place. From the Science Museum, it is a short walk to the Natural History museum (www.nhm.ac.uk) where we spent another few hours. The Natural History museum is an awe inspiring place – from the massive Brachiosaurus fossils in the main hallway to every little display and detail. It is the kind of place you could spend a week exploring and still learn something new. The coach then collected us and brought us to Pizza Hut for dinner, before finally bringing us to our hotel – the Premier Inn at Putney Bridge. The hotel was absolutely perfect, clean and modern and fairly central. Curfew was at 11 and a few of the teachers stayed up to enforce this. To be perfectly honest though, every single one of the students was exhausted after the day and everyone was in bed before the curfew.

Day 2 started early with breakfast at 8. From there were taken to the 'Centre of the Cell' – a working medical laboratory with an interactive education centre. Here the students were treated to a very futuristic show and variety of interactive computer games and lessons on the human body, microbiology, genetics etc. It was a very worthwhile visit and a great experience, even giving the students a chance to see preserved human body parts. After having lunch in the area, the coach took us to the Royal Observatory in Greenwich where we spent a couple of hours. This was another nice experience, with the students (and me) getting a kick out of standing on the Meridian (0'0'0' – Greenwich Meantime). After this, it was back to the coach and into the city for dinner at Fire and Stone. We then walked across the Thames to our appointment with the London Eye. This was definitely one of the highlights of the trip, as it was dark when we went up. We were treated to a spectacular view of London and the students (teachers too) were in absolute awe, frantically snapping pictures. When we got back on the bus, there was a real buzz with the students starting to chant the word 'Science' at one stage!

Day 3 again started early with breakfast and check out by 9. Thorpe Park, the large amusement park famous for its roller coasters was our venue for the day. When we arrived we were seen to very efficiently and brought to a Physics workshop and demonstration. This was really excellent – showing the students the Science behind the rides in the park, we even had to do some calculations!

The workshop lasted about 45 minutes and then they set off around the park for the day. It was an excellent venue and perfect for the last day. Finally, it was then back on the bus to the Airport and home.

Designing a successful tour

The tour needs to be carefully planned and presented to students. It was really advantageous that expectations were presented clearly to students and parents in advance of the trip and this made it quite easy to run (having Thorpe Park on the last day was a great carrot to behave as none of them wanted to miss it).

The students were split into groups of 9 or 10 and assigned a teacher, and these groups were called before and after every event for headcount, for example, after going through security in the airport or before leaving a museum. This made head counting a lot easier, with only 10 instead of 48 to count.

Having the five Science teachers on the trip proved to be a great experience for the department, and in my opinion made the whole department more cohesive.

The whole trip was a huge success, with immense educational value. Uptake of Science at senior cycle has dramatically increased. I would without hesitation recommend a trip like this to any school looking to promote Science.

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Laboratory Accidents # 3

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Introduction

This article is the third in a series which takes a look at some of the accidents that have taken place in the Science laboratory, discussing the chemistry involved and the precautions which could have been taken to prevent the accident.

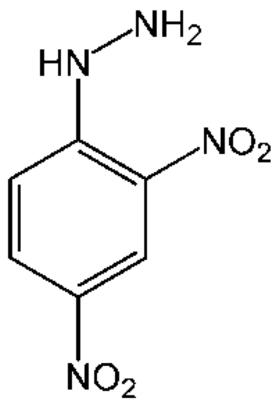
The previous article on laboratory accidents (*CinA!,* # #98) looked at three accidents in the Science laboratory: one involving flame tests, and two involving the hazards of pupils having ease of access to chemicals. Similarly this article will look at some other commonly occurring laboratory issues.

Before conducting an experiment or demonstration it is vital that the science underpinning the experiment or demonstration is understood completely by the teacher, and that it has been tried out before, and that a full safety audit has been done for it. A full safety audit seems like a lot of work, but it is very helpful to make one stop and really think about what you are doing, and how it could be improved and made safer. Once completed, it should be revised regularly (typically every six months to year), but it is still essentially complete and on record. It is well worthwhile making the effort to do a safety audit for the activities carried out in the laboratory, and thus begin to stockpile these into a safety folder. In addition, proper storage of chemicals and regular audits of these chemicals are vital to ensure that they remain in a safe and useable condition.

Laboratory Evacuations and Bomb Squad disposal of chemicals

Recent years have seen an increase in school science laboratory evacuations and the army bomb squad being called in to dispose of hazardous materials. The question is what has caused this increase in these events? We will take a look at the two common substances involved in these instances and the chemistry surrounding them and why they can become unstable.

2, 4-Dinitrophenylhydrazine

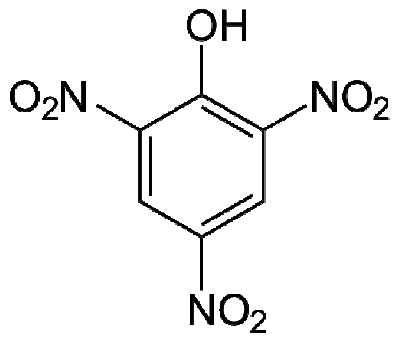


The first chemical that we will discuss is commonly known as Brady's reagent (a solution of 2, 4-dinitrophenylhydrazine in methanol and sulphuric acid), and you may have also seen it in the news as 2, 4-Dinitrophenylhydrazine ($C_6H_3(NO_2)_2NHNH_2$). It would have been used in Organic chemistry at Leaving Certificate level, as it can qualitatively test for the functionality of the carbonyl group in aldehydes and ketones. A bright orange or yellow precipitate indicates the presence of the carbon-oxygen double bond. If the carbonyl compound is aromatic, then the precipitate will be orange/red; if aliphatic, then the precipitate will have a more yellow colour.

2, 4-Dinitrophenylhydrazine is typically available as a wet powder to reduce its hazard as an explosive. Care must be taken to not allow it to dry out. The recommended storage for this compound is in a cool dry place, tightly sealed, at a temperature of 2-8 degrees Celsius (http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=IE&language=en&productNumber=18189&brand=FLUKA&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Ffluka%2F18189%3Flang%3Den). This substance becomes dangerous when it dries out and a risk of explosion develops on oxidation. Therefore it is vital to take extreme care if there is evidence of drying out, crystallisation or the seal is not air tight leading to the risk of contamination. It is very dangerous to open the container as the substance may become shock sensitive leading to an explosion. If in any doubt at all the best course of action is to call the emergency services.

However, we could find no record of an explosion at a school involving 2, 4-dinitrophenylhydrazine.

Picric acid



The next substance which we will discuss is picric acid (2, 4, 6-trinitrophenol, TNP, $C_6H_3N_3O_7$). Picric acid was originally utilised as a military grade explosive, a yellow dye (due to its pale yellow, odourless, crystalline solid form) and an antiseptic. It was named picric acid after the Greek word '*pikros*', which means bitter. It was given this name by Dumas, the French chemist because of its extremely bitter taste when in aqueous solution. In more recent times picric acid would have been more commonly used in schools and universities for the preparation of crystalline salts of organic bases for the purpose of identification and characterisation testing. However, these tests have not been on the Leaving Certificate Chemistry syllabus for many many years. It also has uses as a chemical reagent. It is recommended that picric acid be stored wet, therefore under a layer of water is the most common and safest storage method. It is the dry picric acid which is particularly sensitive to shock and friction

Water can be added to picric acid to act as a desensitiser. The chemical is classified as a flammable solid when wetted with more than 30% water and as a hazardous explosive when less than 30%. It is an explosive, but is also shock, friction and heat sensitive, making it difficult and unsafe to handle in a school laboratory setting. Once wetted the picric acid is considerably less shock sensitive than the dry acid. It is also vital to have an awareness of its reactivity with a variety of materials (metals, metal salts, bases, ammonia, and concrete), and is forms picrate salts easily. The picric acid should be stored in glass or plastic containers as it forms these picrate salts with metals very easily and from calcium picrate with concrete floors if spilled. It is of vital importance that attention be paid to the prevention of the formation of picrate salts during normal use of picric acid.

These salts tend to be even more dangerous than the acid itself. While the picric acid itself is very dangerous if it dries out, it is even more important that it never dries out on metal or concrete surfaces. Do not store in containers with metal lids or ground glass stoppers as these are more susceptible to the formation of picrate salts.

The situation which developed in Irish schools, pharmacies and science laboratory facilities in recent years involved old picric acid (see web links in references), which was discovered during audits. It may still be in schools but is unnecessary as it is no longer used at Leaving Certificate Chemistry level, in the situations referenced in this article it was found by teachers doing stock clearance or was found by chance.

There are two main dangers associated with this, the first being that it has often been sitting in the science store room for many years, and it is often unknown if the picric acid has dried out and whether shock sensitive crystals have formed. The second issue is that it is often impossible to know whether it has been stored correctly, is it airtight and what impurities may have been introduced to the container. This could bring about the formation of picrate salts, both inside the bottle or in the threads of the lid of the container (http://www.tc.gc.ca/eng/canutec/articles-picric-254.htm).

If picric acid is found in the school laboratory the most important safety precaution is Do NOT TOUCH THE CONTAINER. Frequently it is unknown how long the bottle/container has been left and what state the product inside is in. It may still be stored under water, however to check this

can be hazardous, as if not under an appropriate level of water, any disturbance or movement may be dangerous and result in an explosion. If unsure at any point call emergency services.
If visually inspecting the container, look for product identification and check for the expiration date. If you can determine visually what the water content is or if there are any signs of crystallisation this maybe important information. If there is no evidence of crystal formation and the water content is fairly high there is less of a risk, however treat the situation carefully. Secure the area and restrict access. Ensure water and a water spray bottle are readily available.

Prevention is better than cure

Remember that the teacher is often the person most at risk in the science laboratory. You should always wear eye protection, a lab coat, and gloves where required. You should also make sure that you have a suitable fire extinguisher and fire blanket available. Don't forget to consult Material Safety Data Sheets regularly when completing a risk assessment or keep them on file in an easily accessible folder in the laboratory. The Professional Development Service for Teachers has an excellent supply on their website: http://chemistry.slss.ie/ph_materialsafetydata.html . When MSDS are consulted, if the worst happens, then appropriate first aid can then be given. By completing a risk assessment, you are forced to stop and think about what you are doing, to imagine any possible dangerous scenarios, and to put in place appropriate measures to avoid them.

Keeping in mind the chemicals discussed in these articles the best course of action if found in the school laboratory is to call the emergency services.

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This is part of a series of articles on Laboratory Accidents. If you were involved in an accident at school please share it with your colleagues – no names will be used! Your experience might help prevent an accident.

□

Chemistry for Non-specialists: an update

John Daly and Maria Sheehan

What is Chemistry for Non-specialists?

This is a high quality training programme designed by the Royal Society of Chemistry and adapted for the Irish curriculum adapted for the Irish curriculum by John Daly and Jim McCarthy. The aim is to provide teachers who hold a specialism in another subject with confidence, flair and enthusiasm for teaching chemistry. There is an emphasis on gaining hands-on experience with the use of relevant and interesting experiments and demonstrations to illustrate key ideas and phenomena. The course also identifies the topics that challenge students' conceptual understanding of chemistry and provides teachers with strategies to tackle them. Participants received resources to assist them with their chemistry teaching including a course book that provides guidelines on over 80 experiments.

The workshop runs over two days and this year the Chemistry for Non-specialists course took place in two venues in Ireland in the month of June 2013.

- Blackrock College, Dublin ~ 19th and 20th of June and
- Ardscoil Rís, Limerick ~ 25th – 26th June

The aim of the course is to

- Increase your understanding of chemistry
- Become more confident and competent in the teaching of chemistry in junior cycle Science.
- Rehearse relevant and interesting practical experiments and demonstrations to help inspire and engage your pupils
- Develop an understanding of common pupil misconceptions and how these can be addressed

The costs of running the course and providing the extensive course handbook were met by the Royal Society of Chemistry (RSC) Education Division and the Professional Development Service for Teachers (PDST) so there was no course fee for participants and lunches were provided. Places were limited with a maximum of 18 participants allowed. To highlight the popularity of this course, each venue had a waiting list of applicants.

The general themes of the laboratory sessions were as follows:

- Acid and Base Chemistry
- Gases and Combustion
- Electrolysis and Redox reactions and
- Metals

Ratings and comments provided on the evaluation forms used for the workshops were very positive and confirmed that the intended outcomes had been met. Some extracts from the evaluation forms follow;

- “Some exciting experiments and great resources”
- “I am more confident about handling chemicals and ordering / disposing of them”
- “more confident about carrying out chemistry demonstrations”
- “better background knowledge of experiments”
- “Networking gave me new ways and tips for teaching chemistry in the class”
- “Makes you realise how enjoyable the experimentation element of science is”
- “I will include more demonstrations and student practicals in my teaching”
- “When I heard I had to bring goggles and lab coat, I thought “Oh no!” but it’s the best course I’ve been on (and I’ve been to a lot) for ages!

Figure 1: Jenny Egan and Celine Maloney at the Limerick workshop

Figure 2: Participants at the Limerick workshop in Ardscoil Rís

Acknowledgements: The Chemistry for Non-Specialists team would like to thank the following who ensured that each course was such a success:

- Diane Condon, Ardscoil Rís, Limerick and Mishka Abrahams, Blackrock College, Dublin ~ for the preparation of materials and chemicals needed in both venues.
- Claire McDonnell, DIT Kevin St. for her invaluable work as Chair of the RSC Ireland Region Education Division committee and securing funding for the two events

Future events: It is planned that this course will run in at least two venues in summer 2014. I am aware that most readers of *Chemistry in Action*! are chemistry specialists. Could I encourage you therefore to promote this course amongst your science teacher colleagues with other specialisms, particularly those new to the teaching profession.

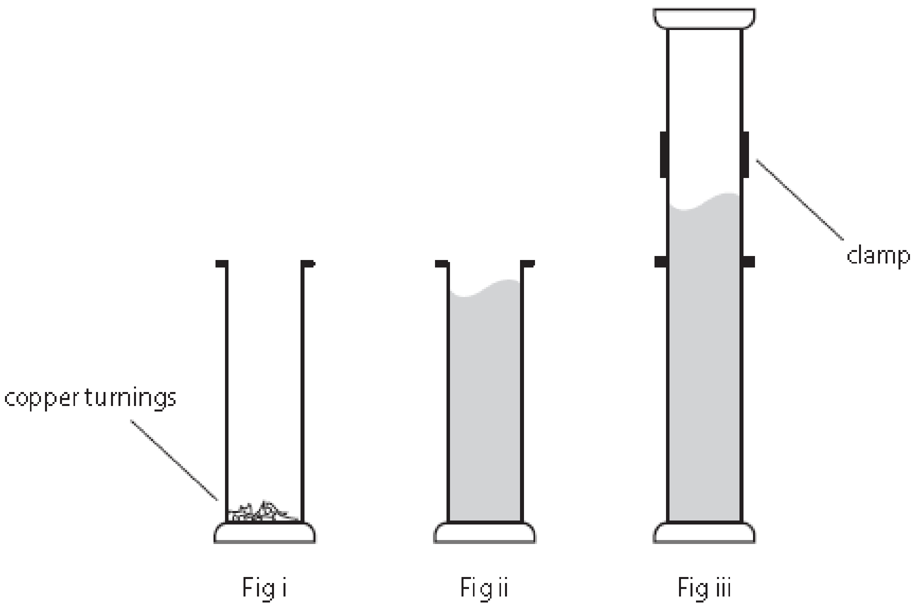
If you wish to express an interested in hearing about the 2014 courses please feel free to email us at chemistryfornonspecialists@gmail.com and we will let you know as soon as any information is available.

CfNS Sample Activity 1: Diffusion of gases – A safer alternative to Bromine

Safety Notice:

Bromine (VERY TOXIC and CORROSIVE) has caused a number of accidents to both teachers and technicians, with serious burns to the skin or breathing difficulties. Bromine is not banned but if it is to be used, a knowledgeable colleague should be in the vicinity to provide assistance in case of an accident. Any person handling bromine for the first time, or who does not handle it regularly, should receive training from an experienced colleague.

Nitrogen dioxide (VERY TOXIC and CORROSIVE) is a heavy, brown gas. Despite the similar hazard warnings, there is a lower risk of serious injury with nitrogen dioxide than bromine and the gas provides a safer alternative. A known volume of concentrated nitric acid (CORROSIVE) is added to an excess of copper turnings to produce enough nitrogen dioxide so that a gas jar of known volume is nearly filled. Another gas jar of air is placed over a gas jar of nitrogen dioxide. Over the next 20 minutes, the brown gas diffuses into the upper jar.



Procedure:

A. Using water and a 250 mL measuring cylinder, establish the volume of the gas jar. Do not use this wet gas jar for the following demonstration.

B. Using a retort stand, boss and clamp, adjust the fitting of a dry inverted gas jar over another dry gas jar of the same size and set it to one side.

C. Place at least 1 g, but no more than 2 g, of copper turnings in the gas jar (Fig i). Knowing that 8 mL of concentrated nitric acid produces 1000 cm^3 of nitrogen dioxide at room temperature and pressure, estimate the volume of acid needed to just fill the gas jar with gas. Wearing eye protection and suitable gloves, place 1 mL less than the estimated volume of nitric acid (CORROSIVE and OXIDISING AGENT) in a 10 mL measuring cylinder. Empty the contents of the measuring cylinder into the gas jar with copper and watch the brown gas rise (Fig ii).

D. Once the reaction stops, invert the second jar over the jar containing the gas. Clamp this jar into position with care (Fig iii). Diffusion takes place in 20 minutes.

Controls and hints:
If the above procedure is followed, a fume cupboard is not required during the demonstration because nitrogen dioxide, being heavier than air, remains in the gas jar. Gloves are not required when an automatic pipettor is used.

Disposal:
Move the gas jars to a fume cupboard. Add water to each gas jar and pour the contents down a foul-water drain, adding more water. Unreacted copper turnings can be dried and reused.

Extension:
The demonstration can be performed along with a similar set up using bromine to show that gases diffuse at different rates. To fill a 1 litre gas jar, use no more than 2 mL of liquid bromine. Adjust the volume of bromine liquid to the capacity of the gas jar that is available. It takes time for bromine to vaporise.

Safety: Use a fume cupboard, wear goggles or a face shield and nitrile or latex chemical-resistant gloves. A bucket of 1 M sodium thiosulfate solution should be available in case bromine splashes onto the skin or is spilled.

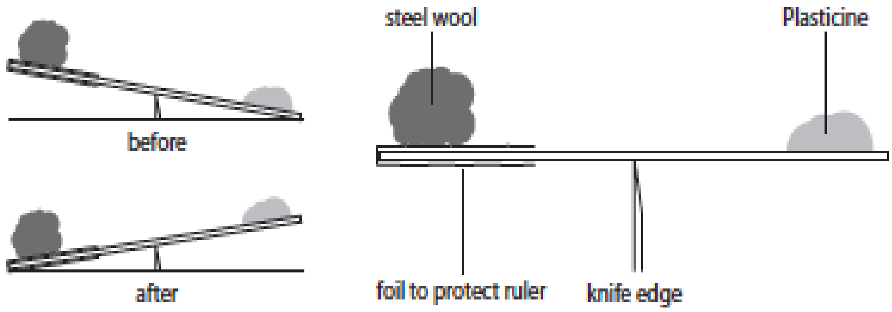
CfNS Sample Activity 2: The combustion of iron wool

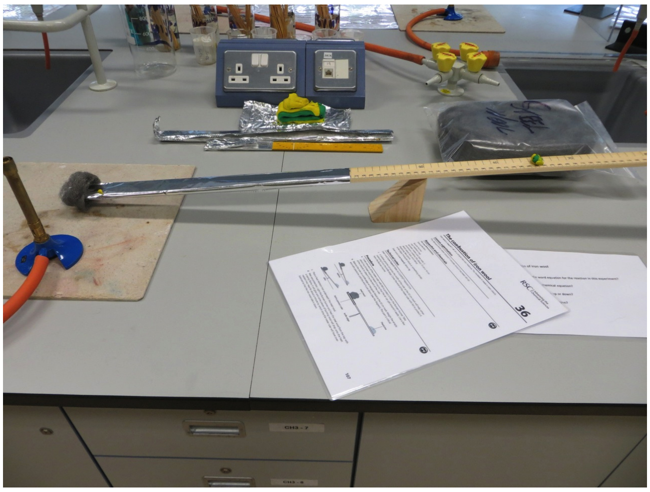
Iron wool is heated in air on a simple 'metre-stick balance'. The increase in mass due to the chemical combination of iron and oxygen is seen clearly. The lesson takes about 5 minutes once it has been set up.

Apparatus & Chemicals (per demonstration):
Eye Protection, Bunsen burner, Heat resistant mat, Wooden metre stick
Aluminium cooking foil (10 cm x 10 cm), Retort stand, boss and clamp
Small ball of plasticine (marla), clamped knife edge, triangular block or similar
Steel wool (about 5 g)

Technical Notes:
A shallow groove cut at the 50 cm mark on the metre-stick will help when balancing on the block. One end of the metre-stick is covered with aluminium foil to protect it from the bunsen flame.

Procedure:





Procedure:

a) Tease out about 4 g of steel-wool so air can get through it and use a few of its strands to attach it to the end of the metre-stick covered in aluminium foil.

b) Balance the ruler on a supported knife-edge or triangular block at the 50 cm mark. Place a small ball of plasticine (marla) somewhere near the other end of the metre-stick so that the plasticine end is just below horizontal but not touching the desk. Place a heat-proof mat under the steel-wool.

c) Wear eye-protection. Use a roaring bunsen flame to heat the steel-wool from the top. Try to lose as little burning steel-wool as possible. After about a minute or two the metre-stick will have overbalanced on the steel-wool side.

Teaching Notes:
Before heating ask your pupils to predict whether the steel-wool end of the metre-stick will go up, go down, or stay the same. Many will predict a mass loss.

Equation:
Iron + Oxygen → Iron Oxide

$2Fe(s) + 3/2\ O_2(g) \rightarrow Fe_2O_3(s)$

Note: A small aluminium cup-cake holder could be used as a holder if it can be attached to the ruler using a tack.

□

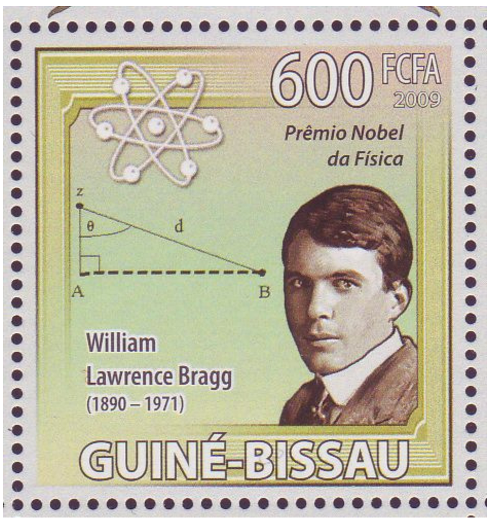
Quotable Quotes

I have no patience with attempts to identify science with measurement, which is but one of its tools, or with any definition of the scientist which would exclude a Darwin, a Pasteur or a Kekulé. The scientist is a practical man and his are practical aims. He does not seek the ultimate but the proximate. He does not speak of the last analysis but rather of the next approximation. His are not those beautiful structures so delicately designed that a single flaw may cause the collapse of the whole. The scientist builds slowly and with a gross but solid kind of masonry. If dissatisfied with any of his work, even if it be near the very foundations, he can replace that part without damage to the remainder. On the whole, he is satisfied with his work, for while science may never be wholly right it certainly is never wholly wrong; and it seems to be improving from decade to decade.

Gilbert Newton Lewis
The Anatomy of Science (1926), 6-7.

Classical Chemical Quotes #6

William Lawrence Bragg (31 March 1890 – 1 July 1971)



The most important thing in science is not so much to obtain new facts as to discover new ways of thinking about them.

Sir William Bragg

Chemlingo: Greek fire and other hot topics

One of the mysteries of the ancient world is the chemical composition of Greek fire, used by the Byzantine Greeks to set enemy ships on fire when fired from a catapult. Earlier versions of this weapon go back to the ancient Greeks. It was also called sea fire or wet fire because it caught fire on contact with water. Some people therefore think it contained quicklime along with an oxidant like potassium nitrate (saltpetre) and a fuel such as oil or pitch. It was the earliest version of napalm. Napalm was invented at the end of World War II as an incendiary by mixing aluminium based soaps of **nap**hthenic acids, **palm**itic acids (hence **napalm**) and oleic acids together and turning them into a flammable gel with gasoline. It is gruesomely effective because it sticks to its target. Interesting that 'napalming' has now become a verb in America to describe spreading one's ideas about, presumably in a way so that they stick, as in *"I napalmed the whole staff with my concept."*

Naphtha is a Greek word used originally for pitch or bitumen, probably derived from a Persian or Indian word, and now used for petroleum derivatives. Hence we get a series of compounds beginning with naphtha- , such as naphthalene. It is now used for a hydrocarbon fraction obtained when oil is distilled boiling between 30^o and 200^oC.

Substances which cause fire are known as incendiary agents (from Latin verb *incendere*), but it is also used of people who stir up trouble. If someone annoys me I can become incensed. So also a firebrand is a brand lit from a fire but it is also a person who lights a fire, often maliciously, or indeed kindles passions and incites a riot. A burning issue is one which gets us worked up and may lead to us blowing our top! We also have flaming rows and talk about verbal fireworks, when someone gets so worked up that they lost control and may explode with rage. It is interesting how many technical words creep into our everyday language as metaphors.

Incense also derives from the word incendiary because it is shorthand for burnt incense, a substance which produces a sweet smell when burnt.

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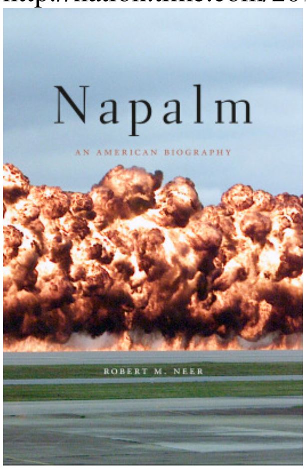


Napalm: an American biography, Robert M. Neer

http://en.wikipedia.org/wiki/Greek_fire

Elementary Chemistry

Search for new elements

48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo

In August 2013 the existence of element 115 was confirmed in Sweden. This should open the way to it being named in the near future.

"Just past copernicium (element 112) in the periodic table, several of the few known heavier elements remain nameless. That's because they've only been observed once, and the scientific bodies responsible for naming new elements, the International Union of Pure and Applied Chemistry and the International Union of Pure and Applied Physics, require, at a minimum, an independent confirmation. That moment has now arrived for element 115. Dirk Rudolph of Lund University in Sweden and researchers working at the GSI Helmholtz Centre for Heavy Ion Research, Germany, report in Physical Review Letters that they have produced and detected the element, corroborating the first observation in 2003 by scientists in Dubna, Russia."
physics.aps.org/synopsis-for/10.1103/PhysRevLett.111.112502

In issue #99 we reported the new names for elements #114 and #116, leaving #s 113, 115, 117 and 118 still to be named. Element #118 completes row 7 of the Periodic Table and any new elements that are made will start a new row, the first time a new row has been started in the search for new elements. Researchers at the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany tried for several months at the end of 2012 for element #119, which will be a member of group I, the alkali metals. They hoped to make #119 by firing titanium atoms (#22) at berkelium atoms (#97) and hoping that some nuclei collide and merge to form a new element. Only three laboratories in the world make new elements – in Darmstadt , Germany; Berkeley National Laboratory, USA; and the Institute for Nuclear Research in Dubna, Russia. All of them now have elements named after them. They are still trying to reach the island of stability with 184 neutrons and more than 120 protons, where atoms are expected by theory to be exceptionally stable. They haven't quite reached there yet, but the new alkali metal would be a step in the right direction.
http://www.popsci.com/science/article/2013-04/making-new-elements
See also: 'Why all the fuss about new elements?' Eric Scerri
http://www.huffingtonpost.com/eric-scerri/element-115_b_3832687.html

Helium supplies may run out

We are all familiar with helium-filled balloons, not to mention airships, but helium has far more valuable uses. Helium in liquid form is essential for cooling superconducting magnets used in MRI scanners and NMR machines. Helium was named after the sun (helios) as it was first discovered in the solar spectrum. Helium is lighter than air and also non-flammable, so it is ideal for balloons and airships (unlike hydrogen), but due to its small mass helium atoms move so fast that they can escape the earth's gravity and when released into the air, helium is lost to space. In the 1920s the USA set up a National Helium Reserve and the USA currently supplies 75% of the world market (with 305% coming from the reserve at below market cost). This reserve was about to be closed down but has now been reprieved by the US Congress, thus ensuring continuity of supply.
http://www.economist.com/news/finance-and-economics/21586840-americas-dominance-global-helium-market-ending-inflation-warning
http://www.washingtonpost.com/blogs/wonkblog/wp/2013/09/27/good-news-congress-just-averted-a-global-helium-crisis/
But where do our supplies of helium come from? Helium is classed as a non-renewable resource as supplies are finite. It is obtained as a by-product of natural gas extraction, which can contain upto7% helium. You may remember that one product of radioactive decay are alpha particles, which are ionised helium atoms. When they pick up electrons they become gaseous helium atoms. This radiogenic helium is constantly being

produced in rocks by radioactive decay. Helium is the second most abundant element in the universe after hydrogen, but not on earth. The main reserves are in the USA
http://en.wikipedia.org/wiki/Helium
http://minerals.usgs.gov/minerals/pubs/commodity/helium/mcs-2012-heliu.pdf
"Helium is the essential component for an amazing range of serious industries, including aerospace, defense, high-tech electronics manufacturing, medical imaging—not to mention welding, commercial diving, and quantum mechanics research. Helium is used to test rocket engines, heat-treat aircraft landing gear parts, make flat-screen TVs, cool nuclear reactors, produce semiconductors and fiber-optic cables, fill weather balloons, and operate MRI machines. And in most of these cases, there is no known substitute for the noble gas, which has the lowest melting and boiling point of any element, and is relatively scarce on earth."
http://motherboard.vice.com/blog/the-global-helium-crisis-is-about-to-get-a-lot-worse

Helium storage tanks at the large hadron collider at CERN in Grenoble

http://www.theguardian.com/science/shortcuts/2012/dec/11/should-we-ban-helium-balloons
Is the party over? It may be that we should ban helium for non-essential uses like party balloons, so that we have enough for MRI scanners, scientific experiments and high tech manufacturing.

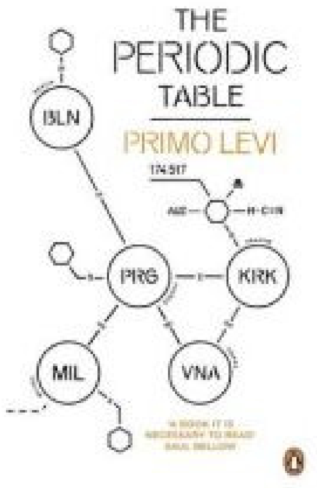
□

The best books on the Periodic Table

There is a wealth of books on the Periodic Table and they are still being published. Here are some that should be in your school library or on your personal bookshelf.

In the list that follows I give the RRP in Euro and also (in brackets) the current price in Euro from The Book Depository UK. Their prices include free delivery even on single titles and the final price is usually less than the RRP and there is no minimum order. At the time of publication all these books are still available. (http://www.bookdepository.co.uk/).

These books are a good source of anecdotes or enrichment material to liven up your teaching of the Periodic Table, and maybe fill a few gaps in your own knowledge.



The Periodic Table
Primo Levi
Penguin Classics pb 2012 €9.24 (€6.20)
This is a work of fiction, partly autobiographical, in which the elements are used as a focus or theme for the chapters.

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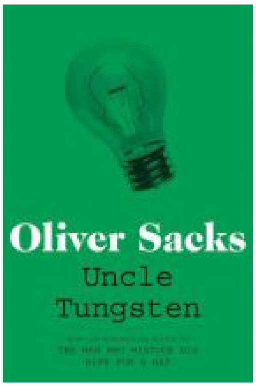

Uncle Tungsten
Oliver Sacks
Picador pb 2012 €11.56 (€7.23)
'If you did not think that gallium and iridium could move you, this superb book will change your mind' *The Times* In Uncle Tungsten Sacks evokes, with warmth and wit, his upbringing in wartime England. He tells of the large science-steeped family who fostered his early fascination with chemistry. There follow his years at boarding school where, though unhappy, he developed the intellectual curiosity that would shape his later life. And we hear of his return to London, an emotionally bereft ten-year-old who found solace in his passion for learning. *Uncle Tungsten* radiates all the delight and wonder of a boy's adventures, and is an unforgettable portrait of an extraordinary young mind.

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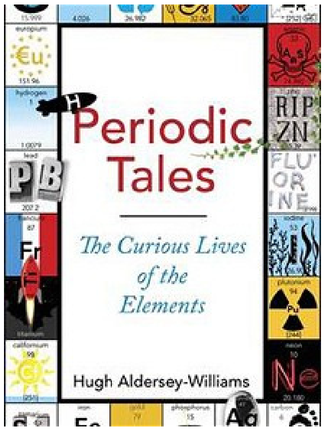

The Curious Lives of the Elements
Hugh Aldersley-Williams
Pengion pb 2012 €11.56 (€8.08)
Full of interesting anecdotes about the elements and their uses.

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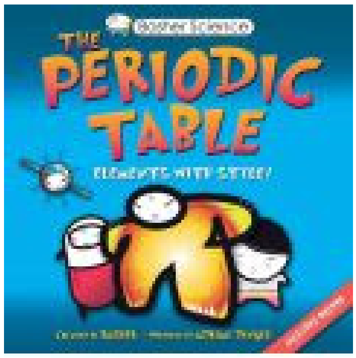

The Periodic Table
Adrian Dingle
[Kingfisher Books Ltd](#) 2007 pb €6.47 (€5.84)
A humorous look at the Periodic Table.

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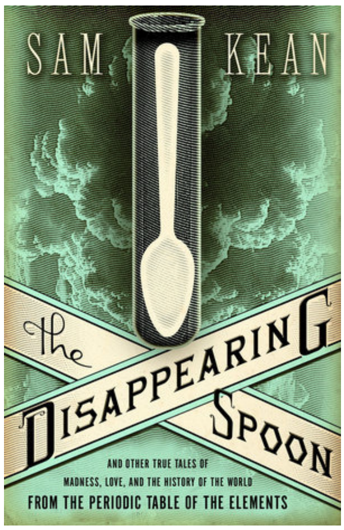

The Disappearing Spoon
Sam Kean
Little, Brown & Company pb 2011 €11.78 (€10.59)

Strange and wonderful tales about the elements.

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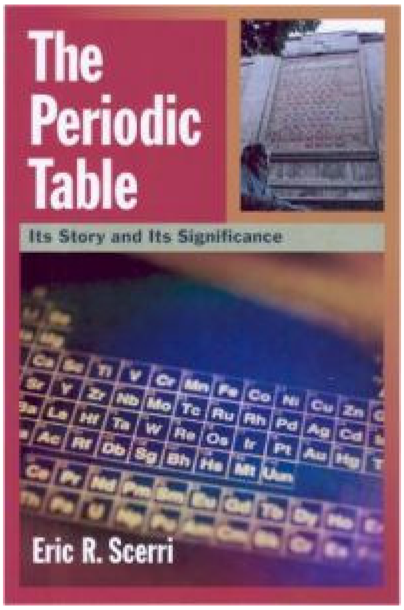

The Periodic Table: Its story and its significnance
Eric Scerri
OUP hb 2006 €26.03 (€22.55)
This is a more academic and systematic look at the history and structure of the Periodic Table, unlike the two other books by Eric Scerri listed below, which have a more popular approach.

30-Second Elements: The 50 Most Significant Elements, Each Explained in Half a Minute
Ed.Eric Scerri
Icon Books hb 2013 €15.03 (€12.02)
For a most unexciting cover, the insides are very attractive with a 2 page spread –one side text the other side illustration, of 50 important elements. A beautifully illustrated, full-colour guide to the periodic table and the stories behind its most significant elements. The snapshot below gives an impression of the book’s layout.

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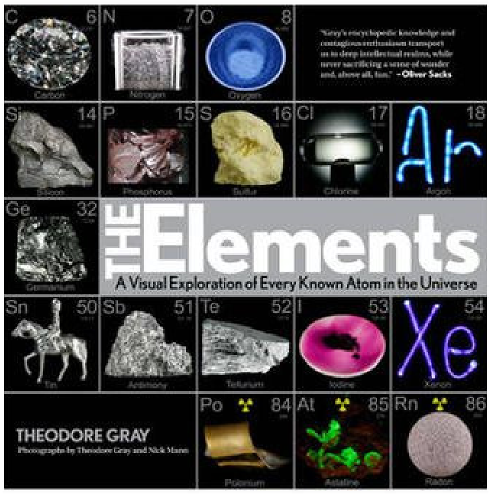

The Elements: A Visual Exploration of Every Known Atom in the Universe
Theodore Gray
Black Dog & Leventhal Publishers Inc hb 2009 €23.00 (€15.47)

This book is the coffee table book of the elements and features 2-page, full colour spreads on each element. You can also buy a wallchart based on the photos in this book.
http://theodoregray.com/

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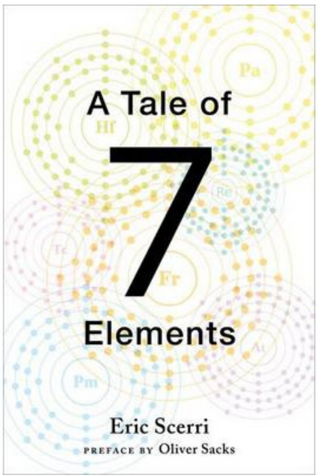


A Tale of Seven Elements
Eric Scerri
OUP hb 2013 €15.03 (€13.51)

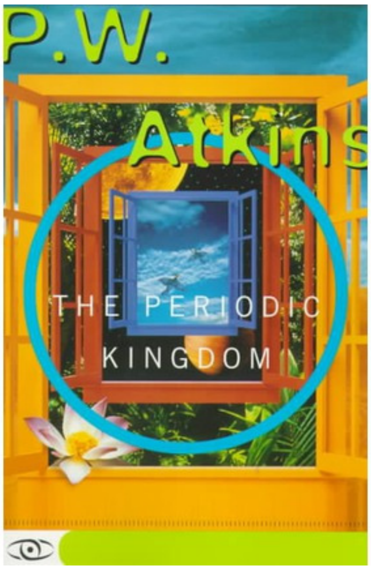
This books tells the story of 7 elements which were 'missing' from the Periodic Table. It is the latest book from the prolific pen of Eric Scerri. This is an interesting and readable book on the chemical elements and the Periodic Table. It is the 'biography' of the seven last elements to be discovered to fill in the gaps in the Periodic Table up to element 92. The elements beyond 92 are synthetic elements. The seven elements, five of them radioactive, in order of their discovery are: Protactinium, Pa (1917); hafnium, Hf (1923); rhenium, Re (1925); technetium, Tc (1937); francium, Fr (1939); astatine, At (1940); promethium, Pm (1945). It is a story of disputes over priority (hafnium had been called celtium by its first 'discoverer'), and national pride. The book has some great quotations from letters and publications, fleshing out the history of these rare elements. This is a readable book although it only has B/W and line illustrations. Henry Moseley's 1913 discovery that X-ray spectra, which were linked to atomic number not atomic mass, were the key to identifying new elements provided the tool both to identify the remaining vacancies in the Periodic Table and to confirm the identity of new elements.

Unfortunately there are a number of typos and misprints: Mosley for Moseley in the dedication and Priestly for Priestley (a common mistake) in the text and index.

Scerri quotes John Emsley (*The Elements*, 3rd. edition, 1998, OUP in the book) in the introiduction (p. xiii):
"As long as chemistry is studied there will be a periodic table. And even if we communicate with another part of the universe, we can be sure that one thing both cultures will have in common is an ordered system of the elements that will be instantly recognizable by both intelligent life forms."

From which we might conclude that one is not an intelligent life form if one doesn't recognize the periodic table!

□



The Periodic Kingdom: A Journey into the Land of the Chemical Elements
Peter W.Atkins
Basic Books pb 1997 €17.30 (€8.55)
This unusual book takes a geographical approach to the Periodic Kingdom and is worth reading, although harder to locate.

*****

Periodic Table Cool Stuff

You can buy almost anything these days as a novelty featuring the Periodic Table or individual elements – T-shorts, ties, scarves, mugs, mouse mats, fridge magnets etc. There are many suppliers in the USA but I have given some UK suppliers below, as these are more accessible.

One Big Element
http://www.onebigelement.moonfruit.com/#
Note books, T shirts, pencil cases etc.

Scienceshirts
www.**scienceshirts.co.uk/**
Ties, scarfs, mugs, mouse mats etc.

ScienceShirts is run by Gordon Woods, a retired chemistry teacher in the UK. He has brought his stall to ChemEd-Ireland and ISTA conferences in the past.

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Zazzle Periodic Table accessories
http://www.zazzle.co.uk/periodic+table+accessories
Aprons, ties, key chains, bags etc.

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Cafe Press
http://www.cafepress.co.uk/+periodic-table+gifts
Mugs, T-shirts, wall clocks, beer mugs etc.

These novelties are great for prizes, for impressing your friends and showing off at conferences!

Quotable Quotes

[On learning about the periodic table] "For the first time I saw a medley of haphazard facts fall into line and order. All the jumbles and recipes and hotchpotch of the inorganic chemistry of my boyhood seemed to fit themselves into the scheme before my eyes — as though one were standing beside a jungle and it suddenly transformed itself into a Dutch garden."

C.P. Snow

Salt making in Bad Sooden-Allendorf, Germany

Peter E. Childs

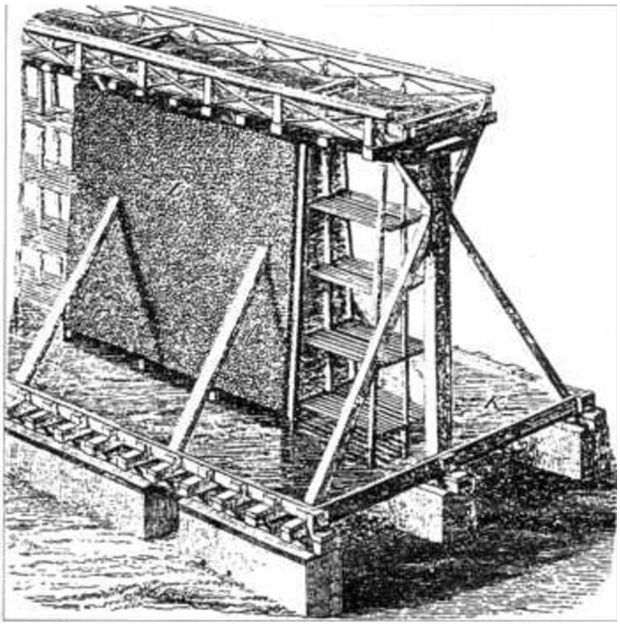
The graduation works at Bad Sooden-Allendorf, Germany (Photo: P.E. Childs)

During a visit to Germany in 2007 I came across an unusual type of salt works in Bad Sooden-Allendorf, although I discovered they are very common in Germany. The central feature is shown on the front cover and above. It is known as the Graduation house (or Gradierwerk in German). The central feature is the long thorn house. The thorn house was used mainly for the salt production in the 16th and 17th century. The graduation house was made of a wooden frame, which was filled with bundles of brushwood, usually the blackthorn (*Prunus spinosa*). Underground brine springs were pumped to the top of the frames using power from water and the water is allowed to trickle down over the brushwood. Due to the large surface area of the twigs the water evaporates and the least soluble salts – calcium carbonate and calcium sulphate – crystallise out on the surface of the twigs. These gradually become encrusted with salts and the water trickling down becomes more concentrated in the more soluble sodium chloride. The brine has thus been concentrated. This process allowed salt springs with a low salt content to produce a concentrated brine (up to 27%). The solution from the bottom of the frames was then sent to boiling house where salt was formed in lead pans. The air within the frames was humid and cool and laden with salt and walking there became a popular health remedy. Spas using the salt water sprang up at the salt works and many of these exist today. This technology goes back to the 16th century and was developed to reduce the amount of wood fuel used in salt boiling. Hen cheap coal became available the graduation works were no longer economic and most closed down or were converted into spas (salt baths).

The twigs encrusted with salts (Photo: P.E. Childs)

As well as the remains of the salt works in Bad Sooden, there is also a spa and in the village a small salt museum in the guard house , which was part of the Söder Tor (Söder Gate), the entrance to the salt works. The remains left today were Salt Works #4 and originally there were fourteen graduation works in the town. In the village you can also find the Salt Office with the Pfennigstube (Tax Office) and the Salztisch (stone table for weighing salt) next to the weighing scales. It was here that the administration of the salt works was housed in ancient times.

A diagram showing the wooden construction is given below.



http://upload.wikimedia.org/wikipedia/commons/c/cf/Gradierwerk.JPG

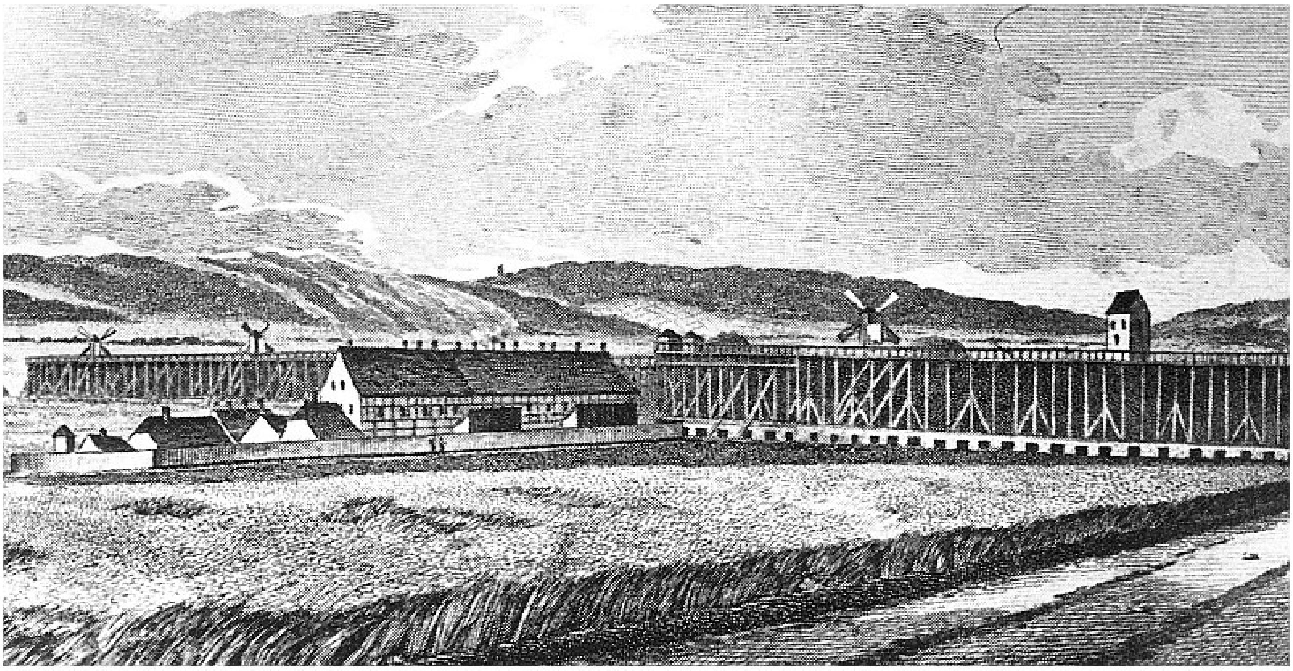
This old engraving below shows a typical graduation works, where wind mills are used for pumping the brine.

http://upload.wikimedia.org/wikipedia/commons/7/78/Fotothek_df_rp-a_0290053_Artern-Unstrut._Saline_mit_Gradierwerk_und_drei_Windm%C3%BChlen%2C_1829%2C_aus%2C_Arterner_.jpg

The link below gives you a description of the graduation works in Germany.
http://en.wikipedia.org/wiki/Graduation_tower

A working model was built at the Lion Salt Works in Cheshire in 2006 and can be seen working in this You Tube video.
http://www.youtube.com/watch?v=bZUxBqBzt-g

The technology was also tried in Australia in the 19th century and this paper by Brian Rogers in *Australian Historical Archaeology* (2: 1984) describes the process in great detail (http://www.ashadocs.org/aha/02/02_04_Rogers.pdf and see also http://www.ashadocs.org/aha/08/08_04_Rogers.pdf).



Quelle: Deutsche Fotothek

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CheMiscellany

Chemical jokes

Why does chemistry have so many bad jokes? Because all the best argon.

A man walks into a pub and asks for a pint of Adenosine Triphosphate. The barman says, “That’s 80p.”

The moment a bar of gold walked into a pub, the landlord shouted “A U, get out!”

Police arrested two kids yesterday-one was drinking battery acid and the other was eating fireworks.
They charged one and let the other one off.
Tommy Cooper

Scientific epitaphs

Lise Meitner 1878-1968
A physicist who never lost her humanity
(St. James’s Church, Bramley, Hampshire, UK)

William Herschel
Caeloum Perrupit Claustra
[He broke through the barriers of the heavens]
(Church of St. Laurence,Upton-cum-Chalvey, Berkshire, UK}

Jack Horkheimer (1938-2010), astronomer
"Keep Looking Up was my life's admonition
I can do little else in my present position."

René Descartes
Putting together the mysteries of nature with the laws of mathematics, he dared to hope to be able to unlock the secrets of both with the same key.

$S = k \log \Omega$
Ludwig Eduard Boltzmann
Carved above his name on his tombstone in the Zentralfriedhof in Vienna

Benjamin Franklin
The body of Benjamin Franklin, Printer (like the cover of an old book, its contents torn out and stripped of its lettering and gilding), lies here, food for worms; but the work shall not be lost, for it will (as he believed) appear once more in a new and more elegant edition, revised and corrected by the Author.

Johannes Kepler
I used to measure the Heavens, now I measure the shadows of Earth. The mind belonged to Heaven, the body's shadow lies here.

George Washington Carver
A life that stood out as a gospel of self-forgetting service.
He could have added fortune to fame but caring for neither he found happiness and honor in being helpful to the world.
The centre of his world was the south where he was born in slavery some 79 years ago and where he did his work as a creative scientist.

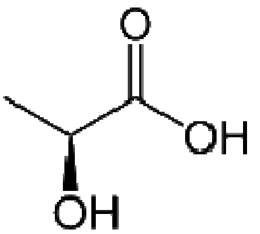
(Epitaph on tombstone at Tuskegee University Campus Cemetery, Alabama)

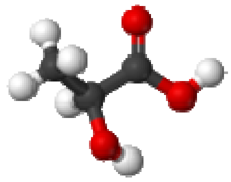
Ludolph van Ceulen:
"3.14159265358979323846264338327950"
A Dutch mathematician who died in 1610 and was the first person to calculate pi to 35 places.

Benjamin Franklin
"The Body of B. Franklin, printer
Like the Cover of an old Book
Its Contents torn out
And stripped of its Lettering & guilding
Lies here food for worms
For, it will as he believed appear once more
In a new and more elegant edition
Corrected and improved by the Author."

□

Lactic acid: no longer a sour taste



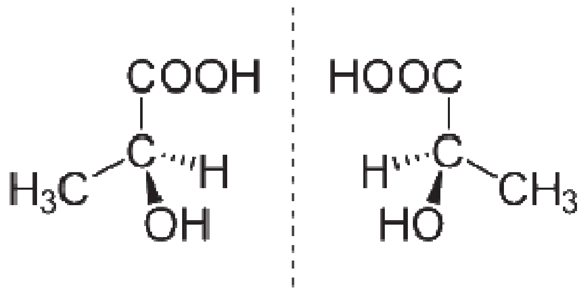


$C_3H_6O_3$ 2-hydroxypropanoic acid $CH_3CHOHCO_2H$

Lactic acid is the milk acid – it is responsible for the sour taste when milk goes off. It was first isolated in 1780 by Scheele. The presence of lactate in muscles was identified by Berzelius in 1808. It is a weak carboxylic acid but it is 10 times stronger than ethanoic acid.

Bacteria in milk (lactobacillus) act on the lactose (milk sugar) and convert it into lactic acid, which in turn sours the milk and curdles the protein to form curds of casein.

Lactic acid can be polymerised to form polylactides (also known as polylactic acid, PLA), which are increasingly important biodegradable polymers (see below).
Lactic acid can exists in D- and L- forms as it shows optical isomerism.



L-(+)-lactic acid or (*S*)-lactic acid

D-(−)-lactic acid or (*R*)-lactic acid

(*S*)-(+)-lactic acid (left) and (*R*)-(–)-lactic acid (right) are nonsuperimposable mirror images of each other

Lactic acid plant in Galway

The Galway-based green technology company Cellulac has won a €2.8 million grant from the European Commission to commercialise its biorefining technology, which converts agricultural waste into lactic acid. There is a growing €4 billion market for lactic acid, which is used in a number of sectors, including food and beverages, cosmetics, pharmaceuticals and biodegradable plastics. It is found in products include shampoos and skin creams as well as food additives, with demand for the product exceeding supply in markets such as China.
With demand for lactic acid-based biopolymers expanding at the cost of conventional polymers on counts of environmental friendliness, easy recyclability and cost-effectiveness, emergence of new lucrative opportunities are portended for lactic acid consumption in the coming years.

Cellulac had been identified as a high-potential start-up by Enterprise Ireland, which supported it in its bid for the grant. The EU grant gives Cellulac the opportunity to source funding from other State, institutional and private investors, which it will then use to develop mass production capability. The company is scouting locations in Ireland and Europe for a plant. Cellulac will create 14 jobs as a result of the grant.
Irish Times 23/4/12

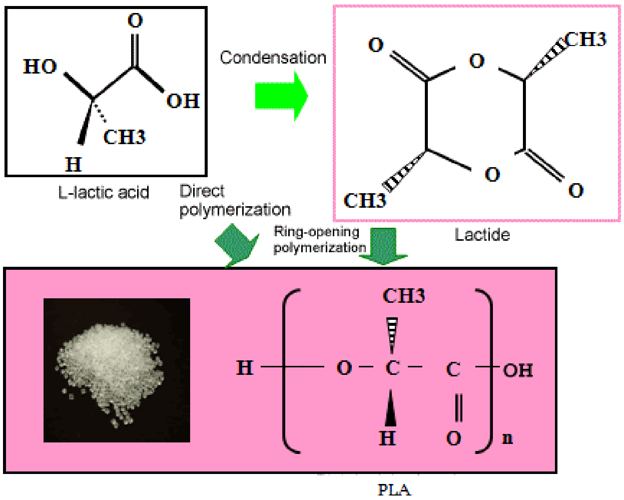
In September 2013 it was revealed that Cellulac has plans for a €50m plant to make lactic acid in Dundalk, which should provide 60 jobs. It will use straw as the raw material.
Irish Independent 19/9/13

Useful website on lactic acid
http://www.lactic-acid.com/index.html

Production process for polylactic acid (PLA)

http://www.hitachi-pt.com/products/ip/process/pla.html
Polylactic acid(PLA) is the most common bioplastic in use today. First, corn or other raw materials are fermented to produce lactic acid, which is then polymerized to make polylactic acid(PLA). Bioplastics are expected to make major contributions to environmental protection, because they reduce CO_2 emissions, as they are made from renewable sources. and because they are biodegradable. The range of applications for bioplastics is growing, from materials used in automobile interiors to packaging for foods and

cosmetics, to agricultural sheeting, to household appliances.



http://www.hitachi-pt.com/products/ip/process/pla.html

Experiment on the Isolation of Casein, Lactose, and Albumin from Milk
http://courses.chem.psu.edu/chem36/Web%20Syn06/Exp112Syn06.pdf

Experiment on making polylactic acid from lactic acid
http://www.rsc.org/Education/Teachers/Resources/Inspirational/resources/3.1.10.pdf

Making a bioplastic from starch
http://www.youtube.com/watch?v=5M_eDLyfzp8

Optical isomerism of lactic acid
http://www.creative-chemistry.org.uk/molecules/optical.htm

More than cheese from milk

Ireland's dairy industry is a world-renowned producer of cheese and other dairy products from milk. However, Ireland also produces annually 33,000 tonnes of casein, the milk protein, and also ~ 10 million litres of ethanol a year. The ethanol is obtained from whey, a waste by-product from cheese making, which contain 4-5% lactose. In 1978 Carbery in Co. Cork developed and patented a process (now exported worldwide) to ferment the milk sugar into ethanol (~4.5%), which was then concentrated by distillation. The alcohol from milk is used in the food and drinks industry and also as a local, green source of bioethanol for adding to petrol (since 2007). This process featured in an early edition of *Chemistry in Action!*

It is estimated that ~8 million tonnes of whey are produced each year worldwide or which ~50% is not used and is thus a waste. If the whey was used for ethanol production it could produce ~2.3 billion litres of ethanol. There are whey to ethanol plants in Ireland, New Zealand, America and Germany.

See:

http://www.liquidirish.com/2012/05/whey-alcohol.html

http://www.independent.co.uk/life-style/motoring/features/cleanrsquo-bioethanol-ireland-discovers-the-whey-to-go-399115.html

□

Quotable Quotes

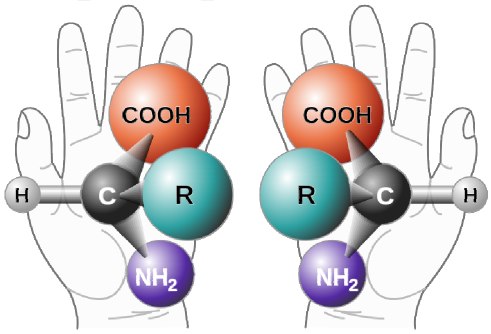
What struck me most in England was the perception that only those works which have a practical tendency awake attention and command respect, while the purely scientific, which possess far greater merit are almost unknown. And yet the latter are the proper source from which the others flow. Practice alone can never lead to the discovery of a truth or a principle. In Germany it is quite the contrary. Here in the eyes of scientific men no value, or at least but a trifling one, is placed upon the practical results. The enrichment of science is alone considered worthy attention.

Justus von Liebig

Letter to Michael Faraday (19 Dec 1844). In Bence Jones (ed.), *The life and letters of Faraday* (1870), Vol. 2, 188-189.

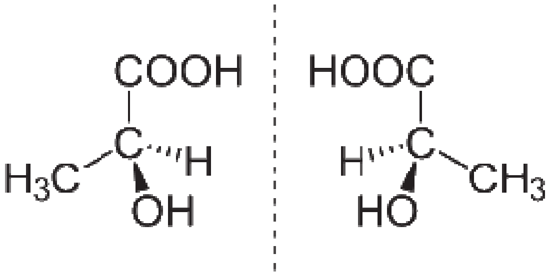
Optical isomerism

– two nonsuperimposable mirror images



http://en.wikipedia.org/wiki/File:Chirality_with_hands.svg

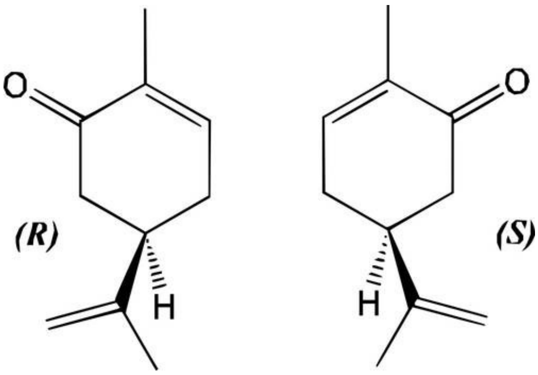
Example 1: Lactic acid



L-(+)-lactic acid or (S)-lactic acid

D-(−)-lactic acid or (R)-lactic acid

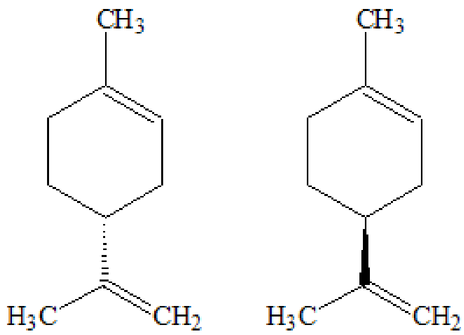
Example 2: Carvone



Peppermint

Caraway seed

Example 3: Limonene



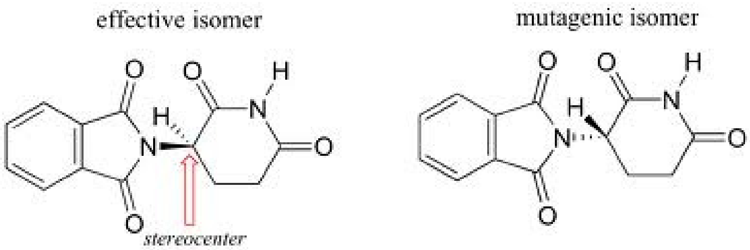
(R)

D-limonene
Orange

(S)

L-limonene
Lemon

Example 4: Thalidomide



Sedative

Teratogenic

Simple Inquiry Science (SIS)

In this series we look at some examples of science-based toys and household products which can form the basis of a science inquiry. Examples are welcome!

1. Self-inflating balloons: how do they work?

I came across an interesting application of science is a 'pound' shop: self-inflating balloons (4 for €2). You can also locate and buy these online. When you squeeze and shake them, the balloons inflate. This provides an excellent opportunity for inquiry: get students to observe carefully before and after squeezing the balloons.

What happens? What changes? What is going on? Can you make a working model to test your idea (hypothesis)?

Some things to measure and observe:
Weigh the balloons before and after inflation: is there a change? (Stays the same)

What is the purpose of squeezing the balloon to inflate it?

Observe and estimate the change in volume. (Increases)

Change in temperature. (The balloon gets cold).

Sound. (You can hear a fizzing noise when the balloon inflates .)

Shaking. (There is a swishing sound suggesting a liquid.)

What might explain these observations? Do we have a chemical or physical change?

The fizzing and change in temperature suggest a chemical change. The fizzing and the increase in volume indicate that a gas is being produced.

A liquid is present and is released when the balloon is squeezed and reacts with something to produce a gas. What chemistry might explain this? It must also involve safe chemicals as it being used by children and sold to the general public.

Liquid + something → Gas + Liquid + heat taken in

Brainstorm what reactions satisfy this equation:

1. Acid + carbonate/hydrogencarbonate → water + carbon dioxide gas
2. Acid + metal → Salt + hydrogen gas
3. Water + reactive metal → Metal hydroxide + water

Any others?

4. Alka Seltzer tablet + water → Solution + gas

Which of these gets cold (endothermic reaction)? Which of these would be safest? (Both 1. and 4. are endothermic and use safe chemicals.) Use of a liquid acid and production of hydrogen would not be safe for general use and distribution. Alka Seltzer tablets contain a hydrogencarbonate and a solid acid (citric acid) and only need water to react and produce carbon dioxide..

How would you create a working model?

We need to separate the liquid (water) and solid until the balloon is squeezed. The water could be contained in a plastic pouch, which bursts when squeezed. It would be easier to do this with the liquid than to put the solid in a pouch.

Possible model: a Ziplok bag, containing an Alka Seltzer tablet and a small, sealed bag of water. Expel the air from the Ziplok bag and seal the bag. Now squeeze the water bag to burst it and release the water. What happens? The tablet reacts with the water and fizzes. The mixture gets cold, a gas is produced and the bag inflates like a balloon. This could also be done inside a rubber balloon: the reactants are placed inside and the neck tied.

The balloon or bag must be gas tight and impermeable to water and have a long shelf life. The commercial self-inflating balloons are metallised foil balloons (like the ones used in helium balloons) not rubber ones. Why is this? (These do not perish and so last longer on the shelf, and are more gas tight.)

□

Teaching Enquiry with Mysteries Incorporated

You may have read the insert with the last issue of CinA! on the TEMI project, Teaching Enquiry with Mysteries Incorporated.

TEMI is new FP7 Science and Society project aims to work with schools across Europe to develop and implement innovative training programmes that assist teachers in using enquiry to teach science. Science teachers across Europe will develop new teaching methods using mysteries or unexplained events, which will support teachers to improve their ability to capture the attention of their students and motivate them to study science. The project aims to equip teachers with new resources and methods to teach STEM subjects (science, technology, engineering and mathematics) using mystery as the starting point. The idea is to use mysteries or discrepant events to arouse student interest, motivate students to inquire and find out scientific explanations, and develop science enquiry skills. Such events stimulate an observer's natural curiosity and will motivate the observer to learn more about the topic. Mysteries or discrepant events engage the observer in the learning process and are rooted in inquiry-based learning.

This teaching idea on the self-inflating balloon above is an example of a TEMI-style introduction to a lesson. The idea is to use a scientific mystery or an unusual or discrepant event, which has a scientific explanation, to initiate an enquiry-based lesson. The University of Limerick is one of the partners in the project and we will be working with 5 or 6 cohorts of teachers over the next 3 years to introduce these ideas and monitor how successful they are in engaging students in enquiry. If you are interested in more information and possibly joining one of the cohorts, please contact:
Dr. Anne O'Dwyer, NCE-MSTL, University of Limerick, Limerick
anne.m.odwyer@ul.ie

One of the first spin-offs from the project in Ireland will be a TY Science module on Scientific Mysteries.

□

Conference Reports:Science on Stage 2013

A report from the Irish team

SŁUBICE SCIENCE ON STAGE 2013 FRANKFURT/ODER

Science on Stage is a European initiative designed to encourage teachers from across Europe to share best practice in science teaching.

The overall aims of Science on Stage are to:

- Provide a forum for teachers to exchange teaching ideas for the sciences
- Inspire and re-enthuse science teachers
- Provide teachers with access to quality science teaching resources and ideas
- Inform teachers about wider science research
- Raise the profile of science teaching with education ministers in the countries involved

Ultimately, the aim of Science on Stage is to enable teachers to deliver science in a more creative and engaging way.

The European Science on Stage Festival is hosted biennially in different countries and is the culmination of national events in the participating countries. 450 science teachers from all over Europe presented their most innovative teaching ideas, in workshops and by performances. Participants are chosen at competitive national events in the 27 member countries.

This year's European Science on Stage Festival was held in Słubice / Frankfurt (Oder) from 25-28 April 2013. The themes of this event included Inquiry-based learning, Information communication technologies, Science in kindergarten and primary school, school cooperation and learning landscapes.

Paul Nugent from the Institute of Physics (IOP) in Ireland led the Irish delegation at the 2013 festival. This delegation also included:

- Maeve Liston ~ Mary Immaculate College, Limerick
- Maria Sheehan ~ Saint Caimin's Community School, Shannon, Co. Clare
- Brigid Corrigan ~ Mount Sackville Secondary School, Chapelizod, Co. Dublin
- Aoibheann O'Gara ~ Coláiste Chraobh Abhann, Kilcoole, Co. Wicklow
- Richard Moynihan ~ O'Carolan College VEC, Nobber, Co. Meath
- Feargal Close ~ St Paul's College, Raheny, Dublin 5

During the festival teachers participated in a number of different activities:

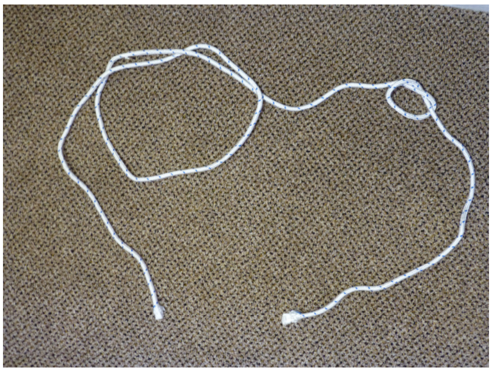
- **The Fair:** This is the exhibition where all participants present their projects. The fair is the key element of the festival.
- **Workshops:** **P**articipants developed teaching materials, recommendations and discussed important issues in education.
- **Master classes:** Teaching methods and concepts were shared in small, informal presentations.
- **On-stage activities:** These included plenary presentations, performances, experimental lectures took place on a big stage.
- **Forum:** Participants engaged with exhibitions of public and private enterprises, organisations, foundations and publishers.
- **Social events:** This year's social events included a conference dinner, barbeque, city tours and a boat trip along the river Oder

Maeve Liston (MIC) presented a workshop titled: Hot Science. This workshop explored the main concepts behind the topic of Heat. The workshop explored both adult and children's misunderstandings on the topic of Heat and involved hands-on interactive problem-solving ideas and a wide range of activities and demonstrations that can be used in the classroom to alleviate such misconceptions.

The Irish Delegation at the Science on Stage Festival April 2013
From L to R: Paul Nugent, Maria Sheehan, Feargal Close, Maeve Liston, Aoibheann O'Gara, Richard Moynihan and Brigid Corrigan.

Sample Activities:
1. Two Knots –One Rope

You will need….
1 piece of rope approximately 2m and 1cm in diameter



Background:
A simple demonstration that illustrates friction and tension.
Using an Inquiry Based Approach, thought provoking questions can be posed

Follow these steps:
Tie two knots in the rope. Keep one loose and the other a little tighter as shown.
Ask a volunteer to hold one end of the rope.
Pose the question which knot will tighten first?
Slowly pull one end of the rope observing the two knots.

So what happened?
As the rope is pulled the looser knot will tighten until it is approximately the same size as the other knot.
The two knots will then tighten at the same instant.
Friction is less in the looser knot. When pulled the looser knot tightens until friction is equal at both knots.

What next?
A longer rope with several knots of different size can be used to demonstrate.
Reference can be made to a similar trick, where a metre stick is balance on a finger of each hand. Alternatively each hand is moved inwards until the stick always balances at the centre of gravity.

2. Surface tension versus a bank card and some coins

You will need….
A container (preferably square).
Water
A bank card
Some cards

Follow these steps:
Fill the container to the brim with the water.

Balance the bank card on the edge -one side in contact with the water but not breaking the surface.
Ask the students what would happen if coins are added to the other side.
Surprisingly a considerable number of coins can be added until the card tips over.

So what happened?
On the water side the surface tension prevented the card from tipping

What next?
By taking measurements of the distance from the fulcrum and the mass added, this simple demonstration can be used to estimate the surface tension. Japenese Yen are ideal as they each have a mass of 1g.
The surface is a function of the perimeter of the card, rather the area in contact with the liquid.
What would happen the number of coins that could be added, if holes were punched in the card?

3. Floating Ice

You will need….
1 Glass
1 drink
Some Ice

Background:
A simple counter-intuitive demonstration that illustrates flotation and Archimedes Principle.

Using an Inquiry Based Approach, thought provoking questions can be posed

Follow these steps:
Fill a class with ice
Pour the drink into the class so that it is full to the brim.
Pose the question what will happen the level of the liquid when the ice melts?
Many students will think that the glass will overflow.
Observe the level of the liquid as the ice melts.

So what happened?
Surprisingly the liquid does not overflow.
The ice was already partially immersed in the liquid and so had already displaced its weight of liquid

What next?
Consider and discuss the difference between floating ice sheets melting and ice melting from land masses, and the effect of rising sea-levels.

Science on Stage 2015

"Illuminating Science Education": At the upcoming Science on Stage festival from 17-20 June 2015 in London, 350 primary and secondary school teachers from all over Europe will present their most innovative teaching ideas for science, technology and mathematics education at stands, in workshops, seminars and performances.
Science on Stage UK (SonSUK) is proud to host the festival at the People's Palace at Queen Mary, University of London right in the heart of London's vibrant East End.

The participating science teachers will be selected in 2014 through competitive national events in 27 countries. National Steering Committees (NSCs) are responsible for the calls for proposals.

The main focus of the Science on Stage festival is to offer science and mathematics teachers a platform from which they can exchange teaching projects and network together.

The festival gives an opportunity to present best-practice ideas for science education and inspire colleagues. In this way, good-practice-examples will be spread all over Europe.

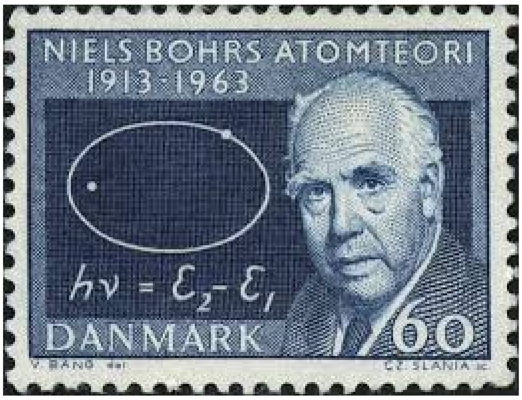
Follow-up activities after the event are organised throughout Europe by the National Committees of Science on Stage in order to spread the results and to encourage and inspire teachers in their home countries.

Download the 2015 brochure at:
http://www.science-on-stage.eu/media/General_information_flyer__Science_on_Stage_festival_2015.pdf

For information on the Irish Science on Stage National Steering Committee see: http://www.scienceonstage.ie/

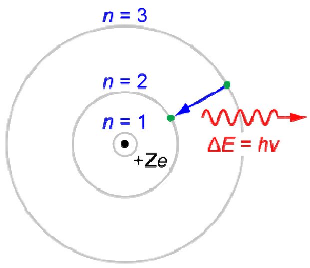
2013 Centenaries: Bohr and the Braggs

The Bohr atomic model

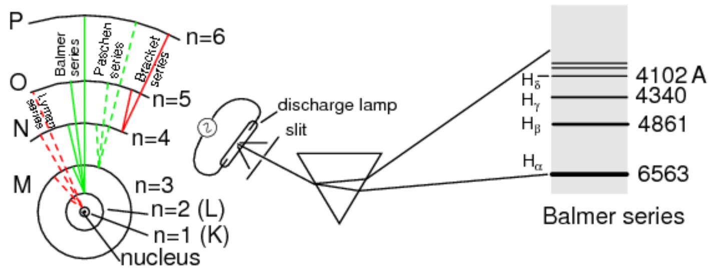


Danish stamp to mark the 50th anniversary of the Bohr atom

2013 is the centenary of the Bohr atom, as it is often called. Niels Bohr came up with an elegant mathematical solution to the problem of the line spectra of atoms. He postulated that electrons could only exist or move in orbits with discrete energy levels and that the emission and absorption of energy by atoms was due to electrons moving between these levels. He was then able to fit exactly the emission spectrum of the hydrogen atom, but not for any more complex atoms. His model assumed the quantum levels found in atoms, but without any underlying theory to back them up. His calculations fitted the data but they were soon superseded within a decade by more a rigorous treatment based on quantum mechanics and the Schrodinger wave equation.



The Bohr atom
http://en.wikipedia.org/wiki/File:Bohr-atom-PAR.svg



The Bohr theory explained the hydrogen line spectra
http://www.allaboutcircuits.com/vol_3/chpt_2/2.html

The Bohr model has been surprisingly long-lasting, despite its flaws, as it is a bridge between classical mechanics and quantum mechanics. It enables students to picture the structure of the atom, even if the idea of electrons moving in definite orbits (like planets round the sun) is wrong. I wrote this Limerick around 30 years ago to express the idea that although the Bohr model is faulty, it is still persistent in the school curriculum.

There once was a Dane named Niels Bohr,
In whose theory we once set great store.
But it proved to be wrong,
and it didn't last long,
So why teach it in school any more?

You can read the original paper, N. Bohr Dr. phil. (1913): XXXVII. On the constitution of atoms and molecules , *Philosophical Magazine* Series 6, 26:153, 476-502, at: www.ffn.ub.es/luisnavarro/nuevo_maletin/**Bohr_1913**.pdf

For a short accounts of Bohr's life see:
http://www.aps.org/publications/apsnews/201203/physicshistory.cfm
http://en.wikipedia.org/wiki/Niels_Bohr
You can see a centenary tribute video at http://my.rsc.org/video/277, which your students might like.

Bragg's Law

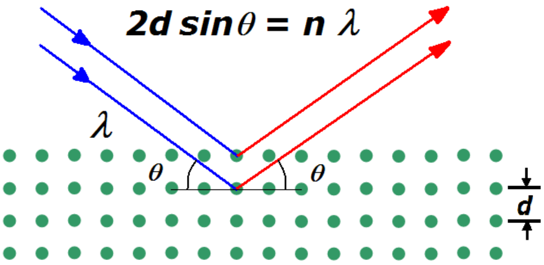
1913 also saw the publication of an important paper by William and Lawrence Bragg, father and son, which laid the foundations of X-ray diffraction and which introduced Bragg's Law to explain the angles of diffracted X-rays by a crystal. The work, which followed that of Max von Laue in 1911, was done and communicated in 1912 but published in 1913.
Lawrence Bragg (1890-1971) presented his derivation of the reflection condition at a meeting of the Cambridge Philosophical Society on 11 November 1912. His paper was published in 1913 (Bragg W.L., 1913, *The Diffraction of Short Electromagnetic Waves by a Crystal*, *Proc. Cambridge Phil. Soc.*, **17**, 43-57.)

They won the Nobel Prize in Physics in 1915 for this work. Father and son were both distinguished physicists and between them started the discipline of X-ray diffraction.

Lawrence Bragg was only 25 and still a young man when he won the Nobel Prize. He had a distinguished scientific career and nurtured many of the emerging leaders of X-ray diffraction. He was in charge of the Clarendon Laboratory in Cambridge when Watson and Crick solved the structure of DNA.

Swedish stamp marking the Bragg's Nobel Prize 1915

Bragg's Law:



William had joined the University Adelaide in 1885, so that Lawrence was born in Australia. William moved back to England in 1909 to become Professor of Physics, and Lawrence went to study Physics in Cambridge. The students in Leeds wrote this verse to celebrate their new professor:
Here's to Professor Bragg
Who sailed in from down under
To make this College wag
Its physics tail in wonder.

Lawrence became Professor of Physics in Manchester in 1919 and then in Cambridge in 1937, in succession to Ernest Rutherford.

To read about the Nobel Prize in Physics for 1915 see:
http://www.nobelprize.org/nobel_prizes/physics/laureates/1915/present.html
Biographies:
http://en.wikipedia.org/wiki/William_Henry_Bragghttp://en.wikipedia.org/wiki/William_Lawrence_Bragg

□

Thomas Andrews plaque unveiled in Belfast

Celebrating a founding father of science in Northern Ireland

*www.rsc.org/AboutUs/News/PressReleases/2013/**Thomas-Andrews**.asp*

16 October 2013

Speaking at a ceremony at Queen's University, Chief Executive of the Royal Society of Chemistry, Dr Robert Parker, said: "I am delighted to honour and celebrate the work of Belfast chemist Thomas Andrews, especially as 2013 marks the two hundredth anniversary of his birth.

"The RSC Chemical Landmark Scheme was first introduced in 2001 and is the official recognition of important historical sites in the UK where a significant chemical discovery or research has taken place.

"This marks a milestone in in our scheme as this is the first Chemical Landmark to take place in Northern Ireland and Ireland as a whole. So we would like to congratulate Queen's University Belfast on receiving this award, as well as welcoming members of the Andrews family.

"Ireland has produced many famous scientists over the centuries, Robert Boyle probably being the most well-known, so it was pleasing that at the *Science and Stormont* event we heard further support for a Chief Scientific Advisor to be appointed for Northern Ireland, continuing the great scientific legacy of this great community."

Professor James McElnay, acting vice-chancellor of Queen's University Belfast, unveiled the plaque and explained the importance of Thomas Andrews to the university: "Professor Andrews was one of seven founding Professors of the University and was the first Professor in the then Department of Chemistry. His original training was as a medic and he went on to be vice-president of Queen's College.

"Andrews made an enormous contribution on the liquification of gases and so fundamental were his discoveries that his work is now included in all the standard A-level chemistry text books.

"Science, engineering and medicine are so important to the modern university and it is a great honour for Queen's University to be recognised for the work of Andrews, by the award of a blue plaque from the Royal Society of Chemistry, for his seminal contributions on the 200th anniversary of Andrews' birth."

Johnny Andrews, one of Thomas Andrews' descendants, expressed his pride at being present for the unveiling. He said: "It's been a great privilege to be here to celebrate the influence of Thomas Andrews on science and Queen's University. As one of the founders of Queen's he was fundamental to this part of Ireland's contribution to the industrial revolution and introduced many of the scientific best practices that continue here to this day.

"In modern life Queen's pioneers discovery in medicine and science, an area that is vital to our economy and I'm delighted that my daughter has recently started studying zoology at Queen's, following in the scientific footsteps of many in our family.

"I am also economy spokesman for the Conservatives in Northern Ireland and I wholeheartedly support the Royal Society of Chemistry's campaign for a chief scientific adviser for Stormont.

"Having a focal point for science at the Assembly, in line with the success of such posts in the other devolved nations, is absolutely vital for informing economic policy with regards to current debates, for example on fracking."

□

A Periodic Table of Limericks~ 1 Hydrogen

Created by Peter Davern
Dept. of Chemical and Environmental Sciences, University of Limerick, Limerick
peter.davern@ul.ie

Hydrogen, H

On *The Table* it sits on the top,

Test-tube lit…it explodes with a pop!

Most abundant by far,

Powered rocket, now car;

Less its bonds water'd ne'er be a drop[1].

(1: i.e. water'd ne'er be a drop at room temperature…and…**DNA's double helix would flop!**)

Notes:

On *The Table* it sits on the top,
Element 'numero uno' sits proudly atop The Periodic Table.

Test-tube lit…it explodes with a pop!
The time-honoured lab test for the generation of hydrogen gas (H_2)…light a test tube full of it and listen for the tell-tale 'pop' as the gas explodes past the sound barrier while it burns.

Most abundant by far,
Some 88% of all the atoms in the universe are hydrogen.

Powered rocket, now car;
Hydrogen as rocket fuel: $2H_2 + O_2 \rightarrow 2H_2O$ + Energy. Cars powered by hydrogen fuel cells…expect to see more of them in the near future?

Less its bonds water'd ne'er be a drop[1].
Hydrogen bonds exist between the H atom of one water molecule and the oxygen (O) atom of another one. Though individually quite weak, they are plentiful enough to keep a substance like water (i.e. made up of an array of small light H_2O molecules) in liquid-form at room temperature, rather than a gas.

DNA's double helix would flop!
Hydrogen bonds play a truly life-defining role in maintaining the elegant 'double helix' 3-D structure of DNA.

Diary

2014

50th BT Young Scientists Exhibition
9-11 January
RDS, Dublin
http://www.btyoungscientist.ie/

ASE Annual Conference
8-14 January
University of Birmingham
http://www.ase.org.uk/conferences/annual-conference/

3rd New Perspectives on Science Education
20-22 March
Florence, Italy
http://conference.pixel-online.net/npse2014/

52nd ISTA Conference
11-13th April
NUI Galway
www.ista.ie

22nd Symposium on Chemical and Science Education
19-21 June
University of Bremen, GERMANY
http://www.chemiedidaktik.uni-bremen.de/symp2014/index.html

12th ECRICE 2014
"New Trends in Research-based Chemistry Education"
7-10 July
Jyväskylä University, Finland
www.jyu.fi/kemia/en/research/ecrice2014//

23rd ICCE
13-18 July
University of Toronto, Toronto, Canada
www.icce2014.org/

2014 Biennial Conference on Chemical Education
August 3-7, 2014
Grand Valley State University, West Michigan, USA
http://www.bcce2014.org/

2nd International Congress of Science Education
27-30 August
Foz do Iguaçu, Brazil
congresso.icse2014@unila.edu.br

32nd ChemEd-Ireland
18th October
DIT, Dublin
Claire.mcdonnell@dit.ie

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

Education is the great engine of personal development. It is through education that the daughter of a peasant can become a doctor, that a son of a mineworker can become the head of the mine, that a child of farm workers can become the president... –

Nelson Mandela 1918 - 2013

Information Page

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*****

Contributions wanted!

Contributions are always welcome to *Chemistry in Action!* providing the material is of interest to second-level chemistry teachers. Articles, experiments or demonstrations, teaching tips, book and AV reviews etc. are all welcome.
Send one hardcopy + diagrams and a copy on disc (or by email as a Word document) when submitting material.
You can contact the editor by email at: **peter.childs@ul.ie**

*****

Internet version

Chemistry in Action! is in the process of being put on the Internet at URL:
http://www.ul.ie/~childsp
It is hoped to put back issues will be put on the Internet one year after publication. This is not yet fully operational and only issues 38 - 68 are now available. In time I hope that most back issues will eventually be available, 3 issues after publication.

At the same site you will also find the University of Limerick's science and technology magazine for schools, *ELEMENTS* and also information on SICICI, ChemEd-Ireland and other chemical education activities.

*****

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Communications in writing/e-mail are preferred rather than phone calls!

*****

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Peter.childs@ul.ie

In the next issue:

Assessment

2013 LC Results

To frack or not to frack?