

*The Higher Education Academy Physical Sciences Centre and  
The Royal Society of Chemistry Education Division/Tertiary Education Group*

# Variety in Chemistry Education 2007

Beaumont Hall, University of Leicester

## Programme

### Thursday 30th August

10.00 - 10.30	Registration and coffee
	Chair: <i>Paul Yates, Chair RSC TEG, Keele University</i>
10.30 - 10.45	Welcome and introduction
10.45 - 11.30	2006 RSC HE Award Winner A Radical Interdisciplinary Case Study' <i>Andrew Parsons, University of York</i>
	Chair: <i>Simon Belt, University of Plymouth</i>
	Oral Presentations
11.30 - 11.45	The Dynamic Laboratory Manual: A VLE Supporting the Real Learning Environment <i>Paul Wyatt, University of Bristol</i>
11.45 - 12.00	Assessment for Learning in Undergraduate Laboratory Teaching <i>James Lovatt, Odilla Finlayson, Sonia Ramires-Garcia, Dublin City University</i>
12.00 - 12.15	Enhancing Forensic Science Context-based Laboratory Activities for Undergraduate Chemistry Students <i>Christine O'Connor, John Fox, Claire McDonnell, Cora O'Donnell, Michael Seery, Sarah Cresswell, Dublin Institute of Technology and Strathclyde University</i>
12.15 - 12.30	A New Laboratory Class for Interdisciplinary Education <i>Janusz Dabrowski, Iwona Maciejowska, Grazyna Stochel, Jagiellonian University, Poland</i>
12.30 - 13.30	Lunch
13.30 - 15.30	Open Space Technology session <i>Kevin Byron, University of Hull</i>

15.30 - 16.00	Tea  Chair: <i>Stuart Bennett, The Open University</i> Oral Presentations
16.00 - 16.15	The Swings and Roundabouts of Placement Learning <i>Simon Bedford, University of Bath</i>
16.15 - 16.30	Developing and Implementing Community Learning for Chemistry <i>Claire McDonnell, Christine O'Connor, Michael Seery, Dublin Institute of Technology</i>
16.30 - 17.15	2006 RSC HE Award Winner Pick and Mix - Getting the Blend Right <i>Linda Morris, University of Dundee</i>
19.00 - 19.30	Wine Reception
19.30	Conference Dinner

## Friday 31<sup>st</sup> August

	Chair: <i>Alan Goodwin, MMU</i>
09.00.- 9.45	The RSC Chemical Education Research Group Lecture Problem Solving - Strategies, Solutions and Success <i>Tina Overton, University of Hull</i>
9.45 - 12.00	<b>Workshops to include coffee</b> Kit in a Kase: Outreach Activities for All <i>Karen Moss, Georgina Westbrook and Alison Mealing, Nottingham Trent University</i> Using Learning Circles in Chemical Education <i>Paul Yates, Keele University</i>
12.00 - 13.00	Lunch
13.00 - 13.15	<b>Chair: Steve Walker, University of Liverpool</b>
	<b>Oral Presentations</b>
	Safe Labs for Science: An Interactive Approach to Safety training
13.15 - 13.30	<i>Michael Bridge, Serena Corr, Sylvia Draper, Noelle Scully, Susan Quinn,</i>

	<i>Trinity College, Dublin</i>
	Threshold Concepts and Troublesome Knowledge in Chemistry
13.30 - 13.45	<i>Karen Moss, C Greenall, A Rockcliffe, M Crowley, A Mealing, Nottingham Trent University</i>
13.34 - 14.00	Narrative Science
	<i>Hywel Evans and Chris Hall, University of Plymouth</i>
	Our First Steps in Enquiry-Based Learning in Chemistry
	<i>Tim Lucas and Natalie Rowley, University of Birmingham</i>
14.00 - 14.10	Chair: <i>Pat Bailey, University of Manchester</i>
	Chemistry For Our Future Strand 3
14.10 - 14.20	Overview of Strand 3 of CFOF
	<i>Pat Bailey, University of Manchester</i>
14.20 - 14.30	Flash Video Clips for Learning Chemistry
	<i>Graham Currell, Dilys Thornton, University of the West of England</i>
14.30 - 14.40	Science for the 21st Century Initiative
	<i>Mo Afzal and Susan Hitchener, University of Warwick</i>
14.40 - 14.50	Developing Inspirational Activities for New Undergraduate Students
	<i>Phil King, University of Hull</i>
14.50 - 15.00	Chemist-2-chemist
	<i>Nigel Lowe, University of York</i>
15.00 - 15.30	Discussion
15.30 - 15.40	Coffee
15.40 - 15.50	New Methods to Enhance the First Year Experience for Chemistry Undergraduates
	<i>Gan Niyadurupola, University of Reading</i>
15.50 - 16.00	Chemistry Boot Camp
	<i>Jonathan Agger, University of Manchester</i>
16.00 - 16.10	From Registration to Graduation: Phase One
	<i>David Read, University of Southampton</i>
16.10 - 16.20	Quantitative Chemistry – A Blended Learning Resource
	<i>Simon Bedford and Dudley Shallcross, Universities of Bath and Bristol</i>
16.20 - 16.30	Chemistry For All
	<i>Jonny Woodward, University of Leicester</i>
16.30	Discussion
	Close

The RSC Tertiary Education Group AGM will take place during the meeting at 17.30 on Thursday 30th August.

## **Keynote Lectures**

- 1**            **2006 RSC HE Award Winner**  
**A Radical Interdisciplinary Case Study**

*Andrew Parsons, University of York*

- 2**            **2006 RSC HE Award Winner**  
**Pick and Mix - Getting the Blend Right**

*Linda Morris, University of Dundee*

- 3**            **The RSC Chemical Education Research Group Lecture**  
**Problem Solving - Strategies, Solutions and Success**

*Tina Overton, University of Hull*

# KEYNOTE 1

## 2006 RSC HE Award Winner

### A Radical Interdisciplinary Case Study

*Andrew Parsons*

*Department of Chemistry, University of York, York*

*Email: Afp2@york.ac.uk*

Radicals are all around us. They are present in the atmosphere and in our bodies and they are formed as intermediates in combustion and in some extremely important synthetic reactions. Whether it is to do with disease, ageing, global warming, food additives, combustion or plastics, radicals have an important impact on all our lives. The study of radicals and their reactions is an ideal topic for showing students the importance of chemistry in the modern world. It also shows the central role that chemistry can play in interdisciplinary research. This is because the study of radicals brings together many different scientific areas including organic, inorganic, physical, analytical, industrial, computational, atmospheric, materials, food and biological chemistry.

This lecture gives innovative suggestions for how radicals and their reactions can capture and maintain the interest of chemistry students aged 16 and above, and improve and widen students understanding of reactivity and mechanism.

## KEYNOTE 2

### 2006 RSC HE Award Winner

#### Pick and Mix - Getting the Blend Right

*Linda Morris*

*School of Life Science Learning and Teaching, University of Dundee*

*Email: [l.a.z.morris@dundee.ac.uk](mailto:l.a.z.morris@dundee.ac.uk)*

Prior to 2001 the first year foundation course, consisting of two modules, was failing 25% of students and not serving its purpose as a general foundation in chemistry for all Life Sciences students. Rather than tinker around with course content and delivery, the decision was taken to totally redesign the course incorporating appropriate learning technologies to produce a blended learning environment that was fit for purpose.

All course and additional materials were made available via our VLE including assessments. Lectures became less didactic and much more interactive with in-class problem sessions utilising a personal response system. Some lectures were replaced totally by interactive web-based materials. Weekly open drop-in sessions were introduced for any student having difficulties. Tutorials and practical assessments were delivered using Questionmark Perception with each being openly available for one week with no restriction on number of attempts allowed. Mid and end of module exams were also delivered using QMP from a secure server.

Pass rates for the modules increased to an average of 95%, a pass rate maintained each year since the new course was implemented.

By using available technologies where appropriate, we now have a course that blends the best of each to provide a learning environment which engages all students no matter what their own preference for learning style.

An added benefit of the new course is that we have seen a three-fold increase in the number of students choosing to study chemistry in their second year of study.

## **KEYNOTE 3**

### **The RSC Chemical Education Research Group Lecture**

#### **Problem Solving - Strategies, Solutions and Success**

*Tina Overton*

*Physical Sciences Centre, University of Hull*

*Email: [t.l.overton@hull.ac.uk](mailto:t.l.overton@hull.ac.uk)*

The ability to solve unfamiliar and novel problem is an important graduate attribute. There has been much research that has explored the factors that affect student's success as problem solvers. This lecture reviews the literature on problem solving with a focus on strategies that aid success. It will then presents some recent investigations into the differences between algorithmic, conceptual and open-ended problems and how cognitive factors may influence success.

## **Oral presentations**

- Oral 1      The Dynamic Laboratory Manual: A VLE Supporting the Real Learning Environment**
- Oral 2      Assessment for Learning in Undergraduate Laboratory Teaching.**
- Oral 3      Enhancing Forensic Science Context-based Laboratory Activities for Undergraduate Chemistry Students.**
- Oral 4      A New Laboratory Class for Interdisciplinary Education.**
- Oral 5      How to impart tacit knowledge - Blending Chess and Chemistry.**
- Oral 6      Developing and Implementing Community Learning for Chemistry.**
- Oral 7      Safe Labs for Science: An Interactive Approach to Safety Training.**
- Oral 8      Threshold Concepts and Troublesome Knowledge in Chemistry**
- Oral 9      Narrative Science.**
- Oral 10     Our First Steps in Enquiry-Based Learning in Chemistry**
- Oral 11     Overview of Strand 3 of CFOF**
- Oral 12     Flash Video Clips for Learning Chemistry**
- Oral 13     Science for the 21<sup>st</sup> Century Initiative**
- Oral 14     Developing Inspirational Activities for New Undergraduate Students**
- Oral 15     Chemist-2-chemist**
- Oral 16     From Registration to Graduation: Phase One**
- Oral 17     Quantitative Chemistry - A Blended Learning Resource**
- Oral 18     Chemistry for All**

## Abstracts of Oral Presentations

### Oral 1 - The Dynamic Laboratory Manual: A VLE Supporting the Real Learning Environment

*Paul Wyatt, School of Chemistry, University of Bristol, Bristol*  
*Email: paul.wyatt@bris.ac.uk*

The talk will describe how teaching chemistry in the laboratory has been completely rethought as part of the Bristol ChemLabS CETL. A Dynamic Laboratory Manual (DLM) has been developed which offers on-line formative and summative assessment and enhances the student learning experience in many ways but does not replace the real laboratory experience.

Interactive animations of specific pieces of apparatus are programmed in Flash which allow students to familiarise themselves with equipment to learn how it works and ‘get it wrong’ before they then encounter the real thing. This gives them confidence and helps them to get more out of the laboratory itself. Videos also show students exactly how to carry out a particular technique. These rich resources are embedded in a teaching framework that is held on Moodle.

The DLM achieves many things

- Teaching resources are provided to the student in an interactive and interesting way
- The learning experience of students to before rather than after the laboratory
- Online assessment with feedback
- Online safety tests with feedback
- Staff can see immediately how well an individual in a group of students has performed.

### Oral 2 - Assessment for Learning in Undergraduate Laboratory Teaching

*James Lovatt, Odilla E Finlayson, Sonia Ramires-Garcia*  
*CASTeL, School of Chemical Sciences, Dublin City University, Dublin 9, Ireland*  
*Email: odilla.finlayson@dcu.ie*

All undergraduate chemistry students spend many hours in the chemistry laboratories improving and / or learning laboratory skills, safe practices and chemical knowledge. Skills such as presentations, problem-solving and experimental design are frequently not addressed in first year laboratories. The large groups of students involved in these laboratories make teaching and assessing students extremely challenging. Moreover, first year students have different levels of prior chemical knowledge and therefore the laboratory activities must be designed to cater for all the levels, i.e. help those with a poorer background in chemistry while still challenging those with stronger background.

To tackle these difficulties, first year laboratory tasks were developed that included elements of skill development, problem-solving, presentation, concept enforcement and experimental design. Assessment criteria were matched closely to each activity. In order to successfully implement these changes the figure of the laboratory tutor was introduced as opposed to the

traditional demonstrator and also the number of tutors in the laboratory was increased to give a tutor:student ratio of 1:10.

This presentation will show examples of the laboratory activities and tasks and the key learning objectives for each task. The role of the laboratory assessment will be discussed and the assessment employed in this study will be given. Students were assessed on their chemical understanding, their laboratory skills, their knowledge of ‘what they were doing and why’ during the practical session and also on presentation and laboratory notebook records. Having tutors actively involved in assessment allowed us to bring small-scale teaching techniques into the big group. The students were constantly challenged and their understanding was evaluated.

### **Oral 3 - Enhancing Forensic Science Context-based Laboratory Activities for Undergraduate Chemistry Students**

*Sarah Cresswell<sup>a</sup>, John Fox<sup>b</sup>, Claire McDonnell<sup>b</sup>, Christine O'Connor<sup>b</sup>, Cora O'Donnell<sup>b</sup> and Michael Seery<sup>b</sup>, <sup>a</sup> Department of Pure and Applied Chemistry, Strathclyde University, Scotland, <sup>b</sup>School of Chemical and Pharmaceutical Sciences, Dublin Institute of Technology, Kevin Street, Dublin 8, Ireland.  
Email: [Christine.oconnor@dit.ie](mailto:Christine.oconnor@dit.ie)*

#### **Keywords: Student centred, laboratory activities, forensic case studies.**

This paper discusses the development of student centred context-based practical activities for use in third level Forensic Science/ Chemical Analysis courses. The project is a joint initiative between the Dublin Institute of Technology (DIT) and Strathclyde University with the aim of developing innovative student centred context-based practicals to engage the students entering the relatively new course in DIT and to build-on the existing undergraduate practical courses at Strathclyde University. It was intended to phase out some of the current “recipe-style” practicals and replace them with problem based laboratories similar to those designed by Seery et al<sup>1</sup>. Due to timetable allocation for running of laboratories there are constraints on time and resources and due to these implications the methodology used was to update the current recipe-style laboratory procedures incorporating (i) chemical risk assessment, (ii) practical learning outcomes, (iii) student self assessment tables, (iv) end of laboratory reflective questions and (v) a case study. Laboratory supervisor guidelines were also designed to enable flexibility in supervision of such laboratories. This will allow for easy assimilation of the new context-based labs into the current module timetable system. It will also facilitate transfer of the labs developed within the discipline. Initially the project was aimed at first year undergraduate chemistry laboratory activities but it has since developed to include second year. The first year manual now contains a case study for each of the individual five experiments selected. In second year there is one case study to be examined using experiments to be carried out on rotation. In fact, two case studies were developed in total to enable parallel sessions to run. The purpose of the case study is to make the students focus on ‘why’ they are carrying out the laboratory work and to encourage critical analytical thinking. This pilot launch of the forensic laboratories in first year and second year has been evaluated and a qualitative methodology has been used to evaluate it. We are interested in examining alternative methods to enhance the student learning experience derived from practical work and are conscious of constructively aligning<sup>2</sup> the learning outcomes and assessment methods in order to ensure the achievement of the learning outcomes. Our work to date in this area has shown that enhanced understanding of the underlying theory, greater interest in the practical aspect of the curriculum and increased overall motivation are among the main benefits of this

context-based approach. Moreover, student enjoyment, engagement and interest are noticeably higher based on informal staff feedback.

1. C. Mc Donnell, C. O'Connor, and MK. Seery, *Chemical Education Research and Practice*, 2007,8(2), 130 - 139.
2. J. Biggs, *Teaching for Quality Learning at University*, (1999).

## Oral 4 - A New Laboratory Class for Interdisciplinary Education

*Janusz M. Dabrowski, Iwona Maciejowska and Grażyna Stochel*  
*Faculty of Chemistry, Jagiellonian University, Ingardena 3, 30-060 Krakow, Poland*  
*Email: jdabrows@chemia.uj.edu.pl*

Photodynamic therapy (PDT) is an interdisciplinary method of cancer treatment which is based on the knowledge of chemistry, biology and physics. PDT involves a photosensitizing agent, molecular oxygen and visible or near infrared light. An activated photosensitizer interacts with molecular oxygen to form a cytotoxic species known as singlet oxygen, which is thought to mediate cellular death. Recently we investigated a water-soluble halogenated 5,10,15,20-tetrakis(2-chloro-3-sulfophenyl)porphyrin (TCPPSO<sub>3</sub>H) with desired physicochemical and biological properties such as solubility in water, negligible tendency to aggregate, photochemical stability, long triplet lifetime, low fluorescence quantum yield, high singlet oxygen quantum yield, small cytotoxicity in the dark and significant photodynamic effect [1]. Considering its physicochemical properties as well as biological activity we conclude that the presented compound is not only a very potent therapeutic agent but also a very interesting model for interdisciplinary education and for research based teaching/learning activity.

This paper presents a new laboratory class designed for those with a general interest in the biomedical application of photochemistry.

The presented laboratory class will enable students to:

- understand basic concepts of photochemistry and photosensitization
- connect these physico-chemical concepts to biomedical applications
- understand the relation between chemical structure, photophysical properties and biological activity

Taking into account the fact that usually in the chemical and physical departments there is no possibility to perform the experiments on neoplastic cells, we use *Paramecium* as the biological model. The presented laboratory course is not expensive and it is not necessary to use very expensive equipment. The main emphasis of this class falls on planning chemical, biological and physical experiments together: dosimetry methods for monitoring the amount of photosensitizer, the amount of light, and the amount of oxygen. The interdisciplinary setting of this topic is definitely able to attract students much more so than a typical program in Chemistry.

References:

1. J.M. Dąbrowski, M. M. Pereira, L. G. Arnaut, C. J. P. Monteiro, A. F. Peixoto, A. Karocki, K. Urbańska, G. Stochel (2007) *Synthesis, Photophysical Studies and Anticancer Activity of a New Halogenated Water-Soluble Porphyrin*. *Photochem. Photobiol.*, **83**, 1–7.

## **Oral 5 - How to impart tacit knowledge - Blending Chess and Chemistry**

*Simon Bedford, Department of Chemistry, University of Bath, Bath BA2 9AY  
Email: s.b.bedford@bath.ac.uk*

Some subjects are harder than others- fact. It is perhaps more true full to say that some topics challenge the learner and teacher alike. One such example of this is retrosynthetic analysis, which can be analogous to playing the game of chess. For sure there are rules, and moves to learn that can give the impression of understanding the game but what takes time to learn and understand are the strategies that underpins the moves. This can be made all too aware to the learner when playing someone further 'up the rankings'. However, teaching strategy and the ability to think several moves ahead is not an easy task. In fact trying to impart such tacit knowledge could well be ineffective, like learning to drive a car, sometimes only learner centred practice and study will do.

Our research in this area over the past year has shown that in order to make learners accomplished players at retrosynthesis one has to provide a suite of blended learning resources that allow for them to become meta aware of the topic. These resources constitute video, and animations as well as walk throughs all housed within Moodle's virtual learning environment. But in addition stand alone resources and context based materials help to drive the learning and allow for learners to 'see' several moves ahead and thus see the consequences of their actions. Just like a chess computer and the guidance from a driving instructor by your side our blended resource package allows the learner to practice and hone their skills in a fully supportive environment.

Initial findings of summative and formative assessment activities informed with learner evaluation and peer feedback has shown that there is a marked increase in understanding of the topic and 'skilling up'. Grandmaster status has yet to be achieved but these are early days.

Due to the short time allowed, this presentation will not focus too deeply on any one aspect of this pedagogical research but give a broad overview of some of the experimental and innovative methods that have been used to enhance students understanding of this difficult subject topic. In particular it will show how face-to-face teaching and e-learning can complement one another. The talk will look at the data results produced by the unique ability to compare different blended practices experienced by those on Chemistry and Natural Sciences programmes of study.

This research although locally based, will have wide resonances with other practitioners around the country interested in converting knowledge from tacit into overt for the learner.

## **Oral 6 - Developing and Implementing Community Learning for Chemistry**

*Claire McDonnell, Christine O'Connor and Michael Seery, School of Chemical and Pharmaceutical Sciences, Dublin Institute of Technology, Ireland.  
E-mail: claire.mcdonnell@dit.ie*

Community-Based Learning (sometimes called Service Learning) is a learning and teaching method that involves integrating classroom learning in any subject with suitable community-based activities.<sup>1</sup> The approach used is to apply academic skills and knowledge to community

needs, assess the academic learning and integrate the experiential learning from the community service activity with classroom learning by structured reflection.

A Community-Based Learning (CBL) programme has been running since 2001 in the Faculty of Tourism and Food at Dublin Institute of Technology (DIT).<sup>2</sup> The programme is being extended across DIT and the School of Chemical and Pharmaceutical Sciences opted to develop two CBL projects in 2006-7, one for a group of 18 second year ordinary degree students and one for a group of 28 final year honours degree students. The approach used was to take an assessment already in place on a module and change it so that it could be applied to the benefit of the community.

The activity for the second year Chemistry group was part of their Professional Skills module and involved them developing and performing suitable demonstrations and posters and interacting with visiting second level students and presenters for an RSC Chemistry at Work event at DIT.<sup>3</sup> The fourth year undergraduates performed a lab safety audit and prepared several chemical risk assessments for practicals on the syllabus in local secondary schools as part of the assessment for their module on Chemical Control.

The responses from the evaluation questionnaires completed by the students showed that they preferred to apply the knowledge and skills they were learning to a real life situation and that they enjoyed interacting with second level students and teachers.

In this oral presentation, the implementation and evaluation of the pilot CBL Chemistry projects in DIT will be discussed and recommendations for future developments will be made.

## References

1. Annette, John, "Character, Civic Renewal and Service Learning for Democratic Citizenship in Higher Education," *British Journal of Educational Studies*, Volume 53 (3), 2005, 326-340
2. <http://www.dit.ie/DIT/news/2005/community-learning-funding.html> and <http://www.dit.ie/DIT/news/2005/docs/CLPBriefingNote.doc>
3. <http://www.dit.ie/DIT/science/chemistry/noticeboard/chemistryatworkreport.html>

## Oral 7 - Safe Labs for Science: An Interactive Approach to Safety Training

*Michael Bridge, Serena Corr, Sylvia Draper, Noelle Scully, Susan Quinn, School of Chemistry, Trinity College, Dublin 2, Ireland*  
Email: [mbridge@tcd.ie](mailto:mbridge@tcd.ie)

Safe working in Chemistry involves critical analysis, interactive thinking and the evolving application of risk assessment to procedure, reagent and environment. It also requires co-operation and teamwork. These are transferable skills that all scientists should possess. They are, however, not often emphasized in degree courses, while safety training is too often presented to undergraduate students as a set of rules that must be obeyed, with little rationale offered to justify them. Attempts to go beyond a set of rules are frequently perceived by students and academics as tedious if not outright boring – however necessary they may be. We describe the first stages of development of a safety training component for mainstream Chemistry courses that will allow students to identify safe and unsafe practices, undertake

formal risk assessment, and enable them to improve the safety of their own environment. Our starting point is a Safety Training Workshop for our own 3rd. year undergraduates. The content of the workshop, including case studies, a (competitive) team exercise (a lab “scavenger hunt”) and electronic self-testing, will be described. We consider the emphasis on the co-operative nature of safe working and encouragement of teamwork – aspects which are normally neglected in degree programmes in Science. We also report on the positive student response.

## **Oral 8 - Threshold Concepts and Troublesome Knowledge in Chemistry**

*K Moss, C Greenall, A Rockcliffe, M Crowley and A Mealing, Centre for Effective Learning in Science (CELS), Nottingham Trent University, Clifton Lane, Nottingham, NG11 8NS  
Email: Karen.Moss@ntu.ac.uk; anne.rockcliffe@ntu.ac.uk alison.mealing@ntu.ac.uk*

In every area of science there are some ideas that many students find difficult to grasp. A lack of understanding of key ideas (the so-called *Threshold Concepts* (Meyer)) can limit a student’s ability to grasp and apply fundamental principles of their discipline, to think like a ‘chemist’. Previous work in this area has mostly focused on conceptual difficulties at school level ( Taber *et al*) and relatively little work has been done to systematically investigate and analyse this phenomenon in undergraduate chemistry programmes, beyond the anecdotal.

Using questionnaires, diagnostic tests and surveys, an initial study involving students and staff at Nottingham Trent University has been carried out in order to determine:

Firstly, which areas of chemistry programmes cause conceptual difficulties for students?

Secondly, whether it is possible to identify the factors responsible for the difficulties students encounter? Is it all just the ‘maths’ issue or are there more complex variables involved?

Thirdly, how much does prior knowledge matter? If you did an access course what gaps in your knowledge are you likely to have? Do you know which topics are still being taught at ‘A’-level? What about the new ‘A’-level syllabi?

This study has included a survey of secondary science teachers, examining areas of the post-16 curricula that students of science struggle with and asks which of these areas of difficulty /misconceptions are carried through into undergraduate programmes? Materials to help with some of these areas are being designed eg moles and VSEPR theory.

J H F Meyer and R Land (2006) *Overcoming Barriers to Student Understanding*, Routledge, London

K Taber (2002) *Chemical Misconceptions*, vols 1 & 2 Royal Society of Chemistry, London

## Oral 9 - Narrative Science

*E. Hywel Evans<sup>1</sup> and Chris Hall<sup>2</sup>, <sup>1</sup>School of Earth Ocean and Environmental Sciences, <sup>2</sup>School of Art & Performance, University of Plymouth.  
E-mail: hevans@plymouth.ac.uk*

Narrative has a long and well established history as a method of learning. Everyone remembers the fairy tales that they read when they were children, or the fables that were part of early childhood education. As adults we realise that these were not just stories designed to frighten little children but often carried important messages about behaviour and social responsibility (e.g. lying and stealing are wrong and lead to dire consequences; it is not safe to go into the forest alone because there are wolves or dangerous adults about). The strength of the narrative method of learning is that it creates a powerful association between the concept that is to be learned and some visual or emotional response, thereby deeply embedding the concept such that it is easily retrieved. The use of narrative in secondary and higher education tends to be more common in the social sciences and humanities, whereas science tends to concentrate on the accumulation of factual information and its applicability to specific problems. Science students often have extreme difficulty grasping difficult concepts that are inherent in the subject matter, hence, it apparent that they would benefit greatly from a narrative approach to learning. If done well this would have the effect of creating powerful associations with difficult concepts; make the learning more enjoyable; and facilitate the learning of the factual matter by adopting a more holistic approach.

The authors have collaborated on a project with the aim of combining art and science to develop a narrative approach to learning. Two approaches were investigated: a purely narrative approach in as which the feasibility of scripting a short play around the Second Law of Thermodynamics; and a student centred approach to develop a package of learning material with the objective of teaching Boyles Law.

This presentation will outline the following outcomes:

1. A full-length play adapted for both radio and stage. The play *Holey Terror* addresses topical issues and uses the Second Law of Thermodynamics as a metaphor for our times. A reading of the play was performed during Science Week at the Barbican Theatre Plymouth, by undergraduate students in Theatre and Performance. Clips of this performance will be shown.
2. A package of learning materials incorporating Boyles Law, historical research into Boyle and his contemporary Samuel Pepys, and demonstration of subject knowledge through the medium of playwriting. The material is currently being adapted for both science and humanities students and will be trialled in Autumn 2007.

## Oral 10 - Our First Steps in Enquiry-Based Learning in Chemistry

*Tim Lucas and Natalie Rowley, Department of Chemistry, University of Birmingham  
Birmingham  
Email: n.m.rowley@bham.ac.uk*

The School of Chemistry (University of Birmingham) aims to introduce Enquiry-Based Learning (EBL) into its curriculum, in order to move the ownership of learning more towards students, and hence to foster independent learning.

Our first attempt at an EBL scenario is in the area of Spectroscopy. Previously, this has been taught by traditional lectures, alongside a series of workshops. The EBL scenario places students in the context of graduate Chemists in a fictional company. Within groups, the students have to identify a number of fictional contaminants in the local water supply, by means of interpretation of a number of spectra. Subsequently, the students must produce a briefing paper, and give a presentation on their findings. Our preliminary findings from a pilot session will be presented.

This research is in collaboration with Dr Mike McLinden (School of Education, University of Birmingham) and Prof. Tina Overton (School of Chemistry, University of Hull, and Director of the Higher Education Academy Physical Sciences Centre).

## Oral 11 - Overview of Strand 3 of CFOF

*Pat Bailey, School of Chemistry, University of Manchester, Oxford Road, Manchester M13 9PL*

*Email: pat.bailey@manchester.ac.uk*

‘Strand 3’ is the ambitious *Curriculum Development* component of *Chemistry for our Future* (CFOF), and involves around 25 universities in a wide range of projects. I will briefly outline the developments under the 4 themes of:

Strand 3.1 School-to-university transition

10 universities, looking at supporting students in this crucial transitional phase

Strand 3.2 Chemistry for All – Alternative approaches to Chemistry Curricula

4 universities, exploring how C/E/P based-learning can improve the learning of chemistry

Strand 3.3 An Open-Learning Framework for Sustainable Part-Time Provision

5 universities producing one year of DL material for part-time students, with analytical focus

Strand 3.4 Mastering Bologna

A consortium of universities, exploring how we might best align ourselves with Bologna

I will focus primarily on strands 3.3 and 3.4, as there will be presentations from strands 3.1 and 3.2 in the Friday afternoon session. In support of strand 3.1, we have also established a *Syllabus Group* (6 teachers, 6 academics), which has analyzed the QCA A-level curriculum, and compared it with university expectations for their 1<sup>st</sup> year courses; I will summarize the findings from our report, for which the key recommendations are:

- Universities to expand their outreach activities, and be proactive in influencing the A-level syllabus.
- Universities need to be more aware of the skills and knowledge that their students possess from A-level, and of their weaknesses, and modify their first year courses appropriately.
- Maths (and physics) needs to be integrated into degree programmes in EBL/CBL format.
- Study skills, and probably literacy, need to be embedded in 1<sup>st</sup> year projects and exercises.
- Practical work needs to acknowledge how daunting labs initially are, and must inspire the most able.

## Oral 12 - Flash Video Clips for Learning Chemistry

Graham Currell, Faculty of Applied Sciences, University of the West of England  
Email: graham.currell@uwe.ac.uk

The presentation reports developments in the use of flash video clips to provide feedback and support for learning in chemistry. Over 300 video clips have been used in a range of different contexts for first year science undergraduates at the University of the West of England. The pass rates in the teaching of mathematics and statistics for science students have improved significantly, and very positive feedback has been received from the students on the value of the video clips in comparison to other learning resources.

The presentation then considers the evolution into current work within the Chemistry For Our Future project, leading to the development of integrated web-based learning units:

- conversion of existing support materials in chemistry into 17 draft flash videos,
- production of related web-based self-assessment questions, and
- development of a structure for web-based self-assessment learning packages in mathematics for chemistry with video overview and feedback.

Hot Potatoes software is being evaluated as a user-friendly framework for creating the generic self-assessment structure, within which the video clips provide the necessary introductions, overview and feedback of learning content.

## Oral 13 - Science for the 21<sup>st</sup> Century Initiative

Mo Afzal and Susan Hitchener, University of Warwick, Coventry  
Email: mohammad.afzal@warwick.ac.uk

The educational venture entitled, *Science for 21<sup>st</sup> Century Initiative* (SCI), for sixth form scientists, gives them a greater insight into the current advancements in science, engineering and technology – an aspect of the subject outside the scope of A level syllabuses. The scheme has received enthusiastic support from industry, academia, and the media as an example of an innovative initiative that has a strong bias for the chemical sciences.

The SCI is a three-pronged programme: Students undertake high quality experimental *Research*, contribute to *N-Lighten* (a journal with review articles on contemporary science), and biennially they organise a national one-day science conference entitled *Showcase Science*.

### 1. Research - Clusters of Schools

Students engage in leading-edge experimental research normally undertaken in university laboratories or industrial research centres. Hence specialised equipment and chemicals are used giving the participating students experience that is way beyond the curriculum. A cluster is where a group of schools (linked to a partner university) meet at one designated school one afternoon per week during the academic year. The **Research Training** programme is for first year sixth form students. Simultaneously, the second-year students embark on **Research** in biochemistry, molecular biology, medicinal and synthetic organic chemistry. Teachers from the participating schools and university researchers are involved in the programme.

### 2. Showcase Science

Biennially, the SCI collaborating schools organise a conference for sixth form science students and their teachers. The most recent conference was held on 15 March 2007 during

National Science Week at Oundle School. The event was broadcast live over the Internet with an estimated 50,000 audience. The exciting role of pure and applied sciences was conveyed to the audience by 6 eminent keynote speakers. Students gave verbal and poster presentations as well as interactive exhibits on contemporary science. Ample data have been collected and will be analysed to demonstrate the persuasive impact of the event on the pre-university students (vast majority of them in the first of their sixth form studies and therefore not committed to reading for undergraduate degrees in chemicals sciences).

3. N-Lighten – *(written by pupils for pupils)*

Three pilot issues of this full colour magazine have been produced.

## **Oral 14 - Developing Inspirational Activities for New Undergraduate Students**

*Phil King, Department of Chemistry, University of Hull, Hull HU6 7RX  
Email: p.j.king@hull.ac.uk*

We are currently developing activity days for first year undergraduate students with a view to improving inter-student relationships, team-working skills, student retention and above all to make the students feel welcome and improve their confidence and willingness to participate. We report here on our efforts and results so far.

## **Oral 15 - Chemist-2-chemist**

*Nigel Lowe, Department of Chemistry, University of York, Heslington, York, YO10 5DD.  
Email: nl6@york.ac.uk*

This project has established a positive relationship with the department's student chemical society to collaborate in the induction and support of new 1<sup>st</sup>-year students. Project funds will be used to register all new 1<sup>st</sup>-years (2007-8 cohort) as chemsoc members, with chemsoc organising an induction event, a continuing programme of lectures with relevant academic content (1 per term), and a 1st-year feedback activity to bookend the year. We are investigating external sponsorship to sustain these activities beyond 2009.

A parallel scheme of mentoring has drawn 40 volunteers from the existing student body. These students will undergo training before running problem classes (2 per term) and acting as contacts within the department's college-based teaching programme. Part of their role will be to slot into the chemsoc-badged induction and feedback events.

The current 1<sup>st</sup>-years have had the opportunity to participate in a CFOF outreach scheme focusing on visits to their old schools/colleges. To date, 8 students have addressed, in total, close to 150 Year 11 & 12 students with another 7 volunteers going into schools in the next few weeks. This scheme has generated positive feedback from schoolteachers and pupils with several requests for repeat visits. A review of the outreach scheme will shortly provide a measure of its impact and prepare us for delivery of a revised version in the spring term 2008 that will involve previous participants.

At the project end (Jan 2009), we expect our 1<sup>st</sup>-year experience questionnaire (first implemented June 2007) to demonstrate how C-2-C has improved the responsiveness of our curriculum delivery and learning support to the needs of new 1<sup>st</sup>-year students. Furthermore, we hope our outreach scheme will continue to be regarded as a rewarding activity for 1<sup>st</sup>-year students with a direct impact on the perception of chemistry in schools.

## **Oral 16 - From Registration to Graduation: Phase One**

David Read, *School of Chemistry, University of Southampton, Highfield, Southampton, SO17 1BJ.*

*Email: d.read@soton.ac.uk*

After a period of consultation involving first year undergraduates during the last academic year (2006/7), we are working on strategies to provide support to incoming students in making the transition from A-level studies. These include a website with useful information for the pre-registration period (available from late August), and additional activities during induction to engage students and help them to settle in. These are based on the suggestions given by current students. Further developments include the use of audience response systems in first year lectures to encourage participation and inform teaching, and the wider implementation of e-learning resources into first year teaching. The presentation will elaborate on our progress in these areas.

## **Oral 17 - Quantitative Chemistry - A Blended Learning Resource**

Simon Bedford, *Department of Chemistry, University of Bath, Bath BA2 9AY*

*Email: s.b.bedford@bath.ac.uk*

Few lecturers in HE would deny that students' ability to deal with the quantitative aspects of science has declined in recent years. An increasing number enter without A- or A/S-level mathematics; even some students with A-level struggle to make the connections with their science programmes. This barrier makes the early stages of HE chemistry programmes difficult; it also serves to put-off some students from studying chemistry at all. This may become exacerbated by the changing nature of GCSE science courses and the remodelling of the A-level Chemistry specifications.

This project aims to lower this barrier by providing blended resources designed to assist student learning in aspects of quantitative chemistry. Packages have been developed to describe essential mathematical principles e.g Quantity Calculus while emphasising the chemical context in which they occur. Initial pilots selected core A-level topics but are now progressing to topics typically taught during the first year of HE chemistry. The primary mode of delivery in our study will be via Moodle, an open-source VLE that can be accessed through a web based interface. The core software engine is based on 'MathsTutor' and is being developed in collaboration with its authors EBS Trust. As well as animations, and video demonstrations self paced assessment and feedback mechanisms have been built in so that students can monitor their progress and so build up their confidence. This will then be compared against the Bristol study involving a greater proportion of f2f delivery.

Ongoing evaluation has been achieved by making use of UG students progressing onto University Ambassadors Scheme and PGCE programmes, as well as students taking Year 1 Maths for Chemists courses. Several local schools have piloted the resources, either in after-school science clubs or as part of the main teaching programme. Soon access will be granted to students who have applied to university in 2007-08 so that some preliminary work can be undertaken in the summer after the A-level examinations. Students would thus be better prepared for entry to HE. A continuum of topics presented in the same style from A2-level through to first year HE will mean a smaller degree of change in style and consequent easing of the school-university transition, at least in this regard. Some contexts have been chosen from (with a chemical flavour) economics, biochemistry, medically related topics to help students on joint programmes such as Natural Sciences or Chemistry with Management. We will also use this opportunity for dissemination at VCE to seek out collaborators at other universities to evaluate the learning packages.

## **Oral 18 - Chemistry for All**

*Jonny Woodward, Department of Chemistry University of Leicester, Leicester  
Email: jrw16@le.ac.uk*

Setting learning in context, engaging students' interest and curiosity, promoting professional thinking and skills, and developing deep, connected understanding of concepts are some of the aims of Problem and Context-Based Learning (PBL and CBL). Strand 3.2 of the Chemistry For Our Future programme is involved with analysing the effectiveness of various PBL and CBL approaches and in developing and evaluating materials designed to address issues in university chemistry education such as engagement, independent learning, and employability. This presentation will demonstrate examples of new materials and will describe how four partner university departments (Leicester, Hull, Plymouth, and Nottingham Trent) are investigating staff and student attitudes to PBL and CBL.

## **Workshops**

**Workshop 1      Kit in a Kase: Outreach Activities for All**

**Workshop 2      Using Learning Circles in Chemical Education**

## **Workshop 1 - Kit in a Kase: Outreach Activities for All**

*Georgina Westbrook, Karen Moss, Alison Mealing, and Sam Tang, Centre for Effective Learning in Science (CELS), Nottingham Trent University, Clifton Lane, Nottingham, NG11 8NS*

*Email: georgina.westbrook@ntu.ac.uk, Karen.Moss@ntu.ac.uk; alison.mealing@ntu.ac.uk, Samantha.tang@nottingham.ac.uk*

Have you thought about doing activities to promote science in schools but don't know where to start? Then come and try out our Kit in a Kase approach in this workshop.

The Centre for Effective Learning in Science (CELS) has run events and activities for over 8000 school children of all ages in the last 20 months. Our activities have encompassed science festivals, lectures, workshops and demonstrations, enhanced by our 'Kit in a Kase' activities within schools.

The 'Kit in a Kase' concept, originally developed in collaboration with the University of Nottingham's Public Awareness Scientist, Dr Sam Tang, allows scientific topics to be delivered in the classroom with the emphasis firmly on practical experimentation. Topics are based on the familiar and help science seem relevant to the students. 'Real' scientists deliver the activities - giving the children an alternative learning experience and exposing them to science role models - helping dispel the myths surrounding scientists.

Initially designed with primary schools in mind, most of our Kits contain equipment that can be bought in high street stores and supermarkets, reducing both costs and hazards. These activities have proved extremely popular with schools regionally. They have supported the pupil's studies by encouraging their interest in science, backing up the curriculum and extending their practical skills base. At present, the topics covered by these Kits include Colour Chemistry, DNA, Environmental effects of an Oil Spill, Materials and The Body. Recently the range has expanded to include Kits for secondary schools.

In our workshop you will have the opportunity to hear about the Kit model and experience activities from our Kit in a Kase suite, aimed at different age groups.

- Colour Chemistry (KS2)
- Materials (KS1)
- Light up materials (KS3)

Issues such as getting the level right, fitting the national curriculum and working with schools will be tackled. At the end of the session you should have a clear idea about what's involved in this sort of activity and how to get started yourself. So why not come and discover science through the eyes of a child?

## Workshop 2 - Using Learning Circles in Chemical Education

*Paul Yates, Centre for Professional Staff Development, Hornbeam Building, Keele University, Keele, Staffordshire ST5 5BG*

*Email: [p.c.yates@keele.ac.uk](mailto:p.c.yates@keele.ac.uk)*

The learning circle is a technique which has been used for problem solving in the general sense, but which also has the potential to be used in an educational environment. In this workshop the technique will be illustrated, and used as a way of discussing problems which have been encountered in teaching.

The technique can be described in terms of five stages, as follows:

1. A problem is described, together with any actions taken so far and the desired outcome.
2. Each member of the circle provides positive feedback on what has been shared in step 1.
3. From the beginning of the circle suggestions are now offered in turn. These are very brief, can be silly, and do not have to be 'right'. An individual may pass in any round.
4. During step 3 the problem holder writes down every idea that is offered, without exception.
5. Step 3 is repeated until there are no further suggestions.
6. The problem holder selects the 3 or 4 ideas they wish to take forward.

In this workshop participants will be invited to share any problems which they have encountered recently in the teaching of chemistry. The learning circle approach will then be used to attempt to identify suitable solutions, using the steps outlined above. Participants will be encouraged to discuss the experience of using this technique, and to suggest any topics and activities in chemistry which they feel this approach could be used to teach.