# ChemEd-Ireland 2008

## Challenges in Chemistry Teaching;
## - Content, Context and Assessment
***(including proposed revisions to LC chemistry)***

Saturday, 18th October, 2008
HG22
Dublin City University, Dublin 9
9:00a.m. — 4:30p.m.

# Conference programme

| Time | | Location |
|---|---|---|
| 9.00-9.30 | Registration with Tea & Coffee | Nursing Foyer |
| 9.30-9.45 | Welcome & Opening Remarks | HG22 |
| 9.45-10.30 | **SCI Lecture:**<br>Ilka Parchmann; **Teaching Chemistry through Contexts**,<br>*University of Oldenburg,* Germany | HG22 |
| 10.30-11.00 | Tea, Coffee, Bookstall & Exhibitions | |
| 11.00-11.45 | Kieran Nolan; **Organic Chemistry Made Easy,**<br>*Dublin City University*, Dublin | HG22 |
| 11.45-12.05 | Maria Sheehan; **The Persistence of Students' Difficulties in Chemistry,**<br>*University of Limerick,* Limerick | HG22 |
| 12.05-12.25 | Lorraine McCormack; **CASE for teaching Chemistry**,<br>*Dublin City University*, Dublin | HG22 |
| 12:25-12:45 | Edelle McCrudden; **LC Chemistry – What is really asked on exam papers!**<br>*Dublin City University*, Dublin | HG22 |
| 12.45-14.15 | LUNCH | Nursing Canteen |
| 14.15-15.15 | **RSC Lecture:**<br>Viktor Obendrauf; **Halogen Reactions on the bench!**<br>*University of Graz,* Austria | HG22 |
| 15.15-15.30 | Break | HG22 |
| 15.30-16.00 | Brendan Duane**; LC Chemistry Syllabus Review & Chemistry Support Service,** *Chemistry Education Officer NCCA*, Ireland | HG22 |
| 16.00-16.30 | Discussion & Wrap-up | HG22 |
| 16.30 | FINISH | |

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# Teaching Chemistry through Contexts

Ilka Parchmann; *University of Oldenburg,* Germany

**Abstract:**

What are the goals and what are the outcomes of science education?
Following the unsatisfying results of international studies, such as TIMSS and PISA, new standards for science education have been implemented into the German school system. These standards describe goals as competencies that should be developed by students in the areas of understanding and applying basic concepts of the subjects biology, chemistry and physics, of describing and applying typical methods of investigation, of communicating scientific knowledge and of evaluating and taking decisions on the basis of scientific knowledge. Similar goals are mentioned in so-called context-based approaches, which put a high emphasis on all four areas of competencies next to the development of scientific knowledge. The presentation will offer a short insight into the framework of both, the National Standards in Germany and the project "Chemie im Kontext" and will then describe some teaching and learning units more detailed, followed by some exemplary results of research studies about the teachers´ and the students´ perception of the new teaching and learning approach.

# Organic Chemistry Made Easy

Kieran Nolan, *Dublin City University*, Dublin 9

**Abstract:**

This presentation deals with the problems of introducing fundamental organic chemistry to secondary level students. Quite often many students demonstrate an excellent understanding of introductory chemistry. However, when the students are introduced to organic chemistry they feel that the area is quite different than the fundamental chemistry they had previously learned, leading to students either being 'turned off of' or intimidated by the topic.

The reality is organic chemistry is not different from anything that the students have seen before. The problem lies in the fact that the topic has not been connected to the fundamental principles that the students have learned and understand about chemistry. My presentation will offer an approach to both interest students in the field of organic chemistry and to connect the field to basic principles.

# An Investigation of the Difficulties in the Teaching and Learning of Chemistry in the Irish School System

Peter E. Childs[+] and Maria Sheehan*

[+]*Dept. of Chemical and Environmental Sciences, University of Limerick,* Limerick

**St. Caimin's Community School,* Shannon Co. Clare

**Abstract:**

This presentation presents the findings of a longitudinal investigation that identified the Chemistry topics that the majority of Irish Chemistry pupils find difficult from Junior Certificate level right the way through to University level. It also looks at how Chemistry ability, Mathematics ability and gender influences the topics students find difficult or very difficult.

Students were asked to complete a questionnaire listing the topics covered in the specific courses that they had covered. They were asked whether they found each topic difficult or easy using a six point Likert scale. Each cohort of pupils: Junior Certificate pupils, Leaving Certificate pupils and University students, had a different questionnaire that listed the Chemistry topics appropriate to their Chemistry education at that point. In the second part of the questionnaire pupils and students were also asked to identify which five topics they found the most difficult in Chemistry. They ranked these Chemistry topics 1 to 5, with 1 being the most difficult Chemistry topic, 2 being the second most difficult Chemistry topic and so on.

This paper highlights the topics that Irish Chemistry pupils and students find difficult in Chemistry. Findings show that topics identified by Irish students are similar to the results of studies carried out in the UK by Ratcliffe2 and Scotland by Johnstone3. At the Junior Certificate level, topics that pupils find difficult can be classified under the following headings: The Structure of the Atom, Bonding and Chemical Equations and Symbols. Responses from the Leaving Certificate pupils indicate that the majority of Irish pupils find topics such as Organic Chemistry, Chemical Equilibria Calculations and Volumetric Calculations difficult. At third level, Volumetric Calculations were identified by students as being the most difficult Chemistry topic. Findings also indicated that three topics ranked high in terms of perceived difficulty in both the Leaving Certificate Chemistry pupils and University Chemistry students' lists. These Chemistry topics were Volumetric Calculations, Redox reactions and Concentration of Solutions. The persistence of these topics being seen as difficult throughout the pupils'/students'

experience of Chemistry indicates that problems associated with these topics have never truly been addressed. Hence pupils in their third year of Chemistry in College are still finding these topics difficult. Other findings indicate that the pupils'/students' Mathematics ability and Gender have an effect on the topics students chose as difficult or very difficult.

## References:

[1] Ratcliffe, M. (2002) 'What's Difficult about A-Level chemistry' *Education in Chemistry*, 39 Number 3, pp.76-80

[2] Johnstone, Alex H. (2006) 'Chemical education research in Glasgow in Perspective' *Chemistry Education Research and Practice*, 7 Number 2, pp. 49-63

***Personal Details:*** *Maria (*maria.sheehan@ul.ie*) graduated from the University of Limerick in 2004 with a degree in Physical Education and Chemistry. Since 2004 she has been teaching P.E, Chemistry and Junior Science in Saint Caimins Community, Shannon, Co. Clare. Her area of research is focusing on the difficulties in the learning of Chemistry in the Irish school system.*

# CASE for teaching Chemistry

Lorraine McCormack*, Odilla E. Finlayson*, Thomas J.J. McCloughlin+,
**CASTeL, School of Chemical Sciences, Dublin City University*, Dublin 9
*+St. Patrick's College, Drumcondra*, Dublin 9

**Abstract:**
Science education in Ireland has seen a number of changes in the last five years including the introduction of a revised primary and post-primary science curricula. These curricula have attempted to address issues in methodology, such as emphasizing a constructivist approach, building-in practical work into assessment and promoting cognitive skills as a key to enhancing investigation, imagination and creativity [1,2]. There are however two separate science curricula for primary and lower secondary science levels and one aim of this study is to bridge these two curricula successfully.

The CASE (Cognitive Acceleration through Science Education) programme [3] was developed in the UK for this age group. The aim of the programme was to encourage higher level thinking, initially among 11-14 year olds, in order for them to better attain the objectives of the curriculum. [4] Numerous studies highlight the successful effects of the programme on students' higher order thinking [5,6]. In this longitudinal study the CASE programme was implemented and its effects were monitored across the primary and second levels in Ireland. The CASE programme was adapted and divided into two programmes suitable for use in the Irish system- namely *Thinking Science 1* and *Thinking Science 2*. *Thinking Science 1* was implemented with 398 primary level pupils ($6^{th}$ class- age 11-12) and 226 $1^{st}$ year second level students (age 12-13). The effectiveness of the programme on cognitive development was tested by the CSMS (Concepts in Secondary Mathematics and Science) tasks, assessing Piagetian levels [7]. The results of both programmes show increases in formal-operational thought. The core test results were analysed by residual gain score analysis, a method used to predict the post- test results for the experimental group as if he/she were part of the control group. Therefore, any great difference could be equated to the intervention programme. Some of these main finding were presented at the previous conferences in 2006 [8].

This work now concentrates on the development and implementation of second level chemistry lessons, central to the CASE methodology- *Thinking Science through topics*.

Increasing the relevance and density of the use of the CASE methodology beyond stand- alone activities (suitable for use once every two weeks) to use within entire topics (from 5- 8 lessons over two weeks) demanded development of additional resources particularly in chemistry. Two chemistry topics were chosen, materials and lessons were designed in accordance with the CASE methodology- to promote higher order thinking- and subsequently used by five teachers, trained in the use of the cognitive acceleration tools. The CSMS Science Reasoning tasks were used to test the effectiveness of the programme on the student's cognitive levels. Preliminary results from half of the cohort indicate that the cognitive levels of the experimental group were much greater than that of the control group, with mean residual gain scores of 4.24 and 0.34 respectively. Detailed results will be discussed at the ChemEd-Ireland 2008 conference.

## References:


[1] Government of Ireland, Junior Certificate Science Syllabus (2003) http://www.curriculumonline.ie/index.asp?locID=442

[2] Government of Ireland, Social, Environmental and Scientific Education curriculum (1999), http://www.curriculumonline.ie/index.asp?locID=9&docID=-1

[3] P. Adey, M. Shayer, and C. Yates, Thinking Science: The Curriculum Materials of the CASE project. London: Thomas Nelson and Sons (1989)

[4] P. Adey, and M. Shayer, Really Raising Standards: Cognitive intervention and academic achievement. London: Routledge (1994)

[5] P. Adey, A. Robertson and Venville, G., British Journal of Educational Psychology, Vol. 72, p. 1 (2002)

[6] H.H. Iqbal, and M. Shayer, Journal of Research in Science Teaching, Vol. 37, No.3, p. 259 (2000)

[7] NFER Science Reasoning Tasks, Windsor: National Foundation for Educational Research (1979)

[8] O. Finlayson, T. McCloughlin, L. McCormack, Sustaining Science- Smoothing the transition, 8th European Conference on Research in Chemical Education Budapest, Hungary (2006)

# Changes in the Leaving Certificate Higher Level Chemistry Syllabus, have they been reflected in the assessment?

Edelle B. McCrudden, Odilla E. Finlayson CASTeL, *Dublin City University*, Ireland

**Abstract:**

Assessment at both second and third level has come under immense scrutiny over the last decade particularly addressing the role which it can play in student learning. Good assessment strategy should be preformed in such a way that it is justifiable and allows all students to achieve their maximum potential [1]. Assessment should also reflect the stated objectives or learning outcomes of a course [2].

The revised Irish second level national syllabus (Leaving Certificate) in Chemistry was implemented in 2000 and first examined in 2002. The syllabus aims to:

- Stimulate and sustain student interest in and enjoyment of chemistry
- Encourage an appreciation of the scientific, social and economic, environmental and technological aspects of chemistry [3]

This syllabus will be assessed in relation to its objectives which include:

- An ability to interpret experimental data and assess the accuracy of experimental results.
- An ability to organise chemical ideas and statements and write clearly about chemical concepts and theories [3].

This new revised syllabus has received criticism due to the implementation of mandatory experiments without the proper equipping of all Irish Secondary and Vocational Schools, and also the failure of the terminal exam to provide adequate assessment to justify this shift in emphasis to applied aspects of chemistry. [4,5]

In this study, analysis has been completed on the last seven annual exams, with focus placed on the frequency of appearance of these particular topics in order to ascertain if there is a high level of predictability within the chemistry paper. Topics which haven't appeared on the last seven years, in either section A or B, also have been identified.

While there are issues in relation to the use of Blooms Taxonomy [6] in determining question type, in this study it is being used purely as a tool in order to compare the examination question over a number of years.

Questions have been identified as knowledge, comprehension, application, analysis, synthesis or evaluation, and this has revealed that the predominant question type is of lower order with only a small percentage of higher order questions appearing in each examination.

Both the question type and frequency of appearance of keys areas and concepts of chemistry will be presented in this talk in an effort to identify or map out the trends and favourite topics of the examination.

Also as the Leaving Certificate Chemistry paper for 2008 has recently been completed in Ireland (05/06/08), an analysis of this paper will also be included in this study.

## References:


[1] Bennet Stuart et al Open University Press, Milton Keynes (2002)

[2] Doran r et al, United Book Press, Virgina (1998)

[3] Leaving Certificate Chemistry Syllabus, NCCA The Stationary Office Government Publications Dublin (1999)

[4] Matthews P Chemistry in Action 46, 24-35 (1995)

[5] Childs P.E Chemistry in Action 46, 42-44 (1995b)

[6] Bloom B, David McHay Co Inc, New York (1956)

# LC Chemistry Syllabus Review & Chemistry Support Service

Brendan Duane, *Chemistry Education Officer NCCA*, Ireland

**Abstract:**

Brendan is National Co-ordinator for Chemistry with the Second Level Support Service and also holds the position of Education Officer on the chemistry course committee with the NCCA.

His talk today will focus on two areas. The first is a summary of the Support service available to teachers and the wealth of resources that teachers can draw on to assist them in their classroom teaching.

Secondly he will deliver a summary of the work to date in drafting the revised Chemistry syllabus and outline the next stage of consultation that will take place in order to take on board suggestions from interested bodies that may modify the final product.

***Personal Details:*** Brendan Duane .B. Sc. M. Sc. in Science Education.