PHYSICAL SCIENCES

A MAGAZINE FOR SECOND LEVEL TEACHERS OF PHYSICS AND CHEMISTRY

Summer 2005 Issue 4

Dear Colleagues,

Welcome back after the summer break.

The Second Level Support Service will continue to support teachers of physics and chemistry at senior cycle during the school year 2005-2006.

This issue of the physical sciences magazine contains some interesting articles to enhance teaching and learning in the classroom. These include the feature article on the role of assessment for learning as well as articles on laboratory tips and evaluated resources.

Feedback on the physics and chemistry support offered last year can be found in pages 2 and 3 while Autumn support plans are on pages 30 and 31.

We thank those who contributed articles to this issue of the magazine and invite you to share your experiences and resources with colleagues by submitting articles for the next issue.

We wish you and your students every success throughout the coming year.

***Brendan Duane**, Chemistry Co-ordinator SLSS*
***Tim Regan**, Physics Co-ordinator SLSS*

Website

The updated website may be found at www.slss.ie
Log on to find details of all upcoming support events. You will also find a wealth of downloadable resources which will be continually updated.

Upon logging on please register and provide an email address if you wish to be informed of upcoming courses and events.

Web plans for 2006 include the setting up of an interactive bulletin board where relevant resources and queries can be shared.

SLSS Physics & Chemistry Support

- The magazine ***'Physical Sciences'*** is circulated to all second level schools.
- A **consultation service** by phone, fax or email is available.
- A limited number of **school visits** will be provided, resources permitting.
- **Regional Network Meetings** to support local identified needs will be facilitated.
- Details of **courses** on offer are contained inside.
- The **Physical Sciences website**, www.slss.ie is regularly updated and contains many useful resources and news of upcoming in-service and events.

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NDP
NATIONAL DEVELOPMENT PLAN

SLSS
Second Level Support Service

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DEPARTMENT OF EDUCATION AND SCIENCE

Physics Support January - June 2005

The two Modular courses offered focussed on the teaching of physics in the classroom. Days two and three of the three-day Modular courses took place between January and April 2005.

SL0414 Induction Course for Physics Teachers

Day 2 of this course was hosted in the Dublin West and Limerick Education Centres. Many of the participating physics teachers were new to the profession while others were new to the revised Leaving Certificate syllabus. Day 3, which focussed on practical physics laboratory work, was held in the Dominican College, Sion Hill, Blackrock, Co Dublin and Cashel Community School, Cashel, Co Tipperary.

Physics teachers at the Labday in Cashel

The course introduced teachers to the structure and content of the physics syllabus, the teacher guidelines and the teacher support starter pack. Teachers also explored effective teacher methods for communicating physics and had a hands-on experience with ten experiments listed in the syllabus.

Feedback from the teachers included,

"Very useful informative course, I was impressed' , 'The networking with other teachers is very useful', 'As a person just starting to teach LC physics, I found it removed a lot of my worries', 'Seeing and actually doing the practicals was very helpful'
'Hands-on practical work was very helpful, allows me to build confidence in using equipment, rectify problems, etc.'

SL0415 Using ICT to Enhance Learning in the Physics Classroom

Days 2 and 3 of this course were hosted by the Kilkenny and Galway Education Centres.
The course focussed on learning strategies using ICT tools such as PowerPoint, CD-ROMs, Internet Applets and Datalogging to engage the learner. The participants did action research in optional topics from their own work situations, reflected on practice and documented the outcomes. It also provided the opportunity to explore and share experiences of best practice with the group.

Teachers at the physics ICT course in Galway

Feedback from the teachers included,

'Many of the resources I had been given in the past were gathering dust because I had not been shown how to use them'.
'A very useful and informative course-renewed my trust in ICT'
'Got inspiration and enthusiasm to generate PowerPoint slides for class
'Modular model is good since the rapport built up with colleagues led to the sharing of resources'.

Datalogging Induction

A series of one day hands-on workshops on how datalogging can enhance practical work in physics were organised in six different venues around the country namely, Sligo, Portlaoise, Navan, Cork, Dublin West and Waterford Education Centres.

Physics teachers attending the Cork Datalogging Induction Course

Feedback from the teachers included,

'It will encourage me to use datalogging'
'Opportunity to perform so many relevant experiments', 'questions answered-getting tips'
'Feel more confident about datalogging', 'Very helpful day, more of the same please'
'Good refresher course on datalogging', 'Good range of experiments'
'It was very well prepared, paced well and certainly increased my ease of use of the datalogger', 'Sorted out my software problems'

Chemistry Support January - June 2005

SL0416 Induction Course for Chemistry Teachers

Chemistry Teachers in UCC

Day three of this Modular course took place in Maynooth University and University College Cork. Once again the main emphasis was on the Mandatory experiments. Teachers both new and old welcomed the opportunity to get hands on experience and many tips and suggestions were shared among the participants. Teachers remarked that the felt much more confident returning to the classroom and that safety issues had been addressed by the laboratory technicians present on the day. There was time during the day to show resources and some PowerPoints in use by teachers. This also made the course very worthwhile.

Feedback:-

"Loved the PowerPoint displays and the interactive software..."
"Great to get hands on experience" .... "Tips very useful"
"Learned so much from just chatting with other teachers"

SL0417 Using IT to Enhance the Teaching and Learning of Chemistry

Teachers at Chemistry ICT in Dublin West

Days 2 and 3 of these Modular courses were completed between January and April in Dublin West Education Centre and Limerick Education Centre. The participants were mostly new to this topic and made excellent progress over the two days. PowerPoint presentations were developed and shared among the group. Teachers learned how to incorporate Websites, Applets, Flash animations and Movies into their work as well as best practice for successful presentations. This area will have to be revisited as so much could be achieved if time were available. It is hoped to run this course in all six Education Centre Regions. See back of this magazine for details of the course near you.

Feedback:-

"Able to now use the internet to download video clips and animations"
"Picked up some very useful resources... "
"Have the confidence to prepare an introductory show on the history of the PTE"

Datalogging

The final two Datalogging workshops took place in Fermoy and Donegal in January of 2005. Teachers do find these experiments useful and easy to prepare. All can be carried out many times in a single 40 min. class period. Full details of the experiments are given on the day and they can be downloaded from the SLSS website under Chemistry. (see cover).

Feedback:-

"Workshop was well laid out and flew through the experiments with ease"
"Will definitely try out some of these when I get back to school."
"Notes are very helpful and all the equipment matched what I have in school."

Chemistry Teachers trying datalogging in Fermoy

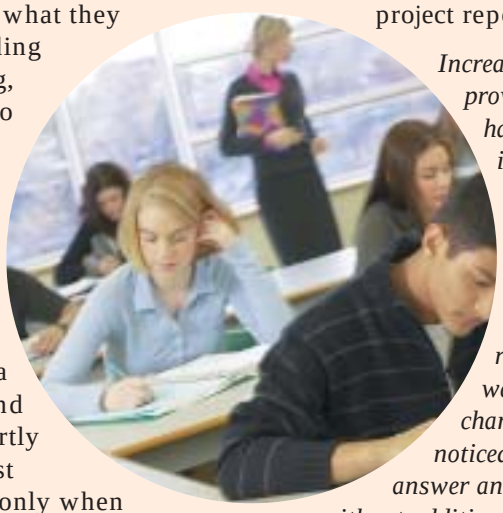
SCIENCE INSIDE THE BLACK BOX
A REFOCUS ON THE ROLE OF ASSESSMENT

Chris Harrison, King's College, London

When I meet new people and they ask me what I do, I usually say educational research. I then take a deep breath because I know what the next question will be and the effect that my response is likely to have. There are a few words in the English language that have dictionary definitions that seem far too innocent for the emotions that they evoke and ASSESSMENT belongs to this group. While most dictionaries quote it as meaning an evaluation or estimation, in school contexts it is often thought of in terms of test and examinations. I try to point out that the term assessment is derived from the Latin verb, *assidere = to sit beside* but this seems a long way from the horror of the examination hall. This article is aimed at trying to dispel the bad press that assessment gets because we believe that assessment is at the heart of teaching and learning .

Assessment has many purposes in schools. Youngsters need to get qualifications and, at times, teachers need to get a measure of how well pupils are learning and how effective their teaching has been. However, the main purpose of assessment that we promote through our work is to inform and enhance future learning. This is formative assessment or what recently has been called assessment for learning.

In the classroom, formative assessment takes place when teachers ask questions or set up activities that find out not only what learners know but also what they partly know or don't know. From finding the leading edge of childrens' learning, the teacher can plan what to do next to take that learning forward and this forms the formative step that drives learning. This is however not an easy thing to do because teachers not only have to find questions or tasks that are capable of taking children to the limits of their learning but they also have to persuade youngsters to have a go at questions that are challenging and searching. In fact, it's locating the "partly know" area of learning that is the most useful in formative assessment as it's only when the misconceptions come to light that the teacher can start to help the learner to improve. Yet there are few adolescents who are willing to reveal their inadequacies in the classroom situation. They have learnt numerous techniques on how to avoid being asked questions by where they chose to sit or by avoiding eye contact with the teacher or by studying their shoes. They have also worked out how to cover up lack of understanding by guessing at key scientific terms to form an answer in the hope that the teacher will pass onto their next victim!



The first step to getting formative assessment working in classrooms is to begin putting together the elements that will promote rich classroom dialogue. Unfortunately many teachers do not plan and conduct classroom dialogue in ways that help pupils to learn. Research has shown that many leave less than one second after asking a question before, if no answer is forthcoming, asking another question, or answering their own question (Rowe, 1974). A consequence of such short 'wait time' is that the only questions which 'work' are those which can be answered quickly without thought, which are mostly questions which call for memorised facts. In consequence, the dialogue functions at a superficial level and so the 'partly know' bits of knowledge remain hidden and so do not get sorted out.

The key to changing such a situation is to find better questions and to increase wait time. The latter looks simple to achieve, but many teachers find it hard to do this: they have to break their established habits, and as they change the expectations of their pupils are challenged as one of the teachers on our KMOFAP* project reports:

Increasing waiting time after asking questions proved difficult to start with - due to my habitual desire to 'add' something almost immediately after asking the original question. The pause after asking the question was sometimes 'painful'. It felt unnatural to have such a seemingly 'dead' period but I persevered. Given more thinking time students seemed to realise that a more thoughtful answer was required. Now, after many months of changing my style of questioning I have noticed that most students will give an answer and an explanation (where necessary) without additional prompting

Derek, Century Island School (KMOFAP)

To exploit such changes it is necessary to move away from the routine of limited factual questions and to

refocus attention on the quality and the different functions of classroom questions. An example is the use of a 'big question': an open question, or a problem-solving task, which can set the scene for a lesson by evoking a broad-ranging discussion, or prompting small group discussions, so involving many pupils. Questions which we would complain about if they appeared in an examination paper because they are ambiguous or too challenging often make good formative questions. For example:

What do you think friction feels like on the Moon and why might it be different to on Earth?

Such a question is likely to reveal misconceptions that learners may harbour about gravity and whether gravity exists outside the context of the Earth, about the relationship they see between forces as well as providing a check on how they describe the phenomena of friction However, if this is to be productive, both the responses that the question evokes and ways of following up these responses have to be anticipated. Collaboration between teachers to exchange ideas and experiences about good questions will be very valuable. The questions themselves then become a more significant part of teaching, with attention focussed on how they can be constructed and used to explore and then develop pupils' learning.

I chose a year 8 middle band group and really started to think about the type of questions I was asking – were they just instant one word answers, what were they testing – knowledge or understanding, was I giving the class enough time to answer the question, was I quickly accepting the correct answer, was I asking the girl to explain her answer, how was I dealing with the wrong answer? When I really stopped to think, I realised that I could make a very large difference to the girls' learning by using all their answers to govern the pace and content of the lesson.

Gwen, Waterford School (KMOFAP)

Teachers have a dual role to play during classrooms discussions. They need to be listening carefully to answers to judge what areas need focussing on but at the same time be facilitating the discussion through impromptu interventions. These often include simple questions such as *'Why do you think that?'* or *'How might you express that?'*, or *'What could we add to that answer?'*. This type of questioning can become part of the interactive dynamic of the classroom and can provide an invaluable opportunity to extend pupils' thinking through immediate feedback on their work.

In essence, good formative assessment questions promote thinking and discussion. Imagine the sorts of ideas that might arise with your learners from giving them time to explore the questions below:

What is similar and what is different about tapwater and seawater?

Is it always true that increasing the temperature speeds up a reaction?

Thinking about the particle model for solids and liquids, what do you think ice looks like at particle level?

Why are some areas of renewable energy more suited to some areas of the country than others?

Would putting a coat on a snowman make him melt faster or slower?

Why does a steel block sink but a steel ship float?

There have been many research studies that have looked at the effect of formative assessment on learning and there is strong evidence that formative assessment can raise standards of pupil achievement, Promoting effective classroom dialogue is the start of developing this work in classrooms and it's easy to see why sorting out misunderstanding as learning is taking place leads to fuller and better understanding later. In the classrooms that we have worked with teachers, we also recognised that this approach to teaching and learning also improved the motivation of pupils and many of the teachers could see how they were regularly making a valued and valuable contribution to childrens' learning.

If you would like to read more about formative assessment and the work that we have done at King's College, then please go to our website on **www.kcl.ac.uk/education/research**

References

* KMOFAP – The King's, Medway and Oxfordshire ~Formative Assessment Project which was an 18 month project with 24 Science and Mathematics teachers who developed and evolved their classroom assessment practices.

Rowe, M.B (1974) Wait time and rewards as instructional variables, their influence on language, logic and fate control. *Journal of Research in Science Teaching*, 11, 81-94

Henry Gwyn Jeffreys Moseley

Henry Moseley was born in Weymouth, England on November 23, 1887. In 1906 he entered Trinity College of the University of Oxford. Moseley's two grandfathers had been fellows of the Royal Society, and his father had founded a school of zoology at Oxford. Mosely himself was perhaps the only important atomic physicist to be educated at Oxford and on graduation from that institution in the autumn of 1910 he came to work as a demonstrator under Rutherford, his salary being paid by a Manchester industrialist. Rutherford was a large, loud, much-loved and foul-mouthed genius. Rutherford had created the modern theory of radioactivity and had won the Nobel prize in 1908. For his first year at Manchester, Moseley had a full teaching load, but after a year he was relieved of his teaching duties and began full-time research. He was assigned a research problem to which everyone knew the answer: how many ß particles are emitted in the radioactive disintegration of radium B (Pb214) to radium C (Bi214). On finding the answer everyone expected, a single ß particle, he proved his competency as an experimentalist.

However, his next experiments would not be so cut and dried, nor would they receive the ready approval of Rutherford. Rutherford was not all that excited by Moseley wanting to study X-rays, but Bragg's offer to Moseley of a visit to Leeds to teach him the techniques of X-ray spectroscopy and the energy and enthusiasm of the younger man soon wore Rutherford down. Moseley was a patrician -- serious as an undertaker. He worked day and night. He openly disapproved of Rutherford's language and went his own way working tirelessly at the problem of finding the electric charge in atomic nuclei.

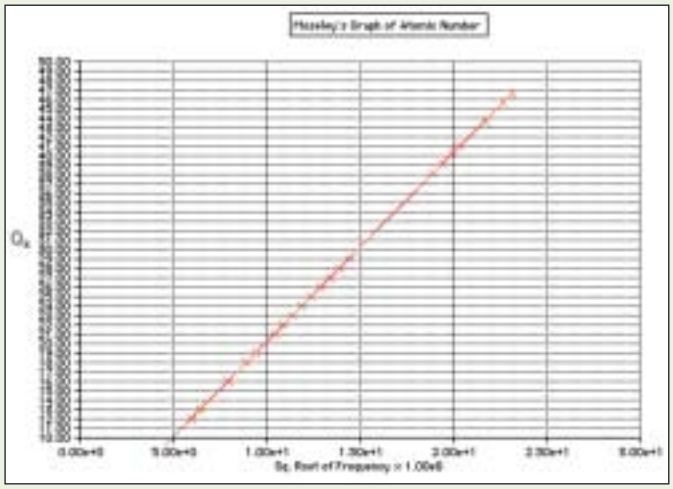
Like the Braggs, and quite independently of them, Moseley was stimulated by the photographs of Friedrich and Knipping, and felt that Max von Laue had misinterpreted them as evidence of five homogeneous X rays. He teamed up with Charles G. Darwin, grandson of the famous evolutionist, and turned to, as he said, the "real meaning" of the German experiments. The Laue dots connoted the structure of the crystal, not the structure of the incoming rays. When presenting his results to a Friday physics colloquium which father Bragg attended, Moseley discovered the similarity in their understanding of the phenomena, and afterwards he wrote to his mother:

*I have been lazy for a couple of days recouping after the lecture I gave on Friday on X rays. It was rather anxious work, as Bragg, the chief authority on the subject (Professor of Leeds) was present, and as I had to be cautious. However it proved quite successful and I managed to completely disguise my nervousness. I was talking chiefly about the new German experiments of passing rays through crystals. The men who did the work entirely failed to understand what it meant, and gave an explanation which was obviously wrong. After much hard work Darwin and I found the real meaning of the experiments.**

Moseley's problem was to find a linear relationship between the atomic number and a measurable property of the nucleus. Moseley used an ingenious device of G. W. C. Kaye's to examine the K rays from copper, nickel, cobalt, iron, manganese, chromium, and titanium. By putting the different elements which served as anti-cathodes on a magnetized truck and rail inside the evacuated chamber, Moseley was able to change anti-cathodes with an external magnet without disrupting the integrity of the chamber. After switching from detecting the K rays by ionization to detecting them by photography, his work went quickly, and in several weeks he showed hat the ranking of elements by K rays followed their ranking by nuclear charge, Z).

Moseley needed some function of a nuclear property that increased in the same pattern, that is, by one, for each element in turn. It turns out that the square root of the frequency moves by a constant value (let's call it "one unit") for each one unit move by the atomic number.

At the time when he was working, most physicists regarded the atomic weight A as the key to ordering the periodic table, rather than the atomic number Z. For example, nickel, with atomic weight 58.7 was placed ahead of cobalt, atomic weight 58.9, in the periodic table. Moseley's work showed that cobalt had an atomic number of 27 and nickel 28. Potassium (Z=19, A=39.10) and Argon (Z=18, A=39.95) were also reversed when listed by atomic weight order. Moseley predicted the existence of an element at Z=72 (Hafnium) which was subsequently discovered in Bohr's laboratory in Copenhagen.



Moseley did not like Manchester and so in November of 1913, despite being refused a fellowship and any form of remuneration he moved to Oxford where he worked at the Electrical Laboratory with no salary. No apparatus was available and he used an award of 1,000 Belgian Francs from the Solvay Institute to pay Charles Cook, an instrument maker for Rutherford's team in Manchester, to make him an X-ray spectrometer. Moseley began a thorough investigation of Mendeleev's table using X rays. He began with calcium and worked across to zinc and then moved on to the rare earths, lanthanum to erbium. George Urbain, a Professor of Chemistry in Paris at one of the Grands Ecoles had been engaged for years in fractionating the elemental rare earths in competition with Carl Auer von Welsback, who performed his fractionations in an Austrian castle. Urbain recognized the power of Moseley's technique and paid him a visit with precious samples of the last four rare earths, thulium, ytterbium, lutecium, and celtium. He was astounded at how quickly Moseley's X-ray spectrometer could determine that celtium was not his sought after new element, but was only a combination of lutecium and ytterbium!

Moseley showed that there were gaps in the sequence at numbers 43 and 61 (now known to be radioactive, non-naturally-occurring, technetium and promethium, respectively). Thus Moseley, in the tradition of Mendeleev, predicted two elements.

Rutherford (in 1914) described Moseley's discovery thus:

"Recently Moseley has supplied very valuable evidence that this rule [atomic numbers changing by one from element to element] also holds for a number of the lighter elements. By examination of the wave-length of the characteristic X rays emitted by twelve elements varying in atomic weight between calcium (40) and zinc (65.4), he has shown that the variation of wave-length can be simply explained by supposing that the charge on the nucleus increases from element to element by exactly one unit. This holds true for cobalt and nickel, although it has long been known that they occupy an anomalous relative position in the periodic classification of the elements according to atomic weights."

The First World War began in August 1914, and Moseley immediately, against the advice of his family and of the Army itself, volunteered for active service, Moseley, with his Eton patriotism, and sense of duty bred in his bones practically forced himself upon the Royal Engineers. He enlisted along with his friend Henry Tizard. He became a signals officer with the Royal Engineers. Tizard survived the Great War, but Moseley died at Gallipoli in the battle of Sari Bari.

It was early morning, August 10th, 1915. 30,000 fresh Turkish troops came down off Sari Bair hill on Gallipoli Peninsula. They fell upon the tired, badly positioned British. They destroyed them in furious hand-to-hand combat. Among the dead lay a 27-year-old lieutenant. Henry Moseley. Even the German press, the enemy press, lamented his death. "Ein schwerer Verlust," they wrote: "A heavy loss -- for science." Why did Moseley against everyones advice volunteer when he had such important work to pursue? Dr. Edith Sherwood, a Houston chemist claimed that her father who was an English chemist and Moseley's contemporary had told her that Moseley's real reason for enlisting was that someone had mailed him a white feather when WW-I began. A white feather is a traditional accusation of cowardice.

Moseley was nominated for the 1915 Nobel Prize and had he survived he would almost certainly have been awarded the Nobel Prize for physics. As to his subsequent career one can only hazard a guess. The speed with which he designed, had constructed, and produced results from, his apparatus in Oxford is remarkable even by present-day standards, and singles him out as an exceptionally vigorous and able experimenter. What is even more remarkable is the fact that he achieved so much and advanced our understanding of the atomic structure and yet his entire research career extended over only 40 months.

Heilbron, J.L., *H.G.J. Moseley: The Life and Letters of an English Physicist*. 1887-1915, Berkeley: Univ. of Calif. Press, 1974.

Early History of X Rays by Alexi Assmus

Irish Physics Students win International Awards

Congratulations to Michael Mulhall and Francis Wasser, sixth year pupils at Synge Street CBS, who won first prize in the physics section (group awards) at the Intel International Science and Engineering Fair which was held in Phoenix Arizona from the 8th to the 13th of May 2005. There were 1444 entrants, comprising 1200 projects, from all over the world for the event this year. Each entrant earned the right to compete by winning top prize at a state or national science fair. Michael and Francis won the top group prize at the Esat BT Young Scientist Competition in January 2005 for their project Numerical Solutions of Hamilton's Equations.

2005 is the bicentenary of the birth of William Rowan Hamilton, Ireland's most famous scientist. In 1834 Hamilton wrote one of his most important scientific papers On a General Method in Dynamics in which he proposed a new formulation of the laws of mechanics.

Michael and Francis devised a new numerical method of solving Hamilton's equations and they carried out a detailed study of the accuracy of the new simulation technique. Their work earned high praise from the judges in both the Esat BT and the Intel ISEF competitions for its insight, originality and thoroughness. Both students acknowledged the support and encouragement of their physics teacher Mr Jim Cooke, congratulations Jim.

Peter Kirkland from Dalriada School, Ballymoney, County Antrim, Northern Ireland won first prize in the engineering section of the competition.

Peter Kirkland, Michael Mulhall, Francis Wasser

Science in Transition Year

PharmaChemical Ireland, IBEC's body representing the Pharmachem industry has launched its Transition Year Science programme at this years AGM for Irish Science Teachers Association (ISTA). PharmaChemical Ireland has developed these resources as part of their program to implement recommendations made in the *Physical Sciences Task Force* report (2002). However, it is calling on Government to use adequate investment to support some of the other recommendations, which include improving the laboratory facilities and introducing laboratory technicians at post primary level.

The aim of this program is to provide science based resources suitable for the Transition Year curriculum. Transition Year is an ideal opportunity for students to gain exposure to extremely interesting aspects of everyday science that may not be on the Junior or Leaving certificate syllabus.

This programme contains four distinct modules:

- *Forensic Science*
- *Sports Science*
- *Cosmetic Science*
- *Microbiology*

Each module covers a range of topics and recommends suggested practicals in addition to material suitable for the classroom. This programme also includes a variety of science based topics suitable for public speaking seminars.

"Transition year can be an exciting stage for students to try new subjects and broaden their horizons. This year can be an ideal platform to generate and or build on an interest in science and encourage students to explore their science interests outside the boundaries of the Junior Cert or Leaving Cert syllabus", says Dr. Mark Glynn, PharmaChemical Ireland's Education Officer. Glynn points out however, limited time and resources available to the science teachers make it difficult for teachers themselves to explore the opportunities outside the curriculum, which make it even more difficult for the students. Each module was launched on a pilot basis throughout the year.

Based on the feedback received, these modules have been revised and the complete programme is now freely available by request on **www.pharmachemicalireland.ie** or by contacting Mark Glynn at **mark.glynn@ibec.ie**. PharmaChemical Ireland would like to thank the schools involved in the pilot programme and acknowledge the funding and support given to this project by Discover Science & Engineering.

Further information:
Dr Mark Glynn, Education Officer,
PharmaChemical Ireland.
Ph: 01-6051581

SECOND LEVEL SUPPORT SERVICE PHYSICS NETWORK MEETINGS

Eleven physics network meetings have taken place this school year in seven different Education Centres. These meetings were organised in collaboration with the local Education Centre Directors and in cooperation with the Irish Science Teachers' Association (ISTA) and the Institute of Physics (IOP).

Areas for development included Particle Physics, Datalogging and ICT in physics teaching.

In all 92 physics teachers (43 male, 49 female) attended the eleven meetings. 88% indicated that they found the meeting very helpful and many indicated that they would be interested in attending another network. The feedback comments were very positive, below is a sample of the feedback.

'Great to get together with colleagues', 'Really enjoyed this, great support, many thanks', 'Excellent presentation, well paced', 'Opportunity to ask questions', 'Each station was well organised', 'Hands-on approach very helpful', 'Builds confidence' 'Instructor was very helpful', 'I really appreciate the work and organisation put into this network – Many Thanks'

Physics teachers networking in Kildare

I wish to thank the Education Centres who participated in this pilot physics network programme, for their support and hospitality throughout the year. Also thanks to the ISTA and the IOP for their cooperation and to my committed colleagues, the physics associates, who helped to organise and facilitate the networks.

The plan for next year includes collaboration with more Education Centres to offer the physics network support to more teachers and to broaden the support topics on offer. If you want any further details or wish to discuss the setting up of a physics network group please contact me.

Tim Regan SLSS Physics Co-ordinator

The ISTA annual conference and AGM was held in Carlow on the 8th-10th April 2005. It was well attended and it proved to be a very enjoyable and informative weekend. The conference was officially opened by Dr. Carol Gibbons Deputy Chief Scientific Advisor to the Government. This was followed by a very interesting lecture on Irish Geneology given by Dr. Dan Bradley Dept. of Genetics, TCD.

The programme was demanding but interesting and all lectures and workshops were well attended.

Saturday' s programme included Gerald Fleming Met Eireann, (Keynote Speaker) Prof. Denis Wearie TCD, Christine Harrison King's College, London and many other eminent scientists and educators.

The conference concluded on Sunday with Mike and Wendy Gluyas 'Musical Squares' – still a very popular and professional performance.

I wish to extend our thanks to all those who helped to make the weekend a success – colleagues who attended, guest speakers, exhibitors, staff of IT Carlow, and the organising committee.

The 44th AGM will be held in Athlone in Spring 2006.

Deirdre Knox, Presentation Sec. School, Loughboy, Kilkenny, Secretary Organising Committee

Mike and Wendy Gluyas

Sharing Science Across Ireland

A joint ELB / ISTA / ASE Project

This is a joint North South Project involving two subject teaching organisations – the Irish Science Teachers' Association and the Association for Science Education Northern Ireland Region in partnership with the Northern Ireland Education and Library Boards Science Advisors' Group. The project aims to promote science and technology among the upper KS2/KS3/5th/6th class primary and 1st Year post-primary age group over a two-year period in the border regions of the Republic of Ireland and Northern Ireland. It provides the opportunity to bring together pupils, teachers and key players in the science education community in an organised framework involving dialogue, cross community and cross border working with joint visits between schools in the target areas. The joint project was launched at the Sharing Science Conference on Friday 26th March 2004 in the Dundalk Institute of Technology. This conference started with a Key Players' Conference on Thursday 25th March and was followed by a conference for teachers, primary and post-primary on Friday 26th, Saturday 27th and Sunday 28th March. 600 teachers, primary and secondary, from both sides of the border attended this conference.

The joint project is supported by European Structural funds and the Department of Education and Science and the Department of Education, Northern Ireland under the EU programme for Peace and Reconciliation in Northern Ireland and the Border Region of Ireland.

AIMS

The project provides opportunities to:

1. To involve large numbers of young people and teachers in programmes of science and technology promotion in the target areas.
2. Support cross border collaborative activities for teachers and pupils in the target areas which promote primarily essential skills in science & technology which lead to greater employability.
3. Encourage pupils to develop strategies in life and learning that will build confidence and self-esteem.
4. Encourage young people to continue with science to the upper levels of post-primary and into third level.
5. Promote the use of ICT in collaborative activities between pupils as well as using ICT as a research, communication and laboratory tool in collaborative projects.
6. To establish a forum for discussion and implementation of joint projects in science education involving schools, teachers and pupils from the primary and post-primary sectors of the target areas.
7. Establish a legacy of joint working between participating teachers and schools and the extension of this into the social and business community.
8. Bring all the key stakeholders in science education North and South together
9. Establish a sustainable platform for the maintenance of contact between key players in science education at government level, primary, post-primary and tertiary level including Initial Teacher Training and Early and Continuing Professional Development and recognised Science Education Bodies to pursue common goals in relation to science education.

This proposed project will encourage an innovative and creative approach to teaching and learning in the field of science and technology. Both jurisdictions are experiencing curricular change at the present time in science and technology and this is an opportunity to model an integrated approach to science and technology education at primary and early post primary levels.

HOW THE PROJECT WORKS

The project proposes to involve a large number of teachers North and South and, through them, a large number of pupils, who will be the ultimate beneficiaries of this project. The beneficiaries will be drawn from the target areas i.e. the Border Areas and Northern Ireland.

The 200 teachers proceeding with the project will be from up to 100 different schools (subject to a maximum of 2 teachers per school) with a breakdown of 45% primary schools and 55% post primary approximately. The teachers will form clusters of two/three partner schools from north and south of the Border, contain at least one post-primary school and one primary school. The teachers will involve one class group of pupils in the project who are in the 10 – 14 year age category.

All the teachers and pupils are visiting W5 in Belfast at the beginning of the project in January/February 2005 – i.e. W5 is being given over to this project for two days a week for 10 sessions so that 400 pupils accompanied by 20 teachers will visit for a workshop session. The W5 staff are working with the pupils engaging them in science/technology promotional activities and facilitating their choice of a topic for collaborative work with their partner schools. The teachers are being addressed by the Science Advisors' Group who are working with them on the goals and practical arrangements of the project. At the end of this day, each cluster group, either two or three partner schools, will have chosen a mutual topic on science and technology to which they will be committed and will have agreed to work on together.

After this initial training day for all participants, the collaborative work between the partner schools will commence and will have to be completed by November 2005. The schools and pupils will communicate mainly over the Internet and will compare and contrast data collected. The use of ICT will be actively encouraged and form an integral part of the work being done. The

Science Advisors Group and members of ASE and ISTA will act as on-line mentors to support the teachers in the ongoing work with the students. The completed collaborative projects between the partner schools will be submitted to the project directors (drawn from ASE, ISTA and the Science Advisors' Group).

Representatives from the participating schools will be invited to display the work done at the Northern Ireland Young Innovators Competition, organised by Sentinus, at the end of June, 2005. Other representatives will be invited to give presentations on the collaborative work done at the Express Yourself Competition, held in Belfast in June 2005.

A more general display and description of the project work done, along with an evaluation of the overall project, will be given at the British Association for the Advancement of Science Conference, scheduled to be held in Dublin in September 2005.

Pupils will be encouraged to display collaborative projects of a high quality at the Esat BT Young Scientists' and Technology Exhibition in January 2006, in Dublin. (Esat BT have been approached with a view to creating a special cross border category for the competition in 2006 i.e. for science and technology project work carried out by pupils together from both sides of the border and the religious and political divide).

BUILDING THE FUTURE

From this outline of the activities involved in the project, it is clear that a large number of young people and their teachers will become involved in cooperative work with their peers from other traditions and culture. The project involves innovative curriculum development which actively encourages education for mutual understanding through shared activities in science and technology. They will experience increased cross border contact, with the setting up of school networks facilitated by the larger network of the ASE and ISTA.

Equally importantly, the young people from the target areas participating will be encouraged into a greater enjoyment of science and technology , learning essential skills and as a result, continuing on with science and technology subjects at higher second level and into third level. Their participation in this project will enhance their understanding of the role of science and technology in career choices and ultimately, their employability.

The project addresses a number of issues including that of the interface between primary and secondary education. It is well documented that while science and technology is enthusiastically embraced at primary level in Northern Ireland, (it has just been formally introduced to the primary syllabus in the South in September 2003) there is a major drop off in interest in the early years of post-primary. These first two years of post-primary science are critical for continued interest and participation in science and technology. By targeting the age group 11-14, the project seeks to improve interest and uptake in science and technology.

For further information contact
Siobhán Greer, ISTA, St. Louis Sec. School, Dundalk, Co. Louth; or sgreer@eircom.net

Sharing Science Across Ireland

What do schools get?

- Opportunity to participate in largest science education project in Ireland
- Financial support for:
  - *Project*
  - *Visits to W5*
  - *Reciprocal visits to partner schools*
  - *Support for attendance at conferences and exhibitions*
  - *Opportunity to participate in showcase science events e.g. Young Innovations, Esat BT Young Scientist, British Association Advanced Science Conference*
- Opportunities to share good practice in science teaching and learning
- Opportunities to form stronger links between primary and post primary schools in the local area and cross border

THE COLOURS ON A COMPACT DISC

We have all seen the colourful reflections from a CD, but what is the cause?

Festoon lamps (small tube shaped 12 V lamps with straight filaments) can be used to compare the spectra seen by transmission and by reflection at two similar diffraction gratings, e.g. 300 lines per mm.

Then look at a CD with a festoon lamp mounted above too produces a similar view due to reflection, and you will see a very similar coloured display.

Side views showing methods of observing transmitted and reflected diffraction, and comparison with a CD

When looking at a CD in daylight or normal room lighting, details of the colours are less easy to observe because the fine lines are circular and reflect light from many directions.

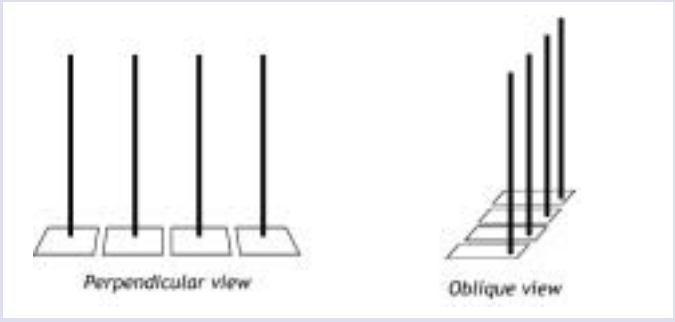
As with a diffraction grating, the lines making the tracks on a CD are so fine that they are difficult to see.
Now we need to look for the effect at larger line spacing.

Diffraction off the Record

Inspect a traditional black "vinyl" record. Being black, the record reflects no colour.

Although quite fine, the grooves on a vinyl record are so widely spaced that we can see them without aid. But if we look along the surface which means from a wide angle, the grooves will appear closer together.

You can consider the same effect with your fingers, a set of railings, a comb or a row of clampstands as illustrated here.



A festoon lamp can be mounted above one edge of a record. Then look towards the reflection of the lamp in edge of the record nearest to you.

Now with the lines apparently much closer together, sets of coloured spectra, caused by diffraction of light being reflected from the edges of the grooves, appear very similar to the view seen by reflective diffraction from a diffraction grating and from a CD.

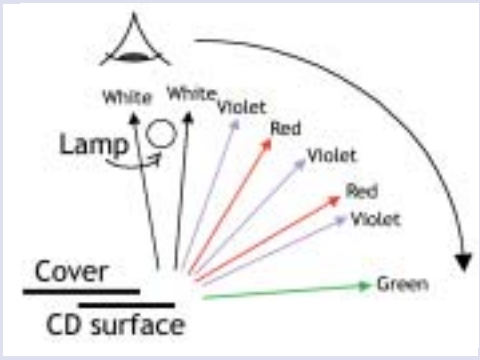
I first described this observation in School Science Review Sept 1996 70(250) page 84

Measurement

With the grooves of a CD being circular, stray light can arrive at the eye from all directions.

So with the following display, only a small portion of the CD is on view (the remainder can be covered by cardboard or wood) and a lamp is placed perpendicularly above it.
Look first from above the lamp to see its white reflection.
This checks that you have an almost perpendicular view.

Now move steadily backwards / downwards.
The first order soon becomes visible starting with violet and giving a bright spectrum through to red. The second order is slightly less bright but a full spectrum is easy to see.
The third order is rather dim, and its violet is so close to second order red that it is difficult to see. So the first clear colour you may notice in the third order is green. At almost 90°, it is still not possible to see yellow or red. So this quite weak green gives access to a simple calculation of line spacing.



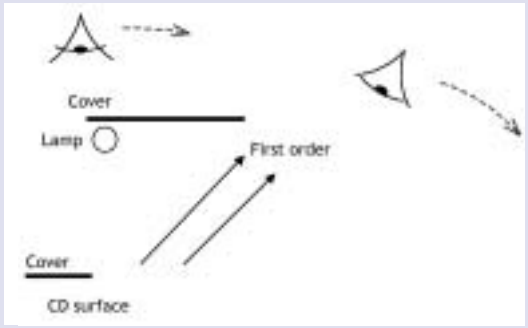
For the third order, $n\lambda = d \sin\theta$ with n = 3, $\sin\theta \approx 1$
and wavelength l of the order 550 nm

The grating constant (spacing) $d \approx 3 \times 550$ nm ≈ 1.65 µm
This translates to approximately 600 lines per mm

A Puzzle to Solve

For the assessment of the line spacing, it was arranged to view only a small part near the edge of a CD.

If now we look at a larger region of a CD surface illuminated by a single lamp above the centre. A viewpoint can be found to see the whole full first order spectrum only. A suitable cover can be used to prevent any other observations being seen.



When this full spectrum is viewed, red is closest to the centre of the CD, and violet is furthest away. The question is why?

According to the previous observations, diffraction causes the largest change of direction for light of the longest wavelength. Hence for each order of diffraction, red is diffracted through the widest angle and violet the least. Yet this view gives the impression that violet is diffracted furthest. Is this a contradiction? Can you work it out?

cf. www.slss.ie

Geoff Auty, ASE Yorkshire

Global Warming: How the world is changing

The level of the major greenhouse gas, carbon dioxide, in the Earth's atmosphere has hit a record high, US government scientists have reported.

The new data from the US National Oceanic and Atmospheric Administration also suggest that the rate of increase of the gas may have accelerated in the last two years. Carbon dioxide emissions, mainly from burning fossil fuels, are thought to be a principle cause of global warming.

Recordings from a volcano-top observatory, NOAA's Mauna Loa Observatory on Hawaii, showed carbon dioxide levels had risen to an average of about 376 parts per million (ppm) for 2003.
This is 2.5 ppm up from the average for 2002. It is not the highest leap in year-on-year atmospheric carbon dioxide levels recorded by NOAA. But it is the first to be sustained, with 2002 levels up 2.5 ppm from 2001.

This year-on-year hike is considerably larger than the average annual increase of about 1.5 ppm seen over the last few decades says Pieter Tans, chief scientist at NOAA's climate monitoring and diagnostic lab in Boulder, Colorado, US. Other NOAA scientists suggest that economic development in China and India, which leads to increased fuel use, could be a key factor.
Evidence is accumulating that global warming, induced by fossil fuel use, is becoming a real threat:

- temperatures have been at a record high for a decade
- coastal shorelines have retreated
- island nations are losing habitable land
- glaciers are melting on five continents

Rising Tides
Some scientists predict that a warmer climate will trigger more violent storms, which will cause increased rates of coastal erosion.

This is a section of shoreline at Cape hatteras in North Carolina in the USA, pictured in 1999 and 2004. The Southern United States and Caribbean region were battered by a series of powerful hurricanes last year. Rising sea levels are also expected to speed up coastal erosion.

Some scientists say an increase in the rate of melting of the world's glaciers is evidence of global warming.

Argentina's Upsala Glacier was once the biggest in South America, but it is now disappearing at a rate of 200 metres per year.

Other scientists say its reduction is due to complicated shifts in glacial dynamics and local geology.

No snow
As the climate warms up, mountainous regions may experience lower levels of snowfall.

This image shows Mount Hood in Oregon at the same time in late summer in 1985 and 2002.

www.teachnet.ie

Teachnet is an educational project that supports Irish teachers in developing websites suitable for use in the Irish curriculum. Their slogan is …by teachers, for teachers. It is an initiative of St Patrick´s College Drumcondra, run in association with the Teachers Network New York, which is funded by sponsorship from Citigroup Foundation and Atlantic Philanthropies.
It operates by awarding grants of €750 to teachers to disseminate innovative student-focused curriculum projects. It equips teachers with the skills needed to develop their project, by conducting training workshops for teachers in all subject areas. (This year most training will be made available online). It requires that the project be the original creation of the applying teacher.

Teachnet continues to develop its online database of the innovative projects for all teachers and students. Its target is to publish fifty projects annually. So far 200 projects have been published across the breadth of the Irish curriculum and these are freely available to all. At present there are nine projects for physics at Leaving Certificate covering such areas as electricity, electromagnetism, X-rays and radioactivity. There are two chemistry projects in the area of Junior Certificate Science.

Perhaps you would consider doing a project for Teachnet. Start by going online and looking at the Teachnet site at **www.Teachnet.ie**

When should you apply?

Many of this year's 50 projects applications have received the go-ahead recently. Nevertheless, if you submit an application as soon as possible there is every chance that you will get into this year's list.

Some advice from one who has been round the block twice.

Don't do it for the money!!! It's a very steep learning curve. Nevertheless there is a great sense of professional development about building your own web resource.

Where can I get more information?

Contact John Hurley or Michael Hallissy at Teachnet Ireland,St. Patrick´s College, Drumcondra, Dublin 9
Email: info@teachnet.ie Tel: 01-4806200

Encourage your colleagues to avail of the resources that are freely available there for use across the breadth of the Irish curriculum.

David Keenahan,
Gonzaga College, Sandford Road, Dublin 6

If you would like to contribute an article for the next issue of the magazine, or if you have tried different teaching techniques and would like to contribute to the next issue of the magazine please contact us.

Contact details are given on the back page

A difficult concept to get to grips with- "surface area"

l was recently watching the Television when a programme about the Luisitania (Sister ship of Titanic?) came on. When l heard one of the theories about the second explosion (A coal dust explosion) which sank the ship, l immediately thought of a "Real Life" way to explain the effect of Surface Area on the rate of a reaction. Try and light a lump of coal (small surface area) in a fire – it takes a while for the fire to get going (but lasts a long time). Throw coal dust on a fire and "watch the sparks fly" (Large surface Area) – the oxygen can "get in" and support combustion but the reaction is over very quickly. lf the starting masses of lump versus dust are the same at the beginning you can draw a graph showing the difference in slopes (and link into the graphs in the textbooks). This analogy can be then extended by a demo of the Lycopodium Bomb – only this time paint the can and put the name "Luisitania" on it. Ah the joys of T.V.!!!

John White, St. Dominic's College, Cabra, Dublin 7

Press Release Issued by: IBEC's PharmaChemical Ireland For immediate issue: Friday, 13 May 2005

People Key for Future Success of Pharmachem Sector in Ireland

The continuous expansion of the Pharmachem industry is resulting in the demand of more scientifically skilled employees. R&D is fast becoming the central focus of a large number of the companies based here. Speaking at their AGM the chairperson of PharmaChemical Ireland, IBEC's body representing the Pharmachem industry, Padraig Somers, said: "16 of the top 20 pharmachem companies in the world are based in here in Ireland. However given the spiralling costs of bringing a drug to market combined with the threat of the newer economies if we are going to continue to retain this lead position in the pharmachem sector Ireland must attract investment in R&D."
The pharmachem industry invests heavily not only in training and upskilling its existing personnel but also invests significantly throughout the education sector from primary through to third level.

In a move to promote stronger industry/education linkages PharmaChemical Ireland has launched an Education Award to recognise its members who best contribute to science education in Ireland. The inaugural award goes to Janssen Pharmaceuticals Ltd. who have developed a science education programme over the last 10 years with over half of their staff directly involved in the programme. Janssen are active participants in programmes like Junior Achievement, STEPS and the Young Scientist exhibition, in addition to close liaison with their local community. It is envisaged that, like Janssen, future recipients will not solely be measured by the amount of sponsorship given towards science education events but will include activities like school tours, student placements and other education liaison initiatives.

"Each award consists of a bursary to be used for future science promotion initiatives" says Dr. Mark Glynn, Education officer with PharmaChemical Ireland. There are two categories of awards: internal and external. The internal awards will be restricted to members of PharmaChemical Ireland whereas the external awards will be for any other individual, company or organisation that has contributed to science education in Ireland. "By recognising the contributions of both companies and individuals to science education it is envisaged that this award will encourage others to promote the study of science," concluded Glynn. Dr. Peter Childs, University of Limerick is the first recipient of the external award for his continued contribution to science education in Ireland

PharmaChemical Ireland director Matt Moran said "For some years now the PharmaChemical Ireland has actively promoted the study of science in this country – as Irelands young scientists are the life blood of our industry." The pharmachem industry, recognise the importance of supporting the education sector and are the only industry sector to have a full time education officer. Through PharmaChemical Ireland the sector have increased and coordinated their promotion on a local and national level. "Industry is acutely aware that these efforts will have minimum effect if significant investment is not undertaken by the government e.g. upgrading of laboratory facilities, provision of laboratory technicians etc.. Ensuring that our nation is highly educated is at the end of the day the responsibility of the government," says Dr. Glynn.

These awards will be made on an annual basis, at PharmaChemical Ireland's AGM, this year in the Rochestown Park Hotel, Cork on Friday May 13.

Further information:
Dr Mark Glynn, Education Officer, PharmaChemical Ireland, Ph: 01-6051581, 086 3816048
Queries: Arnold Dillon, IBEC Press Officer, Ph: 01-6051638, 087-6471824

Pharmachemical Ireland is the only industry sector with a full-time education officer dedicated to the promotion of science throughout the education sector since 2002. For further information on careers in Science please contact ***mark.glynn@ibec.ie***

PharmaChemical Ireland have produced a Transition Year programme freely available to all schools. This programme consists of four modules including: Forensic Science, Sports Science, Cosmetic Science and Microbiology.

Pharmachemical Ireland are running a series of careers evenings throughout science week (7th – 14th of November '05) across the country to highlight the opportunities available to parents and students in studying science.

Pharmachemical Ireland have developed a brochure for post-primary schools "opportunities in the Pharmachem industry". In addition to general career information this brochure gives details which members facilitate school tours. Student and teacher placements etc. This brochure is available on our web site ***www.pharmachemicalireland.ie***

Pharmachemical Ireland have a complete section of their web site www.pharmachemical.ie dedicated to science promotion and education.

Teaching Physics in the Early Years

Teaching a subject at Leaving Certificate for the first time can be a daunting experience especially if you are "fresh" out of college. This is my fourth year teaching and my third year teaching the new physics course. Here are some tips which I have found useful and I hope they will benefit you especially if you are teaching physics for the first time or if you are still in the early years of teaching the subject.

Practical Tips

1. Make sure to try out the experiments yourself a few days beforehand if possible. This gives time to phone a colleague to find out what's going wrong.
2. I found the experimental methods on the Second Level Support Service physics website www.slss.ie (also on the Applied Electricity CD) very useful when doing the experiments. These ones always work.
3. It is a good idea to take photographs of experimental set ups while at in-service.
4. Always keep a spare set of log tables on your desk.
5. Always insist on students removing the batteries from Dataloggers after use.
6. It is advisable to order equipment early in the year as it can take quite a while to arrive.

Theory Tips:

1. Use CDs, PowerPoint Presentations and Applets to help explain difficult concepts or experiment methodology. This can save you time, writing same on blackboard. A Data Projector is essential for this.
2. Use the internet as much as possible. There are some excellent Applets for teaching concepts such as the Doppler Effect and Microwave ovens. Get transition science students to surf the internet, by going into Google and typing in "physics applets", to find and evaluate useful sites for selected topics.
3. Always refer to the syllabus, especially when doing exam questions. Many sample papers have questions which are not relevant to the syllabus. Most of these questions are just copied and pasted from the old course exam papers.
4. Try to get students doing exam questions as early as possible in the first year of the course. Students realise early on the allocation of marks and the depth of detail required.
5. To help motivate and excite students about physics it is helpful to bring transition year students to The Young Scientist Exhibition and Science week.
6. During the Summer while you are job hunting go online (**www.slss.ie**) to check the courses on offer for the coming year or get Physics Resources that would have been given during previous in-services and check out.

Support Available

- Get in contact with local physics teachers, can be very helpful for advice, solutions and equipment. This can be done by joining the local branch of the ISTA or enquiring about Physics teacher networks from your local Education Centre.
- Get in contact with the Physics Support Service. I found the Induction modular course very useful for building confidence with using physics equipment, networking with colleagues and sharing resources. It also helped to answer any questions I had.
- Attend Frontiers of Physics, can be great to pick up new demo's and lab tips.
- Find out where the nearest Education Centre and 3rd Level College is to you. Contact the Physics Department in NUIG who have a very good selection of videos suitable for the Leaving Cert. physics course.

Above all, enjoy teaching the subject yourself and this will pass on to your students. (some of them anyway). Give students a positive experience of physics and relate it as much as possible to everyday life.

Jacinta Fahy, Cashel Community School, Co. Tipperary

Áiseanna Fisice

Tá mé mar mhúinteoir Fisice le sé bliana déag anuas i meánscoil lán-ghaelach agus féadaim a rá gur tháinig feabhas iontach ar líon na n-áiseanna atá ar fáil tré mheán na Gaeilge le roinnt blianta anuas, buíochas le Máire Ní Shlataire agus an seirbhís tacaíochta Fisice.

Chomh maith lena h-áiseanna seo bainim féin úsáid as sraith leabhair darb ainm 'Fisic Shinsearach' (le Matt Hussey) atá an-úsáideach mar fhoinse ceisteanna don ard-chúrsa, leabhar eile de chuid Mhatt Hussey ná 'Nod Don Eolach' a bhíonn an-mhaith mar leabhar thagartha go h-áirithe sa chuid E.T.S. an chúrsa.

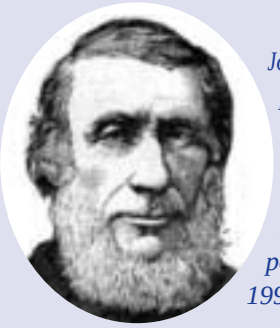
Leis an oiread sin athraithe ag tarlú san Eolaíocht agus san Teicneolaíocht, faoi láthair, bíonn gá le athnuachain a dhéanamh ar ár gcuid téarmaíochta ó am go chéile, measaim gurb é an suíomh idirlíona, www.acmhainn.ie , an áis is fearr faoi choinne sin.

Mar is eol dúinn uilig ,bíonn sé deacair, in amanna, suim na ndaltaí a mhuscailt sa bhFisic mar leigheas ar seo is fiú iad a thógáil chuig na saotharlainn Fisice i gColáiste na hOllscoile, Má Nuad,cuirfidh an Dr.Niall Mc Keith fearadh na fáilte romhaibh ansin.

Go n-éirí go geal libh agus sibh ag craobhscaoileadh soiscéal na Fisice!

Daithí Ó Máirtín, Coláiste Chilliain, Bóthar Nangoe, Dolcáin, Baile Atha Cliath 22

John Tyndall (1820-1893)



John Tyndall was one of the great public figures of nineteenth-century British science. As a researcher, an educator, a lecturer and a controversialist, he played a major role in the professionalization and popularization of science (Attis 1999c).

Born in Leighlinbridge, Co. Carlow, on 2 August 1820, John was educated locally and, at the age of 18, joined the Ordnance Survey in Ireland. After three years, he was in 1842 chosen to transfer to the English Survey, but he was summarily dismissed in 1843 following a protest about working conditions of Irish assistants (Burchfield 1981,2). After returning home for a spell, he worked in England as a surveyor for the railways, and then, in 1847, became a mathematics teacher in Queenwood College in Hampshire. His interest in science stimulated there, he transferred to the laboratory of the famous Robert Bunsen (1811-1899) in Marburg, Germany, where he obtained his PhD within two years. After a further year in Germany, he returned to England in 1851, but was unsuccessful in applications for academic posts in universities in Toronto, Sydney, Cork and Galway.

His abilities as a lecturer, however, led to his appointment as Professor of Natural Philosophy at the Royal Institution in 1853. He was to remain there for a further 34 years, succeeding Michael Faraday (1791-1867) as Director in 1867.

> *Almost from the moment he arrived in London, Tyndall became an evangelist for the cause of science. His experience in Germany had convinced him that traditional British education, with its emphasis on the classics and rote mathematics was hopelessly outdated and detrimental to the good of the country. Thus, his lectures at the Royal Institution were not merely to entertain or even to instruct his audience, but to awaken them to the beauty and importance of science (Burchfield 1981,6).*

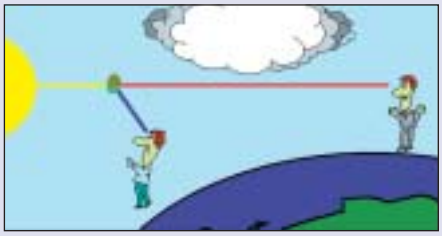
John had wide interests, studying diamagnetism and the magneto-optical properties of crystals. He studied glaciers, solar heat and radiation. He was the first to explain why the sky is blue – a result of the scattering of light of different wavelengths to different extents in the atmosphere. He made the first pollution measurements of the London atmosphere, and was involved in early work on bacteriology. Several scientific phenomena are named after him – including the *Tyndall Effect* and *Tyndall Scattering* (both referring to the scattering of light), *Tyndallimetry* (dealing with the concentration of suspended material in a liquid) and the related Tyndall Cone, and *Tyndallisation* (used in bacteriology) (Walker 1995,1143). His scientific reputation was such that he was awarded honorary degrees from Cambridge (1865), Edinburgh (1866), Oxford (1873), Tubingen (1877), and Trinity College Dublin (1886) (Burchfield 1981,5).

He helped found the famous journal *Nature* in 1869, was a prolific author of books, and played an important part in advancing the cause of science in America (Sopka 1981,193-203). John remained a bachelor until the age of 56, when he married Louisa Hamilton. It was a very happy, though childless, marriage – but it ended in tragedy at Hindhead in Surrey on 4 December 1893, when Louisa mistakenly administered to him a lethal dose of chloral (Burchfield 1981,12).

This article is from *'Physics- a teacher's handbook'*, Dept. of Education and Science.

Why is the sky blue?

A clear cloudless day-time sky is blue because molecules in the air scatter blue light from the sun more than they scatter red light. When we look towards the sun at sunset, we see red and orange colours because the blue light has been scattered out and away from the line of sight.



Tyndall Effect

The first steps towards correctly explaining the colour of the sky were taken by John Tyndall in 1859. He discovered that when light passes through a clear fluid holding small particles in suspension, the shorter blue wavelengths are scattered more strongly than the red. This can be demonstrated by shining a beam of white light through a tank of water with a little milk or soap mixed in. From the side, the beam can be seen by the blue light it scatters; but the light seen directly from the end is reddened after it has passed through the tank. The scattered light can also be shown to be polarised using a filter of polarised light, just as the sky appears a deeper blue through polaroid sun glasses. This is most correctly called the Tyndall effect, but it is more commonly known to physicists as Rayleigh scattering--after Lord Rayleigh, who studied it in more detail a few years later. He showed that the amount of light scattered is inversely proportional to the fourth power of wavelength for sufficiently small particles. It follows that blue light is scattered more than red light by a factor of $(700/400)^4 \approx 10$.

Dust or Molecules?

Tyndall and Rayleigh thought that the blue colour of the sky must be due to small particles of dust and droplets of water vapour in the atmosphere. Even today, people sometimes incorrectly say that this is the case. Later scientists realised that if this were true, there would be more variation of sky colour with humidity or haze conditions than was actually observed, so they supposed correctly that the molecules of oxygen and nitrogen in the air are sufficient to account for the scattering. The case was finally settled by Einstein in 1911, who calculated the detailed formula for the scattering of light from molecules; and this was found to be in agreement with experiment.

This article by Philip Gibbs is from the website **http://math.ucr.edu/home/baez/physics/index.html**

The Blackrock Castle Observatory, Cork

Cosmos at the Castle

'Science isn't just a subject at school, it is a human endeavour'.

This is just one of a number of core concepts at the heart of an inspirational new project in Cork city which sees the re-development of local landmark Blackrock Castle as a centre of excellence in scientific research, outreach and communication. The project entitled **'Cosmos at the Castle'** is a joint venture between Cork City Council, Cork Institute of Technology and a private benefactor to establish Blackrock Castle as Ireland's first robotic astronomical observatory.

The project has been developed in response to the growing recognition that for sustained economic growth and the development of a knowledge-based economy, increased investment in research and innovation infrastructure is required. *"As part of this investment, children and adults should be encouraged to become more interested in science, engineering and technology"*, says Dr. Niall Smith, who leads the scientific team from CIT who will develop the facility as a research centre. Central to the project is the concept that if you want to foster interest in science, engineering and technology; then research, outreach and communication must be integrated in an inspiring way. For this approach to be successful, thereby affecting children and adults positively, an inviting environment where people can part-take in science and discovery must be created. *"In such an environment we can begin to show the value of science and enable people to experience it for themselves firsthand, making them the scientist as distinct from an observer"* says Dr. Smith. Key to any such initiative is selection of an interesting method of delivery. *"Astronomy is the perfect candidate … it has long been a subject that captivates and inspires us to question the world in which we live, a critical component in any field of scientific endeavour"*, argues Stephen O'Driscoll, project scientist at the observatory. Astronomy's broad appeal provides a unique medium through which important ideas in science can be conveyed, and is a scientific field which has been at the forefront of technological development and innovation, particularly in computing and optics.

What will be truly unique about this facility however is the manner in which children and adults will be allowed to interact with science. Using the technical expertise of the Astronomy and Instrumentation Group located in the Dept. of Applied Physics and Instrumentation at CIT, two robotic telescopes will be developed for the project. Robotic telescopes are the latest generation of telescopes being developed by scientists for astronomical observations. Robotic telescopes can be of any size and are designed to "think for themselves" meaning that they can operate without human intervention. At the Blackrock Castle Observatory, young students and members of the public can use the castle's telescopes themselves, controlling the systems and requesting images from them via the internet. This for example, will allow children studying science at school, to log on during class, plan observations, take images and study objects in space. This is seen as an important means of empowering children in science, shifting the emphasis that science is just another subject at school to it being a human endeavour in which they have a right to be involved. This promotes the concept that children are scientists during science class and not just students; we have as much to learn from them as they do from us. To complement the knowledge gained by students through their activity in science using the telescopes, an interactive exhibition centre is currently being designed for the site. The exhibition will provide students with up-to-date information about a number of areas in astronomy, including the areas of research conducted by the castle's scientists on extra-solar planets, near-earth objects and other exotic astronomical objects such as black holes. It is envisaged that the castle's exhibition centre will become a focal point for the general public who can visit the centre and experience the castle's unique environment. The observatory will also house modern audio visual facilities for meetings, conferences and corporate events, and a restaurant situated in its courtyard.

For further information visit:
www.physics.cit.ie/blackrock,
or Google '**Blackrock Observatory**'.

A Brief History of Fireworks

by Dennis Loney

In an 8th century work with the startlingly direct title "Book of Fires for Burning the Enemy", Marcus Graecus (a.k.a. Mark the Greek) reported on a black powder comprised of potassium nitrate, sulfur, and charcoal—the first modern high-energy composition that today we call gunpowder. The Greeks used this mixture (and a similar one that generated flames and dense fumes when ignited) almost exclusively in military applications—in both sea and land battles—and changed the face of military science.

But the history of gunpowder does not begin with the Greeks and their enemy burning fires.

It is thought that thousands of years ago, some smarty in China (or perhaps India) discovered that this potassium nitrate, sulfur, and charcoal mixture burned with a bright orange flash and plume of smoke upon ignition—perfect for scaring away evil spirits.

Subsequent smarties fiddled with the black powder and discovered that particle size and mixture ratios affected the performance of the powder. They also found out that placing the powder in a paper tube would noisily explode upon ignition, a precursor to firecrackers. They also discovered that if the powder were arranged in a thin line, it would quickly burn along that trail, a precursor to fuses. And finally, if the powder were compressed in a tube with a sealed end, the hot gases from the ignited powder would propel the tube happily skyward, a precursor to fireworks.

By the 10th century, the Chinese were adept at utilizing the black powder mixture and developed rockets and other types of fireworks. By the early 13th century, the black powder mixture found its way to Europe. Roger Bacon, the English scientist, published a formula for preparing what he called the "thunder and lightning" composition.

Black powder was used as a propellant for cannons in the 14th century. During the 15th century, likely by accident, a major innovation in black powder technology occurred. It got wet. Once thought this spoiled gunpowder (because it formed hard cakes), another smarty realized that if they ground up the caked powder, it was superior to the blended, loose powder. During the same century, Russia began producing quality black powder to arm Ivan the Terrible's 200 cannons. In times of peace, Russia turned its attention to the more artistic endeavor of making fireworks. And through the centuries, advances in pyrotechnic mixtures for military purposes—cannons and rifles—progressed simultaneously with advances in fireworks.

The next major advance took place in the 1780s. Claude Berthollet, the great French chemist, prepared potassium chlorate ($KClO_3$) to use as a replacement for potassium nitrate. Although $KClO_3$ had a propensity for causing deadly explosions when blended with sulfur, metal powders, and ammonium salts, it did add color to the pyrotechnician's arsenal.

Pyrotechnic technology really, um, took off in the 19th century. Pyrotechnicians started putting metal chlorides in the fireworks to produce a dazzling array of color. Barium chloride produces a brilliant green, strontium a vivid red, and copper compounds a whitish-blue. There were some setbacks though. Beautifully named chemicals like Paris green (copper acetoarsenite), calomel (mercurous chloride), and realgar (arsenic sulfide), proved to be hazardous to the pyrotechnician's health.And aside from tinkering with visual effects (the star, the smiley face, the sparkler, etc.) fireworks have stayed pretty much the same until recently.

In the last couple of decades, fireworks designers have used a magnesium-aluminum alloy know as magnalium in their fireworks, which brightens and deepens the colors, almost to fluorescence—which I've heard not only frightens away the evil spirits, but attracts the good ones.

HAMILTON 2005

Launch of Science 2005

The full calendar of Einstein Year and Hamilton Year events can be found on http://www.science.ie/ (click on the Science 2005 logo).

A copy of the list of events can also be obtained from Niamh Morris (Email n.morris ria.ie tel. 01 - 638 0922).

einstein year

Frontiers of Physics 2005

National Commission for the Teaching of Physics
and The Institute of Physics in Ireland

Teachers of Physics Annual Conference

A day of lectures, demonstrations, and workshops
for Post-Primary teachers of physics at all levels
Saturday, 24 September 2005
Department of Physics,
University of Limerick.

CONFERENCE OBJECTIVES

- To inform teachers of the exciting and innovative work at the frontiers of Physics that is being carried out in Ireland
- To provide teachers with examples of simple and inexpensive physics demonstrations
- To inform teachers of the latest developments and resources available in physics teaching.
  This will include the new IoP Supporting Physics Teaching 11-14 initiative.

The assistance of the Second Level Support Service (SLSS) with this conference is greatly appreciated
Details will be sent to all Post-Primary schools in advance of the conference.

Or contact

Dr. George McClelland, Head, Department of Physics, University of Limerick. **george.mcclelland@ul.ie**
Paul Nugent IoP Network Coordinator: **paulnugent@eircom.net**

SCIENCE on Stage

Science for Humanity

CERN, Geneva
21-25 Nov 2005

Are you interested in new ideas for teaching science from all over Europe?

Are you willing to share the ideas of Irish science teachers with teachers from other countries?

Did you use any of the ideas from the Physics on Stage2 booklet?

If the answer to any of these is YES then read on !

You might be one of the enthusiastic teachers we are looking for to travel with all expenses paid as part of the Irish delegation to a European extravaganza of Science teaching to be held in CERN in November 2005. The purpose is to share all the best ideas about teaching science amongst European secondary school teachers.

In addition, there will be a topic for each day of the festival, around which presentations, demonstrations and workshops will be themed.

The topics will be:

- Einstein Day
- Sustainability Day (e.g. environment, climatology, oceanography, energy)
- Space and Astronomy Day
- Life Sciences Day (e.g. health, biotechnology, genetics)
- Science & Technology in Society Day

For the last event the Department of Education and Science provided paid cover for the teachers to attend and this has been applied for again.
The *Physics on Stage3* booklet will be distributed to teachers by the JSSS and SLSS Physics.

If you are interested please contact without delay irelandsos@gmail.com or
"Science on Stage", School of Physical Sciences,
Dublin City University, Glasnevin, Dublin 9.

Ireland Science on Stage Committee:

Eilish McLoughlin, Alison Graham, Paul Nugent, Sean Fogarty, Vida Given, Siobhan Crowe, John Hennessy, Michael Grehan

It's not all fun and games...honest!

Kevin McCormick, Moyne Community School, Co. Longford.

Sometimes the demos for physics can be a little bit far removed from what students may be used to seeing in their everyday lives. The following is a list of some of the gadgets and gizmos that I've found to grab the attention of my students. The list here is only a sample of what is available and unfortunately many others can only be on my "wish list". The equipment below could possibly be used in Junior Cert, Leaving Cert, and Transition Years or in all three.

The three sites below are the sources of where this equipment can be purchased over the Internet. Of the three the Educational Innovations site was the one I found to be the best, and Klein Bottle to be the best value for the spouting bowl. I found there were problems with the PayPal method of paying the 4physics site so I ended up wiring the money through at an extra cost. All guide prices are in US dollars and are taken from the Educational Innovations catalogue unless otherwise stated. The addresses of the sites are as follows:

http://www.teachersource.com/ *(Educational Innovations site)*
http://www.kleinbottle.com/ *(Chinese Spouting Bowl-well worth a look and cheapest here!)*
http://www.4physics.com/

Mechanics

Astro blaster: Several balls are threaded on a wire. When the apparatus is dropped straight downward onto a hard surface, the top ball can rebound to a height equal to five times the original drop. Leads into an interesting discussion of what's happened to the Law of Conservation of Energy not to mention momentum. Potential energy and kinetic energy calculations could also be done. **Guide price: $4.95**

The Squiggle Ball: Place this ball on your classroom floor and watch it explore your entire room. The ball's transparent case allows you and your students to view the inner workings consisting of a specially weighted motor. A nice way of showing the difference between velocity and speed.

Guide price: $7.95

Magnets

Buzzing Magnets: Toss the two hematite magnets into the air! As they collide and fall, they produce a screaming, clattering sound, much like a Cicada or high voltage sparking. Or, place them both on a low friction surface about 15 cm apart. As you turn one, the other will turn. If you spin one fast, you can observe coupling with the other.

Guide price: $11.95

Optics

Micro Light Wand: Uses three individually coloured LED's, one for each of the primary colours of light (red, green, and blue) to produce a series of coloured lighting effects. Instructions are included. Because it is completely controllable, this device can be used in place of a 'light mixing box' for many experiments and lessons. Due to its size it only works when very close to a sheet of paper, if used in a bright room. **Guide price: $11.95**

The mirage: Creates a 3-dimensional real image. Simply place any small object in the Mirage. Instantly, incredibly, it appears ABOVE it, in full 3-dimensions. Study this image from all sides. You can even see its reflections! You can shine light on it! But reach to touch it . . . your fingers go right through. It is one of the most baffling, attention-getting conversation pieces you'll ever own. Great for teaching about virtual images.

Guide price: $29.95

Current Electricity

The Energy ball is completely self-contained and requires no additional batteries or energy source. It is often used to demonstrate closed and open circuits by having two students each touch a different electrode and then activate the device by holding hands. **Guide price: $3.25**

Heat

Ice melting blocks: Place an ice cube on each of these two identical looking black blocks at room temperature. One ice cube instantly begins to melt and is totally gone in about 90 seconds. The other ice cube shows no evidence of melting whatsoever. Great for showing the difference in heat conductivity in different materials.

Guide price: $18.95

Touch and See Square: Place your hand on this black plastic square and create a thermal handprint. Each colour represents a different temperature. Can be used over and over again.

Guide price: $8.95

Waves and Sound

Chinese Spouting Bowl: Fill the 38 cm diameter bowl halfway with water and rub the handles vigorously with wet hands. The resonance set up within the bowl is powerful enough to actually 'spout' water up and out of the bowl!

Guide price: $ 125 for large bowl from the Klein Bottle website, $163 including post+packaging

Electromagnetism

Dynamo Hand-Powered Flashlight: Change kinetic energy from your hand into light energy. This hand-held "dynamo" is completely visible. It clearly demonstrates how moving an electrical conductor through a magnetic field - a discovery made by Michael Faraday, can produce electrical energy.

Guide price: $11.95

Secondary Teacher Assistant Researchers (STARs)

Science Foundation Ireland (SFI) is a research funding agency which invests in academic researchers and research teams in Ireland who are most likely to generate new knowledge, leading edge technologies, and competitive enterprises, in particular in the science and engineering fields underpinning two broad areas: Biotechnology and Information and Communications Technology.

Amongst its activities, SFI strongly encourages research collaboration between SFI funded scientists& engineers and teachers. The Secondary Teacher Assistant Researchers (STARs) programme is an initiative through which teachers can receive support to conduct research within an SFI-funded research team during school holiday periods for up to eight weeks. Teachers receive an equivalent of up to two months' salary for their participation in the programme. The goal is to help teachers renew their interest in science as researchers, connect them with faculty in the universities and institutes of technology, and enhance the teaching of science across the educational system. The primary aim of the programme is dissemination of new skills and knowledge to teachers which can be passed onto their students - the scientists & engineers of the future.

The Irish Science Teachers' Association (ISTA) has been closely involved with SFI in the development and promotion of this programme. In 2004 SFI funded 29 STARs and aims to fund up to 50 STARs in 2005.

STAR ALERT!!!

If you would like to be a STAR – Secondary Teacher Assistant Researcher – funded by Science Foundation Ireland in the summer of 2006 make sure that you check out the website **www.sfi.ie** , click on the STAR link and forward your email details. This exciting programme is open to all science teachers and teachers of associated disciplines. You will get the chance to work alongside the best investigators in Ireland and be part of cutting edge research. Don't miss out on a golden opportunity and forward your email contact details today so that you can be kept informed of the possibilities open to you! The closing date for applications for 2006 is the end of September 2005.

Using ICT to enhance Learning in the Physics Classroom – my experience

Admit it! We all need a nudge now and then. Yes, your pupils seem to be doing well. Their results are surely indicative of this and so you assume that you are a reasonably good teacher. But every so often, perhaps during a moment of reflection and personal assessment, you feel that you could extend yourself and enhance your methodologies a little (or a lot). But of course that old adage - if its not broke don't fix it - intrudes and tells you that all is well. You are tempted to carry on as before. Been there and done that!

Then an e-mail arrives with an invitation to participate in something coded SL0415. Apparently it is a course entitled *"Using ICT to enhance Learning in the Physics Classroom"*. I signed up.

The course was offered to teachers of physics at second level and its aims were to:-

- Explore learning strategies with ICT tools such as PowerPoint, CD-ROMs, Internet Applets and Datalogging to engage the learner.
- Explore practical ideas and strategies for communication physics.
- Develop experiental teaching skills to enhance teaching and learning in the physics classroom.
- Explore and share experiences of best practice with the group.
- Support networking between teachers of physics.
- Undertake some action research in teachers' own work situations, reflect on practice and document the outcomes.

I attended the course which took place in the Kilkenny Education Centre. This proved an ideal venue with excellent facilities and being just off the ring-road was easily accessible. Our group, of approximately 14, came from Leinster and East Munster. The course consisted of two full day sessions, which were six weeks apart to allow for action research and one evening session, six weeks later.

A typical meeting began with group feedback on the ideas generated or on action research undertaken from the previous session. Internet sites identified as being relevant were evaluated online. New or unusual teaching aids or items of equipment – often not sourced from the usual catalogues – were demonstrated. We communicated between meetings by email which allowed support material to be exchanged, evaluated and customised.

I was most impressed by the PowerPoint presentations that many of my fellow physics teachers had prepared on Leaving Cert course topics and learned from their shared experiences of using them in the classroom. Most of the presentations included animated items and applets from the net which rekindled the 'wow' factor in physics for me. It was a bonus that all the presentations generated were compiled and circulated to course participants.

I'm glad I participated in the course and valued the opportunity to network with like minded colleagues. I am currently customising the resources generated for use in my physics classes and hope to continue networking and sharing progress with the group.
This course has encouraged me to continue using software in teaching, I highly recommend it.

Kieran Dennehy, CBS Youghal, Co Cork

Answers to questions on school exams...

"Nitrogen is not found in Ireland because it is not found in a free state."

"To collect fumes of sulphur, hold a deacon over a flame in a test tube."

"A fossil is an extinct animal. The older it is, the more extinct it is."

"When you smell an oderless gas, it is probably carbon monoxide."

"Blood flows down one leg and up the other."

"Dew is formed on leaves when the sun shines down on them and makes them perspire."

"Water is composed of two gins, Oxygin and Hydrogin. Oxygin is pure gin. Hydrogin is gin and water."

IDEAS FROM A STAR

Last summer I was one of the first cohort of "Stars" teachers - an initiative set up by Science Foundation Ireland to give Science Teachers the opportunity to work as Assistant Researchers in SFI funded research groups. For me the benefit was not so much the research in which I was involved as the opportunity to pick up on ideas and resources which specifically benefitted my classroom teaching.

Working with Eoin O'Reilly, of the Photonics theory group at the Tyndall National Institute in Cork, I was able to learn about current research and update my own knowledge of lasers and LEDs and to think about ways of incorporating laser and LED demonstrations into the new Science syllabuses. I also had the chance to work out extended experiments in the wider curriculum including Transition Year and the Young Scientist Exhibition.

There are certainly improvements that could be made to the mandatory experiments in Physics. Fig 1 opposite has worked well for me as part of the I vs V experiment substituting an LED for a normal diode.
Although not listed in the syllabus try using a spectrometer to view the narrow continuous spectrum of an LED.

A couple of possibilities for the demonstration experiments include "UV beads" that change colour when exposed to UV and a "colour wand" for mixing the primary colours. Both these products were sourced from Educational Innovations based in the US.

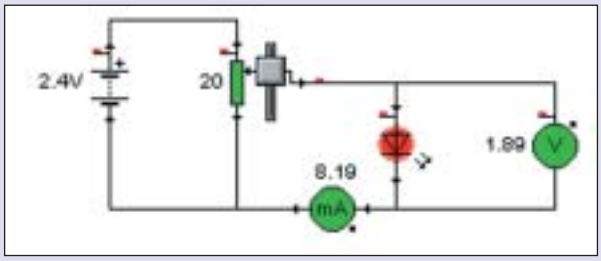


Fig 1: Alternative layout and equipment for V vs I.
LED is less easy to abuse, and shows students when current flows;
2.4V provided by NiCd rechargeables- well worth investing in class sets;
2.4V from 2 AA in a double holder from stockists.*
Old style school rheostat works perfectly.

I have taught "Exploring Electronics" to Transition Year students for four years and was keen to redesign my scheme of work to incorporate LEDs and optical fibre communication. So I soldered a variety of flexi strand components and designed worksheets for use with both the components and "crocodile clips" a widely used software package. The increased practical activity has made the module a more effective learning experience for the students.

The components box (see fig 2) I now use facilitates resource management, The knock on effect for Leaving Certificate Electricity work has been immense. Any time I want to get the students to experiment I just whip this out.

I also worked to develop a reliable optical fibre phone system as an alternative to the "madlab" circuits used in Exploring Electronics. This is being incorporated in a work experience project for Transition Year students at Tyndall as part of their Outreach programme to raise awareness of Science as a career option in its own right.

Working with our school Music department we supported a Young Scientist project which was presented at this year's Exhibition. The students sampled several light sources to determine if they were flickering. The frequency of the intensity change was converted to sound - *"Making Music From Light"*

Fig 2: Organising components for everyday use in school

During the web based searches for ideas and resources I repeatedly chanced upon applets built by teachers, students, researchers and enthusiasts. It became evident that there was an almost limitless resource available to teachers (with on-line facilities in their laboratories). Since the summer I have put together a catalogue of some of the best web sites which communicate concepts in Physics and Chemistry to students in a form that is unmatched by text or talk.

I invite you to try searching for yourself: an example is given below. Try any word or combination of a physics/chemistry nature (eg: ***photoelectric effect***)

Go into **google**
Type in **lens applet**
Click on the first find - if you like it -
Save it in ***favorites*** in a folder called ***optics applets***
If not try the next find. The first *hit* at the moment is excellent.

It was certainly daunting to enter a working environment where the vast majority of employees were post grads (I had not worked in a third level science institution since graduating in 1984). In fact I worked with two other secondary teachers (also Stars) and students, professors, technicians and administrators. After a couple of days coming to work felt very normal!
Certainly, last summer was an experience - if you are looking to try something different this is as far from superintending or marking as you can get and it is much more invigorating.
And SFI will double your salary!
If that doesn't tempt you…..

CONTACTS

If you are interested in these or other resources developed or might be interested in finding out more about being a Stars researcher over the summer e-mail me at
mneaves@eircom.net
For information on current Stars projects visit:
www.sfi.ie and click on the "**Stars**"

Question From the Classroom: Deadly Poisons

Bob Becker

Q: What is the most deadly poison in the world?

A: The answer to your question depends on how you define "poison" and what you mean by "most deadly". You might be tempted to define a poison as being any chemical that can cause death, but this is probably not a very good definition. It would have to include water, since drowning accounts for nearly 4,000 accidental deaths each year in the United States, yet it is doubtful that anyone would ever think of water as a poison, since we need to drink it for our very survival! Webster's defines poison as "a substance that through its chemical action usually kills, injures, or impairs an organism." This definition rules out water but certainly includes a vast number of compounds for which human exposure, even at very low levels, can be fatal.

The words "most deadly" are also open to interpretation. Does this refer to the substance that is responsible for the most deaths each year, or the substance that requires the smallest dose to cause death? If one is referring to the substance that causes the most deaths worldwide each year, the poison would have to be tobacco. It has been estimated that 500,000 people die each year of tobacco-related illnesses in the United States alone, and 4–5 million worldwide. No other poison even comes close to these numbers.

Tobacco is a chronic poison; repeated exposure to it over the long term kills. If one decides to ignore the actual death toll caused by a poison and focus instead on its sheer potency, then we need to learn how acute toxicity is measured. The most common method for identifying the toxicity of a substance is LD_{50}, which stands for lethal dose–50%. The LD_{50} indicates the mass of the poison per kilogram of body weight necessary to kill 50% of a given population. Because individuals in any population will have a range of tolerance levels to any given toxin, it would be difficult to quantify LD_{100} (the dose that would kill 100% of the population). LD_{50} serves as a sort of average lethal dose. It is important to point out that these toxicity tests are not conducted on humans (obviously), but instead on laboratory animals such as rats and rabbits. One could certainly question how ethical such research is, or even how applicable it is to humans. Who's to say that a substance lethal to rats would necessarily have the same effect on humans?

Nevertheless, LD_{50} yields valuable information, especially when it comes to making decisions about what compounds to allow in a certain insecticide or building materials. It is also important to point out that the LD_{50} of a substance depends quite a bit on the route of exposure: by inhalation (breathing in), absorption (through the skin or eyes), oral ingestion (swallowed), intravenous (injected into the vein), intramuscular (injected into the muscle), subcutaneous (injected under the skin), or intraperitoneal (injected inside the membrane that lines the interior wall of the abdomen).

If one looks up the LD_{50} for arsenic, for example, it is listed as ORLRAT LD_{50} 763 mg/kg and IPR-RAT LD_{50} 13 mg/kg. This means that a rat ingesting 763 mg (about $^3/_4$ of a gram) of arsenic per kilogram of its body weight would have a 50:50 chance of dying. A rat having only 13 mg of arsenic injected intraperitoneally would have this same risk. If this can be applied to average (75 kg) humans, it would take 57,000 mg (57 g, about 2 oz) of ingested arsenic to kill off an average human. As it turns out, compounds of arsenic are considerably more lethal than the element itself. The ORL-RAT LD_{50} for diarsenic pentoxide (As_2O_5) is only 8 mg/kg—meaning that it would only take 600 mg (0.6 g, about half the mass of a dollar bill) of ingested As_2O_5 to kill off a 75 kg human.

As_2O_5 is toxic, but dioxin (often labeled the world's most deadly poison) is about 400 times more deadly. With an ORL-RAT LD_{50} of only 20 µg/kg, it would only take about 1.5 mg (the mass of an "O" on a printed magazine page) to kill an average human. In comparison, the nerve gas VX has an absorption LD_{50} of 60 µg/kg.

Ricin, a protein found in castor beans that's been associated with recent acts and threats of terror, has about the same toxicity level as dioxin. But all of these toxins would be considered "lightweights" compared to the protein-based botulin toxin, produced by botulinum bacteria and associated with botulism, the most severe form of food poisoning. It's arguably the most deadly poison in the world. With an LD_{50} in the range of 5–50 µg/kg, it is nearly 1000 times as toxic as dioxin.

Institute of Physics in Ireland

Lab in a Lorry

Lab in a Lorry, an initiative for Einstein Year, is a partnership programme between the Institute of Physics and the Schlumberger Foundation. It aims to enthuse the next generation of scientists and engineers by giving young people (11-14 year olds) the opportunity to explore real science through state-of-the-art hands-on experiments *(see **http://www.labinalorry.org.uk/**)*.

Lab in a Lorry will be launched in the Republic of Ireland at the 2005 BA Festival held at Trinity College Dublin (3 - 10 September and continue a tour in Ireland as follows. See **http://ireland.iop.org** for the full tour.

Republic of Ireland Tour

5 - 9 Sept BA Festival, Trinity College Dublin
Volunteers and schools / visitors contact:
Eleanor Cooke, eleanor.cooke@dcu.ie, 01 - 7008977

12 - 16 Sept Waterford Institute of Technology
Volunteers contact: Claire Keary, ckeary@wit.ie, 051 - 302057
Schools / visitors contact: Eleanor Reade, ereade@wit.ie, 051 - 302037

19 - 24 Sept NUI Cork
Volunteers and schools / visitors contact:
Anne Cronin, ae.cronin@ucc.ie 021 - 4903299

26 Sept - 1 Oct NUI Galway
Volunteers and schools / visitors contact:
Gary Gillanders, gary.gillanders@nuigalway.ie, 091 - 492529

New Teacher Network Co-ordinator for Institute of Physics appointed

Ms. Siobhan Crowe from Dominican College in Wicklow, Co. Wicklow has been appointed as the third Teacher Network Co-ordinator for Ireland. She graduated from the University of Limerick in 2001 with a degree in Science Education. She joins Ms. Vida Given and Mr. Paul Nugent who were appointed in 2003. The Teacher Network was established by the Institute of Physics with the aim to provide support for those involved with the teaching of physics at an individual level whether it is to primary children or third level students. The aim is to work in collaboration with partners such as the Second Level Support Service to develop a community for physics teachers to help avoid the feeling of isolation that some teachers may experience being the only physics teacher in a school or an area.

At present the IOP is developing a set of CD-ROMs to help such individuals called Supporting Physics Teaching 11-14. If you would like to be included in the teacher co-ordinators' email lists please contact one of the co-ordinators:

Teacher co-ordinators:
Paul Nugent, St Dominic's High School, Santa Sabina, Sutton, Dublin 13 paulnugent@eircom.net 87 2719349 01 8322200
Vida Given, 94 Beltany Road, Omagh, Co Tyrone V.given@btinternet.com 048 82244676
Siobhain Crowe, Dominican College, Wicklow, jacketgirl00@yahoo.com 087 2500690

Paperclip Physics

Household items such as washing liquid, cardboard, pepper, paperclips, wire, weighing scales, skateboards, CDs and even stiletto heels were used in combination with creative dialogue and dramatic presentation to great effect at the Paperclip Physics competition heats and branch final this year. This is all part and parcel of the way Paperclip Physics communicates the same old physics in new innovative ways.

From 43 teams, which entered the competition throughout Ireland and competed in local heats at Cork Institute of Technology, Dublin City University and Queens University Belfast, 8 teams came through to the branch final at University College Dublin on February 8, 2005. An extremely high standard was evident in all the presentations, and after much deliberation the winning teams were chosen: from Northern Ireland: 'Physics around the Fairground' by Omagh Academy, Omagh, Co Tyrone, and from the Republic of Ireland: 'Surface Tension' by Scoil Mhuire, Strokestown Co. Roscommon.

The winning Paperclip Physics team from the Republic was from Scoil Mhuire, Strokestown, Co. Roscommon. From l to r: Eilish Duke, Niall O'Connor, Marion Kelly, and Andrew Duignan, with their project "Surface Tension".

These two teams went on to the Institute's Paperclip Physics Grand Final, which was held for the first time at the Think Tank Science Museum in Birmingham - a superb venue according to all reports. 13 regional finalists from the UK and Ireland competed, but unfortunately neither team from Ireland took the top prize. This honour went to Altrincham Girls Grammar School in Manchester for their presentation 'How Stars are Born'.

NANOTECHNOLOGY

A.A. Cafolla and E. McLoughlin, School of Physical Sciences, DCU.

As part of his doctoral thesis, Albert Einstein calculated the size of a single sugar molecule from experimental data on the diffusion of sugar in water. His calculation showed that a sugar molecule measures about a nanometre in diameter. At one billionth of a metre (10^{-9} m), a nanometre

- is the length of 10 hydrogen atoms laid side by side
- it is one thousandth the length of a typical bacterium
- one millionth the size of a pinhead
- a human hair is about 80,000 nanometers wide
- a nanometer is about how much your fingernails grow each second
- how far the San Andreas fault slips in half a second
- the thickness of a drop of water spread out over a square metre
- or one-tenth the thickness of the metal film on tinted sunglasses.

The smallest lithographic feature on a Pentium computer chip is about 90 nanometers.

Nanotechnology is, simply put, the science of the very small. Nanotechnologists study the world on the nanometer scale. While there is a commonly held belief that nanotechnology is a futuristic science with applications 25 years in the future and beyond, nanotechnology is anything but science fiction. In the last 15 years over a dozen Nobel prizes have been awarded in nanotechnology, from the development of the scanning tunnelling microscope (STM) by Binnig and Roher (Nobel Prize in Physics, 1986), to the discovery of fullerenes by Smalley, Kroto and Curl (Nobel Prize in Chemistry 1996).

In 1959 the Nobel prize-winning physicist Richard Feynman described the possibility of manipulating matter on a small scale in a speech entitled "There's Plenty of Room at the Bottom." (***http://www.zyvex.com/nanotech/feynman.html***). At that time it was not possible to manipulate single atoms or molecules because they were far too small for the tools available. Thus, his speech was completely theoretical and seemingly fantastic. He described how the laws of physics do not limit our ability to manipulate single atoms and molecules. Instead, it was our lack of the appropriate methods for doing so. However, he predicted that the time would come in which atomically precise manipulation of single atoms and / or molecules would inevitably arrive. Nanotechnologists have developed several techniques, the most notable being **scanning tunnelling microscopy** (STM). One of the defining moments in nanotechnology occurred in 1989 when Don Eigler used an STM to spell out IBM by positioning xenon atoms on a copper surface.

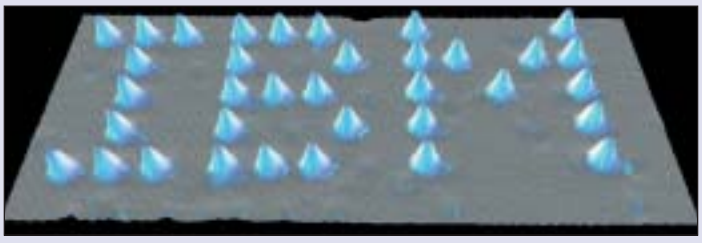
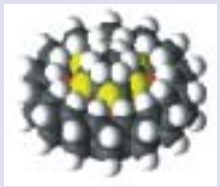


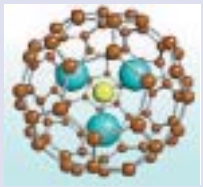
Figure from http://www.almaden.ibm.com/vis/stm/atomo.html

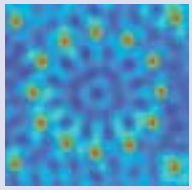
Feynman described such atomic scale fabrication as a **bottom-up** approach, as opposed to the current **top-down** approach used in the manufacture of a remarkable variety of micro-machinery and electronics devices such as the Pentium chip. The top-down approach involves the construction of micro-components through methods such as cutting, carving and moulding. However, the sizes at which we can make these devices is severely limited by our ability to cut, carve and mould. When Feynman gave his talk, computers were just beginning their evolution from room-sized collections of vacuum tubes to the lap-tops we use today. Since then, Moore's law, which predicts that computers will double their speed every two years, has held true. Scientists are not sure how much smaller they can go, they are already reaching the limits of the top-down approach. Bottom-up manufacturing, on the other hand, would provide components made of single molecules and lead to devices with vastly increased computing power, digital storage capability, and communication bandwidth.

Nanotechnology is a fundamental understanding of how nature works at the atomic scale. New industries will be generated as a result, just as the understanding of how electrons can be moved in a conductor by applying a potential difference led to electric lighting, the telephone, computing and the internet. Recent estimates show that over 600 companies are currently active in nanotechnology, from small start-ups to some of the world's largest corporations such as IBM and Samsung. Governments and corporations worldwide are currently spending over $5 billion yearly on nanotechnology R&D. Even more significantly, there are companies applying nanotechnology to a variety of products we can already buy, such as automobile parts and clothing. Nanotechnology is already all around us if you know where to look.
Nanotechnology has shown promise in the fields of medicine and biology as well. Though we are no where near disease-fighting nano-machines, many companies are already in clinical trials for drug delivery mechanisms that minimise side effects on healthy tissue and cells. For example, pulmonary or epidermal methods to avoid having to pass through the stomach, encapsulation for both delivery and delayed release and eventually the integration of detection with delivery in order for drugs to be delivered exactly where they are needed.

Nanotechnology is very real, and is changing the way we think about matter. Though its contributions may seem small at the moment, as funding and manpower continue nano-research will provide new and exciting technologies. Rather than nano-machines or faster computers, the greatest legacy of nanotechnology may well prove to be the unification of scientific and engineering disciplines and the resultant ability of researchers to adapt a multidisciplinary approach to problem solving.







LABORATORY TIPS

DEMONSTRATING LENZ'S LAW, EDDY CURRENTS AND INDUCTION WITH AN ALUMINIUM CAN

A quick accessible demonstration of Lenz's law is to use the set up as shown. The can must be balanced on its ring-pull. As the neodymium magnet is lunged towards the top of the aluminium can it will recoil and as the magnet is pulled away it will move towards the can. With a little practice, the can will begin moving to and fro in sympathy with the magnet's motion.

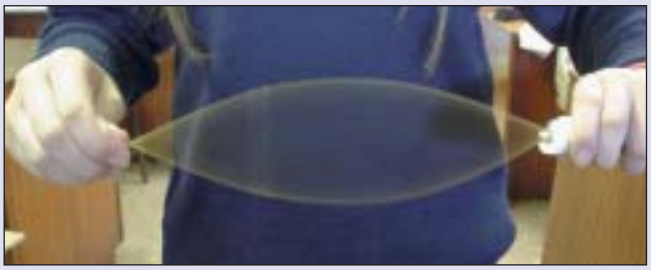
If the can is manually set rocking and the magnet is held stationary along its line of movement the can's motion is quickly dampened due to the induced eddy currents.

These demonstrations may also be effectively shown on an OHP.

Graham Hewston, St. Clare's Comprehensive School, Manorhamilton, Co Leitrim

USE OF HOUSEHOLD MATERIALS TO CARRY OUT PHYSICS EXPERIMENTS

Attaching an elastic band to the motor of an electric toothbrush can see a clear standing wave. The toothbrush was bought in a discount store for €3. The metalwork teacher in school kindly exposed the motor, allowing easy attachment of the elastic band.



A piece of waste pipe from the drain of the sink, which the caretakers were discarding, was salvaged. Yet again the metalwork teacher in the school cut it and smoothened the edges. Placed into a large graduated cylinder of water, it acts as an excellent resonance tube.

Sheila Curley
Cobh Community College.

Thoughts on the Chemistry Induction Course

J.White, St. Dominic's College, Cabra.

I found the course to be extremely useful for a teacher embarking on the new syllabus for a number of reasons:

(1) There was an emphasis on Mandatory Experiments, Specified Demonstrations, and exchange of Ideas/Resources. I walked away from these sessions full of confidence and ideas about how to make the theory more understandable for students

(2) More experienced teachers who attended have a wealth of knowledge about what "worked" in their classes with different topics. I found tapping into their knowledge very helpful as it kept me "real" and not get too carried away with ideas that would "go over the heads" of most students.

(3) The course gave me an opportunity to see what other teachers thought of digital resources I was using, and how I could improve on them so that topics could be conveyed to students in a more clear and concise manner.

(4) Different teachers approach the syllabus from different viewpoints and it was very beneficial to me in finding out what order they taught the syllabus in and why.

(5) "Simplified" procedures were used which were laminated - a class set can then be used at each group location. From a health and safety point of view I thought these were an excellent idea. My first practical session afterwards brought home the logic of this approach - imagine the nightmare of bulky textbooks and experiment hardbacks surrounding experiments like ethanal and ethanoic acid. I have used this idea and expanded on it - One student in a group (ideally a pair) is the "doer" one week and "recorder" the following (and vice versa This way it's fair and skills of setting up and observation are built up in both students - not one doing all and the other slacking off!!!).Now all that surrounds experiments is the laminated sheet and a clipboard for recording all observations. Students can then transfer these observations later. (Students who take pride in their labbooks especially love this as their labbooks don't get "wrecked).

Supporting Physics Teaching 11-14

Who is it for?

The Supporting Physics Teaching 11-14 initiative is intended to support non-specialist teachers who teach physics at secondary education. It will also be very useful for more experienced physics teachers as it gives an insight into common misconceptions.

What is it?

The essential features of the package are a set of CDROMs, which can be used by training providers as a basis for in-service training programmes or by teachers as a stand-alone training resource.

Each CD balances the consolidation of existing good practice amongst physics teachers with the development of new teaching tools to enhance current provision. The CDs comprise three elements:

1. The physics narrative, is a teacher focused section, bringing together the important aspects of the chosen topic in a coherent, comprehensive and engaging manner.
2. Teaching and learning challenges for pupils make explicit what pupils find 'easy' or 'difficult', drawing on both research evidence and on the classroom wisdom of practicing teachers.
3. Teaching approaches provide proven teaching ideas and strategies designed to present the topic in an interesting and engaging manner. The resources within this section will include some materials for direct use in teaching, such as practical activities, video clips and formative assessment materials. Such materials have been chosen to address the key teaching and learning challenges; there will be no attempt to produce a complete course.

Each CD will map on to a key physics topic to be found curriculum guidelines found in Great Britain and Ireland for the new Junior Science Course.
The topic areas to be covered are:

- Forces
- Energy
- Light and Sound
- Electricity and Magnetism
- Earth in Space

How was it produced?

The Institute of Physics brought groups of science teachers together to develop the materials by drawing on their own experience and expertise. Each group was led by a university lecturer in physics education, experienced in training teachers. These materials have then been worked into an interactive resource with the help of Atticmedia, a multimedia company.

How do I use it?

Training is essential if teachers are to use the resource in the intended manner and gain maximum benefit from it. Such training will introduce the principles of and method of working with the CDs. In Ireland this training will be given by the IoP at events such as the Frontiers of Physics and also by the Junior Science Support Service (JSSS)

Will it help?

During the summer of 2004, a prototype CD based on electricity was produced and used in inservice sessions with trainee teachers and non-specialist teachers. The resource was independently evaluated; the comments below were collected during this process:

- *"Excellent range of strategies (…) new ideas I was not aware of. Good resources..." (Teacher)*
- *"I think the CD will also help me supporting not only non-specialised teachers, but also younger teachers in my department." (Teacher)*
- *"Was very uncertain about electricity before and knew very little. Feel much more confident now." (Trainee Teacher)*

How much will it cost?

The Institute has invested £750,000 in the development of SPT. The Institute does not intend trying to recover the development costs. The may be some small charge to contribute to duplication and distribution costs.

When will it be available?

The complete set of five CDs will be available by September 2005.

paulnugent@eircom.net

the BA Connecting science with people

The BA Festival of Science 2005

5 - 9 September 2005
Trinity College Dublin

The theme of the 2005 Festival of Science is 'Setting the Agenda for Science'.

This theme is concerned with issues of ownership and control of science and technology (i.e. who should have ownership and control?), and the role of the scientist in an increasingly public arena.

More information:
http://www.the-ba.net/the-ba/Events/FestivalofScience/

SCIENCE WEEK IRELAND 13-20 Nov 2005

Science Week - Republic of Ireland
13 - 20 November 2005
events throughout the Republic.

Science Week Ireland is the celebration and demonstration of science, technology and innovation in Ireland. For one week, people of all ages are given the opportunity to explore, discover, experiment or invent their way to a better understanding of Irish innovation and its relevance to Ireland's economic prosperity through hundreds of events held nation-wide.

More information:
http://www.science.ie/

Chemistry Support Autumn 2005

Leaving Certificate Chemistry

The Leaving Certificate Chemistry Support Service will once again provide support for Chemistry teachers at senior cycle during the school year 2005-2006. This support will take the form of the following:-

Three-day Modular courses.

1. Induction for New Chemistry Teachers
2. ICT in Chemistry.

Course Title: Induction Course for Teachers of Chemistry

Target Group:

Teachers of Chemistry new to the profession.
Teachers of Chemistry new to the revised Leaving Certificate syllabus.
Teachers of Chemistry who feel they need practical hands-on experience of the Mandatory Experiments.

Aims

- Familiarise the new teacher with the structure and content of the new chemistry syllabus and the teacher guidelines.
- Explore and investigate best practice in laboratory safety and management
- Explore effective teaching methods for communicating chemistry
- Provide practical hands-on experience with a large range of experiments listed in the syllabus
- Provide a forum for teachers to reflect on their own teaching and share experiences and useful resources.

This is a three-day Modular course and is available nationally at the following venues.

Venue	Dates	Closing Date
Cork	15-Sept. 2005 and 6- Dec 2005 Further day in 2006	9th Sept 2005
Maynooth	27- Sept 2005 and 15- Dec 2005 Further day in 2006	9th Sept 2005
Athlone	29- Sept 2005 and 13 - Dec 2005	9th Sept 2005

Datalogging Induction in Chemistry

A series of one day hands-on workshops on how datalogging can enhance practical work in chemistry have been organised.
This is a good opportunity for teachers to make practical use of the Datalogging equipment which in some cases may still be in boxes in the Lab. You will be taken step by step through the experiments and shown how to transfer data to your computer for manipulation and print outs. Each experiment needs a minimum of preparation and can be easily completed inside a forty minute period. News of new products available and the new version of Logger Pro will be demonstrated. Twelve experiments suitable for Leaving Certificate Chemistry can be sampled. This datalogging workshop has been organized in the following six areas.

Dundalk	October 11th 2005
Wexford	October 25th 2005
Letterkenny	October 27th 2005
Birr	November 10th 2005
Dublin	January 17th 2006
Mayo	January 26th 2006

Course Title: Using IT to enhance the teaching and learning of Chemistry in the classroom

Target Group:

Chemistry Teachers at Senior Cycle.
Chemistry Teachers wishing to learn how to develop Powerpoint presentations with little or no previous experience in same.

Aims

- Explore learning strategies with ICT tools such as ChemSketch, Powerpoint, CD-ROMs, and Internet Applets which will engage the learner
- Explore practical ideas and strategies for communicating chemistry
- Develop experiential teaching skills to enhance the teaching and learning in chemistry classrooms
- Explore and share experiences of best practice with the group
- Support networking between chemistry teachers
- Undertake to develop PowerPoint presentations for each section of the syllabus and to share this resource with the participants.

This is a three-day Modular course and is available nationally at the following venues

Venue	Dates	Closing Date
Donegal Education Centre	Sept 13th 2005 Nov. 17th 2005 Further day in 2006	9th Sept 2005
Monaghan Education Centre	Sept 17th 2005 Nov. 15th 2005 Further day in 2006	13th Sept 2005
Co. Wexford Education Centre	Sept 22nd 2005 Nov. 22nd 2005 Further day in 2006	16th Sept 2005
Galway Education Centre	Oct 4th 2005 Nov. 29th 2005 Further day in 2006	30th Sept 2005
Dublin West Education Centre	Oct. 6th 2005 Nov. 24th 2005 Further day in 2006	30th Sept 2005
West Cork Education Centre	Oct. 13th 2005 Dec 1st 2005 Further day in 2006	7th Oct 2005

Network Meetings

Following on from the success of these evening courses last year it is hoped to run evening meetings in each of the six Education Regions.(see Map in Brochure). The aim is to run a Chemsketch workshop in selected Education Centres. These workshops are organised in partnership with the Education Centres and with the local branches of the ISTA . Notification of the dates will be sent to your school.

Physics Support Autumn 2005

Leaving Certificate Physics

The Second Level Support Service (SLSS) will continue to support the teachers of physics at senior cycle during the school year 2005-2006 through courses organised in association with Education Centres.
SLSS will collaborate with Education Centres, the Irish Science Teachers' Association and the Institute of Physics to support local identified needs of physics teachers through physics networks set up around the Education Centres.
School visits will be undertaken in response to requests and by agreement with school management, where resources permit.
A consultation service by fax, phone or email will be available. Further support will be offered through an issue of the magazine *"Physical Sciences"* which will be circulated to all schools during the coming term and through the Physical Sciences website, www.slss.ie which will be further developed.

Course Title: Datalogging Induction

A series of one day hands-on workshops on how datalogging can enhance practical work in physics have been organised. The course venues selected for this term are in the Education Centre Regions 1,5 and 6. It is planned to organise further datalogging workshops in Regions 2,3 and 4 during second term.

Day	Date	Venue	Closing Date
Monday	24-10-05	Carrick-on-Shannon EC	09-10-05
Tuesday	15-11-05	Drumcondra EC	27-10-05
Thursday	24-11-05	Clare EC	10-11-05

Course Title: Induction Course for Physics Teachers

Target Group: Physics teachers new to the profession and teachers of Physics new to the revised Leaving Certificate syllabus.

Aims

- Familiarise with the structure and content of the physics syllabus, the teacher guidelines and the support starter pack
- Explore and investigate best practice in laboratory management
- Explore effective teaching methods for communicating physics
- Provide practical hands-on experience with ten experiments listed in the syllabus
- Provide a forum for teachers to reflect on their own teaching and share experiences and useful resources
- Undertake some action research in teachers' own work situations, reflect on practice and document the outcomes.

This is a three-day Modular course and is available nationally at the following venues.

Venue	Dates	Closing Date
Cork ESC	30-09-05 and 24-11-05 Further day in 2006	15-09-05
Dublin West EC	4-10-05 and 24-11-05 Further day in 2006	18-09-05
Galway EC	13-10-05 and 6-12-05 Further day in 2006	29-09-05

Course Title: Using ICT to enhance learning in the Physics classroom

Target Group: Teachers of Physics at second level.

Aims

- Explore learning strategies with ICT tools such as PowerPoint, CD-ROMs, Internet Applets and Datalogging to engage the learner
- Explore practical ideas and strategies for communicating physics
- Develop experiential teaching skills to enhance teaching and learning in the physics classroom
- Explore and share experiences of best practice with the group
- Support networking between teachers of physics
- Undertake some action research in teachers' own work situations, reflect on practice and document the outcomes.

This is a three-day Modular course and is available nationally at the following venues.

Venue	Dates	Closing Date
Athlone EC	18-10-05 and 1-12-05 Further day in 2006	3-10-05
Kildare EC	20-10-05 and 26-01-06 Further day in 2006	6-10-05
Tralee EC	29-11-05 and 2-02-06 Further day in 2006	10-11-05

Physics teachers Datalogging in Cork

Calendar of Events 2005

September 5-9, 2005
Course: The BA Festival of Science 2005
Venue: Trinity College Dublin

September 13, 2005
Course: Using ICT in Chemistry
Venue: Donegal Education Centre

September 15, 2005
Course: Induction Course for Chemistry teachers
Venue: Cork

September 20, 2005
Course: Using ICT in Chemistry
Venue: Monaghan Education Centre

September 22, 2005
Course: Using ICT in Chemistry
Venue: Co Wexford Education Centre

September 24, 2005
Course: Frontiers of Physics 2005
Venue: University of Limerick.

September 27, 2005
Course: Induction Course for Chemistry teachers
Venue: Maynooth University

September 29, 2005
Course: Induction Course for Chemistry teachers
Venue: Athlone Institute of Technology

September 30, 2005
Course: Induction Course for Physics teachers
Venue: Cork Education Support Centre

October 4, 2005
Course: Using ICT in Chemistry
Venue: Galway Education Centre

October 4, 2005
Course: Induction Course for Physics teachers
Venue: Dublin West Education Centre

October 6, 2005
Course: Using ICT in Chemistry
Venue: Dublin West Education Centre

October 11, 2005
Course: Datalogging Induction in Chemistry
Venue: Dundalk

October 13, 2005
Course: Induction Course for Physics teachers
Venue: Galway Education Centre

October 13, 2005
Course: Using ICT in Chemistry
Venue: West Cork Education Centre

October 18, 2005
Course: Using ICT to enhance Learning in the Physics classroom
Venue: Athlone Education Centre

October 20, 2005
Course: Using ICT to enhance Learning in the Physics classroom
Venue: Kildare Education Centre

October 24, 2005
Course: Physics Datalogging Induction Course
Venue: Carrick-on-Shannon Education Centre

October 25, 2005
Course: Datalogging Induction in Chemistry
Venue: Wexford

October 27, 2005
Course: Datalogging Induction in Chemistry
Venue: Letterkenny, Co Donegal

October 31 - November 4 Mid-term break

November 10, 2005
Course: Datalogging Induction in Chemistry
Venue: Birr

November 13-20, 2005
Course: Science Week - Republic of Ireland
Venue: Venues throughout the Republic

November 15, 2005
Course: Datalogging Induction in Physics
Venue: Drumcondra Education Centre

November 15, 2005
Course: Using ICT in Chemistry Day 2 Further day in 2006
Venue: Monaghan Education Centre

November 17, 2005
Course: Using ICT in Chemistry Day 2 Further day in 2006
Venue: Donegal Education Centre

November 22, 2005
Course: Using ICT in Chemistry Day 2 Further day in 2006
Venue: Co. Wexford Education Centre

November 24, 2005
Course: Datalogging Induction in Physics
Venue: Clare Education Centre

November 24, 2005
Course: Induction Course for Physics teachers Day 2 Further day in 2006
Venue: Dublin West Education Centre

November 24, 2005
Course: Using ICT in Chemistry Day 2 Further day in 2006
Venue: Dublin West Education Centre

November 24, 2005
Course: Induction Course for Physics teachers Day 2 Further day in 2006
Venue: Cork Education Support Centre

November 29, 2005
Course: Using ICT in Chemistry Day 2 Further day in 2006
Venue: Galway Education Centre

December 1, 2005
Course: Using ICT in Chemistry Day 2 Further day in 2006
Venue: West Cork Education Centre

December 1, 2005
Course: Using ICT to enhance Learning in the Physics classroom Day 2
Venue: Athlone Education Centre Further day in 2006

December 6, 2005
Course: Induction Course for Physics teachers Day 2 Further day in 2006
Venue: Galway West Education Centre

December 13, 2005
Course: Induction Course for Chemistry teachers Day 2
Venue: Athlone Institute of Technology Further day in 2006

December 15, 2005
Course: Induction Course for Chemistry teachers Day 2 Further day in 2006
Venue: Maynooth University

December 22, 2005 - January 9, 2006 Christmas Holidays

Contact Information

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