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Outreach Activities

A summary for UK university physical sciences departments

A Physical Sciences Practice Guide

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The views expressed in this practice guide are those of the author and do not necessarily reflect those of the Physical Sciences Centre.

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Introduction

The dictionary definition of outreach refers to surpassing, outwitting or the act of 'reaching out'. The Funding Councils see it as "widening access and improving participation in higher education…… to equip people to operate productively within the global knowledge economy. It also offers social benefits, including better health, lower crime and a more tolerant and inclusive society".

Here in the Physical Sciences, whilst reaching out to widen access is an important part of our agenda, we see Outreach activities as primarily being targeted at improving the recruitment and retention of students and more recently, playing a key role in promoting "strategic and vulnerable subjects" e.g. Physical Sciences, Engineering and Mathematics.

This document summarises the published information both in print and on the web which deal with the questions: "Why are students turning away from the Physical Sciences" and "How can we reverse this trend". We also look at a selected number of initiatives that are actively generating materials and methods that might change the current situation.

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Background

Chemistry departments are under pressure due to the recent drop in entrants. The numbers of pupils attempting Chemistry A-level has been declining since 1995, following a gradual and spasmodic increase in numbers from the 1960s. The recent absolute decline also reflects a greater relative decline in terms of a percentage of all A-level entries and as a proportion of the relevant 16 to 19 year old cohort. Compared with 1991, the overall numbers of A-level entries in 2005 were 12.1% higher. But entries in physics were 35.2% lower, entries in mathematics were 21.5% lower, and entries in chemistry were 12.6% lower.

Since 1996, 28 universities have stopped offering chemistry degrees. Philip Kocienski, head of department at Leeds, says: "If the current trends continue, I estimate that there will be a maximum of 20 universities in the UK teaching and doing research in chemistry.

Physics is similarly under threat. A survey of 432 schools and colleges in England and Wales revealed that although A-level entries in all subjects have risen by 14.6% since 1990, the number of physics entries had fallen by 38%. Nearly 10% of state schools with sixth forms now do not offer A-level physics, and of those that do 39.5% had five students or fewer taking it this year. Almost a third of university departments offering physics have closed in the past decade.

In a recent Institute of Physics report Lord May said "The profound problems facing science at A-level extend well beyond physics. We have consistently highlighted the general downward trend of students studying the sciences and if we fail to address this then we risk losing the ability to train the next generation of scientists, technologists and engineers."

Of course, the situation is somewhat alleviated by the boom in Forensic Science studies and the upsurge of interest in Astronomy, and many UK Higher Education Physical Science Departments are relying on these trends to remain viable. However, these cannot be considered as replacements and their popularity may be short-lived. As the recent report into Forensic Science studies states,

> Employers in both the Forensic Science sector and in other Science areas consider Chemistry a more desirable degree qualification than Forensic Science. While a number of Forensic Science employers have employed Forensic Science BSc graduates, the ideal combination for these employers is a Chemistry first degree with an MSc in Forensic Science. Other Science employers consider Chemistry, or another pure science degree to be ideal; they would consider a Forensic Science graduate if the degree contained the requisite level of scientific knowledge in a relevant discipline. However, a large proportion of these employers have little or no knowledge about Forensic Science BSc degrees. Those who had knowledge criticised the courses for a lack of clarity and consistency regarding content.

There is a great deal of confusion within Universities as to how and why this situation has arisen. Those of us who work in the Physical Sciences often assume that the unpopularity of our subjects is related to public attitudes of fear, distrust and poor

subject image. Furthermore, we have the feeling that our disciplines are ‘hard’ whilst all others are ‘soft’ and this deters potential applicants. Add to this the commonly-held view that science teachers are poorly qualified and motivated and that careers teachers do not understand the sciences and you have the recipe for a substantial self-inflicted inferiority complex. The fact that the majority of ‘famous’ personalities – presenters, entertainers and celebrities, plus the opinion formers – politicians, journalists and writers, have no scientific grounding and are often openly antipathetic or derisive of scientific matters, simply compounds the issue. Matters are not helped when apparently 25% of the population prefer ‘creationism’ to evolution and prominent members of the aristocracy espouse homeopathy and crystal therapy. There are encouraging early signs that this trend may be in reversal. The massive publicity given to the cuts in chemistry coming from all walks of life appears to be bearing some fruit. Educational initiatives, re-launched chemistry courses and renovated laboratories, together with a six-year high in student enrolment, are giving many academics reasons to be cheerful.

Departments which have closed or been relegated to service teaching for aspects of bioscience or forensic science are now reinstating their chemistry honours stream. Queen Mary College and the University of Central Lancashire are two examples of this and the chemistry departments at Liverpool, Bristol, Leeds and Newcastle are receiving major investment.

It is not yet clear whether this is yet another short term blip or we are seeing a sustained recovery. It will be quite a while before this becomes apparent and, even if it is permanent, it will be a long time before industry and the economy feel the benefits. In the meantime we shall continue to have a national skills shortage.

There is no sign as yet that a similar renaissance is occurring in physics or indeed any of the other ‘subjects at risk’ such as engineering, mathematics and IT.

Surveys of Opinion

It is often thought that we do not know what influences students in their choice of post-school studies and future employment. Whilst it may be that large-scale in-depth studies are thin on the ground, there is plenty of evidence pointing to the basic problems.

Physics Students

A survey of the attitudes of Physics students can be found in “Getting Started in Pedagogical Research in the Physical Sciences”, by Norman Reid.

> One question explored what were the likely factors which attracted the students into physics as a degree course. This question was given to 218 level 1 and level 2 students taking courses in physics and asked them to look back: Which factor(s) influenced your choice of planned honours subject(s)?

87%	Enjoyment of subject	3%	Friends
74%	Good grades at school in subject	49%	Likely career opportunities
27%	Your teacher at school	9%	Demonstrations, exhibitions, festivals
9%	Your parents	7%	Any other factors (please list below)
4%	Information from mass media	.....	

There is no need to do more statistics on this. The pattern immediately tells us that, if we wish to attract more students into physics, then we can safely ignore most of the factors. *It tells us that the school experience is by far the dominant factor*. The quality of the school syllabus and the quality of the teachers are the critical factors. It is unlikely that we can influence the school physics curriculum although we might be able encourage able students to consider school teaching. However, any efforts in arranging special events, demonstrations, science centres, exhibitions are likely to have only marginal effects in attracting students towards physics and are unlikely to justify the effort, energy and expenditure. There is one area which is open to us - *the perception of career opportunities*. Other research in the same survey confirmed that this is an area where more information is needed by school pupils and students.

GCSE Pupils

A recent online survey by the OCR examination board involved 950 pupils from Years 9, 10 and 11, across a range of schools (both public and independent) and range of abilities between November 2004 and February 2005. This revealed some interesting attitudes.

- Over 50% said that science lessons were boring, confusing or difficult.
- 25% of GCSE Science students say they won't be doing science after Year 11.
- The Human Body and Earth & Space are the most popular science subjects.
- 'Experiments in class' are the best thing about learning science followed by field trips and videos. 'Reading text books' or 'researching on the internet', are seen as some of the least effective methods, nominated by just 20%.
- 77% of pupils believe that the science they learn in school will be useful to them in the future. However, Year 11 pupils are twice as likely (30%) as Year 9 pupils (16%) to say it will be 'not very useful/of no use' implying that the level of relevance diminishes as the subject's complexity grows.
- 92% say curing diseases is the most important priority for science.
- Astronaut tops the list of 'most interesting scientific professions'.

- When asked to name a famous scientist, most students named Albert Einstein or Isaac Newton. With role models from centuries ago it's perhaps not surprising that when asked to describe a scientist the words 'boring', 'eccentric' and even 'dim' emerged. Just 7% described scientists as 'cool' and only 6% 'fun'. On the plus side, 79% of pupils associated scientists with being clever (although perhaps to be clever is not cool).
- When asked what science subject they would take if it were not compulsory, 45% said they would take biology, 32% chemistry, 29% physics and 19% combined science - but 16% would not choose any of them.

Popular Opinion

Physical Scientists often assume that the unpopularity of our subjects is related to public attitudes of fear, distrust and poor subject image. Admittedly there are problems associated with risk assessment and images of pollution but the products of science are widely respected and valued. Science is seen as important both by the public and the Government. However, many aspects are not presented or perceived as part of science. Examples of this are nanotechnology, which is perceived as engineering, and pharmaceutical products used by medicine are not seen as products of chemistry and chemists. This means that the sciences do not benefit as much as they could from the respect given to their products.

A survey of adult public opinion in 2000 yielded the following major conclusions, which are often at variance with those held by school pupils.

- Three-quarters are 'amazed' by science.
- Two-thirds think it makes our lives better.
- Only 20% have no interest.
- 80% believe we should invest heavily.
- 70% approve of 'blue-sky' research.
- 43% think the benefits outweigh the disadvantages, 17% disagree.
- 43% think politicians support science 'for the good of the country', 25% disagree.
- 40% think the rate of progress is beyond government control but 30% disagree.
- 53% believe that politicians' decisions are swayed by the media with insufficient lead.
- 84% of people think scientists are valuable contributors and three-quarters think science is a good career choice.
- Two-thirds believe that scientists wish to improve our lives but the same proportion think we should listen more to ordinary people.

A similar survey was carried out in 2005 and revealed an increase in regard for science and scientists.

- Most people think science makes a good contribution to society, and that on the whole, science will make our lives easier.

- Positive associations of science with advancement and progress – particularly in the field of healthcare – and with laboratories far exceed negative images of science as a boring subject at school, and associations with war/bombs/destruction. Likewise, positive images of scientists as skilled people are much more widespread than the stereotype of the scientist as an eccentric.
- Few say they see or hear too much information on science and far more people now say they receive too little information on the subject. Health-related applications: medicines, transplants, surgery generally, cures for diseases and genetic testing – as well as computers/the internet - are widely seen as beneficial. Yet cloning, radioactive waste, 'designer babies' and GM food are generally perceived in negative terms.
- Regarding climate change, the same proportion now, as five years ago, feels that 'discovering global warming/climate change' is beneficial to society overall.
- 'Radioactive waste' - which probably carries considerable negative connotations from having 'radioactive' and 'waste' in its name - is once again regarded by a huge majority as being a very or fairly bad thing and is now more marked than two years ago. Similarly, a large majority now feels the risks of radioactive waste outweigh the benefits, representing a considerable increase in the last two years.
- The awareness of nanotechnology is extremely low and the seemingly positive attitude is reflecting inferences based on beliefs about technology in general rather than about nanotechnology in particular.
- The importance of young people having a grasp on science is almost universally recognised, and most now feel strongly about this.
- A clear majority places the same amount of trust in scientists as they did five years ago - and we know that most people trust scientists (and that trust in scientists has been consistently positive since measurements began seven years ago).
- Scientists are one of the most valued sources of information. However, scientists working for industry and for government are much less widely trusted than those working in universities or for charities. Crucial factors for the public in determining trust are: competence, credentials, experience and honesty. For a third of the public, it is important that scientists listen to or share their concerns. By contrast, appearance – being smartly dressed or wearing a lab coat – is far less important.
- There is widespread feeling that the independence of scientists is often put at risk by the interests of their funders.
- The view that the media sensationalises science is even more widely held than before, and is now more strongly felt. This is despite people's reliance on the media as a source of information on science.

Recommendations

Two thorough and substantial documents have been written with particular relevance to science recruitment.

Nick Jagger

Nick is a Research Fellow of the Institute for Employment Studies, with over 20 years of policy research experience. He particularly concentrates on scientific, engineering, IT, and managerial skills and their formation. He is also involved with international comparisons of high-level skills. Nick has examined regional, national and international labour markets, especially the labour markets for the highly qualified including scientists and technologists. These studies have used a wide range of approaches and methodologies.

Nick has a number of more general and wide-ranging ideas with particular emphasis on Chemistry, though most of his ideas are equally applicable to Physics. The paper contains a substantial collection of reviews of knowledge in this area. The following is based upon some of his suggestions arising from these surveys which are aimed more at policy making and policy makers rather than teachers.

Build on the positive attitudes to chemistry and its products
The benefits of the products of chemistry, such as pharmaceuticals, are widely accepted and acknowledged. There is a need to translate this into more positive attitudes towards chemistry and its study. This means linking chemistry and chemists to positively viewed products such as pharmaceuticals.

Reincorporate modern technologies into chemistry
Chemistry appears to spin off a sequence of new disciplines which are no longer identified with chemistry, such as nanotechnology, semiconductors, medicine, major aspects of gene manipulation, pharmacy, and forensic science and so on. This means that the public and potential students rarely understand the full scope of chemistry and its new developments.

Pre-empt public misunderstanding of science and technology
Actively engage in a debate about safety and ethics associated with technology, perhaps by trying to refocus the debate around physics and chemistry rather than the technology. Technology also tends to be an instrumental term with negative connotations. By changing the terms of the debate it is to be hoped that many of the problems that became associated with for example, biotechnology, will not be repeated.

Encourage science teachers to take-up and use appropriate careers materials
The changes in the Careers Service and the increasing need for science teachers to provide careers advice causes problems. Unfortunately these teachers often do not have up-to-date careers knowledge or use available materials. This suggests that there is a need for teachers to be encouraged to use appropriate material promoting science careers.

Understand the career and study aspirations of 16 to 19 year old students
It is surprising that it appears that the only study of the career and study aspirations of A-level students covered only Northern Ireland. If effective careers material and advice is going to be developed we need to know what resonates with 16 to 19 year olds. Therefore, an understanding of post-16 science students, based on a sufficiently large UK-wide study, could underpin the development of policy, careers materials, attractive curricula and university recruitment material.

Engage in the development of new curricula
It is known that science taught using up-to-date and everyday examples engage students better, and thus encourages take-up.

Encourage a dialogue between industry and teachers
It is known that industrial visits and industrial placements, if organised successfully, are very effective. However, work experience is often difficult to organise because of perceived health and safety problems.

Understand why science undergraduates choose science
There is a need to understand why science undergraduates choose to study science and why those who are otherwise qualified choose not to study it. An important part of this process would be understanding why females with chemistry A-levels do not choose chemistry at university as much as their male counterparts. The results of such a study could inform the development of policy and the development of university prospectus material.

Urge universities to co-operatively respond to university funding changes
The climate of rapid and relatively dramatic decline in the number of entrants has resulted in some universities increasing their entry through bursaries and other measures. This can only lead to a more rapid decline of entrants at the other universities. This in turn could lead to the closure of more science departments - to the long-term detriment of the disciplines.

University lecturers should be aware of and engage in the debate surrounding 14-19 education changes
Curriculum changes undoubtedly have implications for the knowledge, skills and attitudes of entrants to chemistry courses in the future. Therefore, it is critical that those involved with university science engage with those developing any new curricula in a two-way dialogue.

Averil Macdonald

Averil is a well known education consultant, science communicator and author.
She makes a number of valuable points on recruitment to individual departments and improving the perception of science among the general population. She has quite specific recommendations for encouraging more students to study science post-16 and points out that whereas some 300,000 students are eligible to go on to A-levels or Highers in the physical sciences each year, only around 40,000 - 50,000 choose to do so (the proportion in Scotland is 55% ; in England and Wales it is only 10%!). There is no doubt that the majority has already decided upon their post-16 subject direction by the age of 15 and projects targeting this age group may influence some to consider

science-based careers who would otherwise be persuaded to choose non-science subjects post-16. Averil's comments are aimed squarely at the practitioner - the following is based upon her suggestions.

Produce resources
Teaching Resources which directly target elements of the 14 - 16 age range will be of great use to teachers if they introduce some cutting edge science that does not feature in text books and to which teachers may not have easy access.

Worksheets must be able to be photocopied, or easily downloaded from a website or a CDROM. They should fit onto an A4 sheet and must provide information as well as activities such as questions, quizzes, word searches, crosswords, comprehension exercises, data analysis (a great favourite with teachers!) etc. It is essential that the demand level is appropriate to the curriculum requirements and that the language level is not too high. Teachers often appreciate questions at two levels - for those who find science easy and also more straightforward (all the information required is found on the sheet) for the less able. Resources are particularly useful if a teacher can copy a class set and use them for homework rather than relying on access to school based resources. Provision of answers for the teachers is always very much appreciated.
Websites should also provide information and associated activities such as those above. Students love interacting with websites but will not read vast amounts of text. Animations that illustrate a phenomenon are particularly good as they can explain the concept better than a static diagram in a book. Supplying the material on a CDROM allows the school to network the materials.

Videos or DVDs make a popular addition to a teacher's resources but must last for less than 30 minutes (preferably in short, say 5 minute, segments) as students' attention wanders. The topic must be directly related to the curriculum and ideally a topic for which other materials are not available e.g. manufacturing processes, nuclear power, sustainable energy, astronomy, medical physics or forensic science.

Careers Materials focusing on opportunities for those with science qualifications are often lacking in schools. Many 14 - 16 year olds are often advised about career possibilities by people who have no background in the sciences and therefore have little idea about the range of opportunities that science opens up to them. Research has shown that some students do consider the career (and earning) potential when selecting subjects - hence the massive uptake of Law and Medicine. However, as Norman Reid has found (above), surveys have also shown that the majority who are currently doing Physics at university chose it because they liked it. Clearly we must improve both aspects!

Activities and Visits to Universities
Masterclasses, Lectures, Visits and Open Days are a good way to introduce 15 year old students to what university life is like. However if this is done on a departmental basis the number of students invited from any one school will need to be restricted and this will result in teachers sending the best students only and we end up preaching to the converted again.

General Open Days which can accommodate all a school's 15 year old students (perhaps 250) are much more effective but really have to be organised across the whole faculty, if not the whole university. If 15 year olds can be invited *en mass* to the main university Open Day this will be extremely popular with teachers who will bring a coach load of students. Despite many students using them as an opportunity to go shopping, these events do enable students (who may never have considered a science subject or even going to university at all), to see what's on offer.

Activities and Lectures in School

Lectures should address the target audience and be of an appropriate level - some groups will be mixed ability and not all high flyers. They must also fit into the school timetable, lasting 45 minutes at most. The best lectures use a range of elements including images and practical demonstrations. Don't use a series of PowerPoint slides listing bullet point after bullet point as 15 year old students lose concentration far more quickly than conference delegates. Lecturers may need to take lots of equipment though most schools can now provide data projectors if given notice. Others may have interactive white boards.

Activity days (or experience days), where students try out a range of 'experiments', have the benefit that they can accommodate all the members of a year group rather than just a few. There are two problems here – providing the materials and the time available. Schools will be reluctant to change the whole school timetable however good the event and other subject teachers will rarely release students to undertake a science activity when they are timetabled to do other studies. Ideally the activities should be able to accommodate a whole class (around 30) or multiples of 30 up to a half-year group (perhaps 150), which may be timetabled at the same time. Each repeat should fit into a school lesson - which varies from school to school but is most likely to be between 50 and 70 minutes. Be aware that many schools use their main school hall for school lunches so any apparatus brought in for the day to be used in the hall must be able to be dismantled and removed for the lunch hour. Alternatively the event could be devised to fit into a half school day: 9 - 12 or 1 - 3.30. Schools will appreciate briefing materials in advance of the event so that students and teachers are fully aware of what to expect and therefore can benefit fully from it. Never expect a school to keep students behind to participate in events as many are constrained by transport issues.

Competitions are popular with universities but not as popular with teachers as they can rarely put in the additional time and money required to run the competition in school time and after-school activities are constrained by the need to get students onto school buses. Competitions will typically attract most entrants from the independent sector as they are less constrained by time and money. Some competitions have proved to be exceedingly popular (see below).

Resources

Outreach activities and the materials produced to support them bring benefits beyond the original institutions; fostering a general improvement in attitude to both the subject and HE. In several areas, the funding for activities is conditional on free dissemination to all appropriate institutions. We are in the process of collecting information on the availability of these items and this will be published on our website in the near future.

Two substantial collections of resources have been produced by the Centre:

The Chemistry Box (see p15)
The Physics Box (see p17)

The Chemistry Box

The Chemistry Box is written and published by the Centre and the resources may be downloaded from our website.

- Spreadsheets downloaded from government statistics covering the remuneration and employment of scientists. Presented via 'PowerPoint'.
- Useful data for visiting speakers extracted from recent studies covering public attitudes to science and University admissions procedures.
- Practical resources such as structure-drawing software.
- A collection of 60 Chemistry experiments ranging in difficulty from ones requiring little supervision to 'demonstration-only' versions.
- Games.
- Videos from the Liverpool University video library. These can be used as complete films or selected snippets may be pulled.
    - Salt (Helen Aspinall), 30 mins.
    - Liquid Air (David Nicholls), 55 mins.
    - Oxidation (Jon Iggo), 30 mins.
- E-learning modules covering particular areas of the school syllabus usually thought of as 'difficult' e.g. The Mole, Spectroscopy (IR, NMR, MS), Kinetics, Particles and Waves in Physics.
- The Chemistry Tutor II (Web-based)

Chiral molecules	Diastereomers	Conformations	Projections
Carbonyl compounds	Aromatic substitution	Alkenes and alkynes	Alkyl halides
Introduction to spectroscopy	NMR spectroscopy	Atomic structure	Molecular energy storage
Descriptive trends in the Periodic Table	Numerical trends in the Periodic Table	VSEPR theory	Periodic Table database
Elementary radioactivity	Gaseous equilibrium thermodynamic	Chemical calculator	Molecule viewer
Glossary	Help with SI Units	Help with Algebraic manipulations	Help with Tables and graphs

- Case Studies (PowerPoint)

    - **Waking without Chemistry**

The backbone of the series is a light-hearted look at what a school pupil might encounter upon awakening and preparing for school should there be no such thing as a chemical industry. It contains lots of sound effects, videos and fancy transitions plus a little humour. It deals with topics such as semiconductors, electricity and lighting, polymers, electrochemistry, medicine, cosmetics, food, transport and clothing. The final part suggests a few topics that might assume importance in the future. Using this as a starting point, there are additional cases with the following contents:

- Semiconductors
- Cosmetics
- Food
- Medicine

Medicines

How medicines work
- Enzymes
- Receptors

History
Statistics
Drug synthesis
- Design strategies

Examples
- Antibacterials
- Analgesics
- Amphetamines
- Tranquilisers
- Antihistamines
- Hormones
- Hallucinogens

Homeopathics
Viagra, the Pill
Abuse

Cosmetics

History
Skin
- Aging
- Colouring
- Moisturisers
- Deodorants
- Sunlight

Hair
- Colouring
- Perming
- Combing

Perfume
Lipsticks
Toothpaste

Semiconductors

Bonding in metals, insulators, and semiconductors
Impurities and Dopants
n-type and p-type
Zone refining
Chip fabrication
Nanotechnology

Food

Vitamins
Minerals
Additives
Energy
- Dieting

Proteins
Carbohydrates
- Bread

Fats
- Prostaglandins
- Cholesterol
- Margarine
- Chocolate

Cooking
Smells
Drinks
- Caffeine
- Fruit Juices
- Alcohol
- Beer
- Wine
- Water

'Specialities'
- Natural Food
- Organic Food
- Junk Food

Chirality

The Physics Box

The Physics Box is written and published by the Centre and the resources may be downloaded from our website.

- Exemplar Case Studies (PowerPoint presentations) – around 20 are available:

Amaze Your Mates
This case study is simply a collection of off-beat puzzles and activities

ACTIVITY: Weaklings Revenge	ACTIVITY: A Knotty Problem	DEMO: A Mind reading act	QUIZ: Cable round the Earth
ACTIVITY: Hole in the Hand	ACTIVITY: Subtle Bomb Drop	QUIZ: Coin Pyramid	VIDEO CLIP: Tablecloth Pull
ACTIVITY: A Strange Plane - The Hoopster	ACTIVITY: Straw Flutes	ACTIVITY: Sound of the Sea	QUIZ: The Case of the Shiny Spoon
ACTIVITY: Hammer and ruler puzzle	ACTIVITY: Best Physics Experiment Ever - Microwave Oven	QUIZ: Hollywood Blockbuster Physics	FINALLY: Websites for simple builds and amateur science

Balls in Flight

'Roulette Scam'	Mechanics and elastic/inelastic collisions	VIDEO CLIP: Dropping a hammer and feather on the Moon – Apollo 15	Coefficient of restitution, $e = 0$ for a cow pat!
Kinetic and potential energy gives e as function of initial and rebound heights	ACTIVITY: get them to measure bounces (and e) of different types of ball	APPLICATION: slides to show how LTA uses these simple techniques to assess tennis balls and ball-turf interactions	THOUGHT EXPERIMENT: Perpetual Motion Machines – what if $e > 1$? Cartoon of perpetual motion machine
DRAMATIC DEMONSTRATION: The pesky ping-pong ball!	Slides to explain mathematically the rebound phenomenon	Centre of Mass and motion in a gravitational field	Compute the time taken for a ball to drop to the floor from height, h
ACTIVITY: Measure your reaction time	QUIZ: Hanging in the air – footballers	IMPROBABLE RESEARCH: Flea Jumping	CHALLENGE: The Subtle Bomb Drop
QUIZ: The tumbling telescope	QUIZ: Fight flabbiness with physics	QUIZ: Flower power – fastest plant seed ejection	FINAL VIDEO CLIP: Stick motion beats gravity

Other PowerPoint presentations

Become an amateur scientist	Communication and Coding	Defying Gravity	Electrons in Motion
Kitchen Physics	Magnetism and Magnetic Devices	Natural Disasters	Natural Sounds
Our Natural Environment	Physics - a sideways view	Physics Tricks and Optical Illusions	Quest for Invisibility
Relativity & Reference Frames	Renewable Energy Resources	The Doppler Effect	The Radio Universe
Quiz Questions I	Quiz Questions II	Quiz Questions III	

- Exemplar quiz/challenges on individual PowerPoint presentation slides to stimulate discussion – these are logical, mathematical and physics puzzles and activities.
- Lots of individual Word files containing suitable newspaper articles, short scientific texts, images, sound snippets, video clips, cartoons and background text relevant to GCSE level curricula.
- List of websites are given which are excellent resources for on-line teaching, books and also articles for further reading and descriptions of materials for demos/activities.
- Links to different careers: application of physical principles in everyday activities.

Activities

Most departments carry out some or all of the activities listed above: master classes, experiments at school, lecture programmes and so on. The following is a selection of national events that departments may subscribe to, or become associated with:

Chemistry Week

The RSC Chemistry Week is a themed week of events that is held every two years to promote a positive image of chemistry and increase the public understanding of the importance of chemical science in our everyday lives. As well as national events, activities are organised throughout the UK and the Republic of Ireland by RSC Local Sections.
The next national Chemistry Week will take place from Saturday, 3rd November through to Sunday, 11th November 2007.

Lab in a Lorry

Lab in a Lorry is an interactive mobile physics laboratory staffed by volunteer practising scientists and engineers. The aim is to give young people aged 11-14 the opportunity to do experimental science in the way it actually happens; exploratory, accidental, informed by curiosity and intuition, but also bounded and guided by the experience and insight of practicing scientists.
The Lorry is staffed by working physicists who are willing to share their time, enthusiasm and knowledge of science with young people.
Each Lorry is a self-contained experience – it rolls up and is ready to go. Year-round, the vehicles tour the UK and Ireland – visiting schools, festivals, and other venues.
It is a joint initiative between the Institute of Physics and the Schlumberger Foundation and one of several Institute of Physics outreach programmes. It aims to make physics and scientific careers more attractive to young people.

National Science Week

National Science Week aims to celebrate science and its importance to our lives, providing an opportunity for people of all ages across the UK to take part in science, engineering and technology activities. Hundreds of thousands of people across the UK take part in National Science Week activities every year.
The British Association coordinates National Science Week, providing a national context for each event.

Young Analyst Competition

Organised by the Analytical Division of the RSC, this encourages younger Analytical Chemists and involves them at all levels of AD activity. Last year this involved over 200 schools in regional heats and a national final.

Salters' Festival

The Salters' Festivals of Chemistry are an initiative of the Salters' Institute. Their objective is to help promote the appreciation of chemistry and related sciences among the young.
The Festivals are one-day fun events held at universities throughout the UK and Ireland. They begin in late March and run through to mid June.
Salters' Festivals provide the opportunity for enthusiastic young students to spend a day in a university department and to take part in practical chemistry activities which are fun! Cash and prizes are awarded to the winning teams and all students receive participation certificates and fun prizes.
During the last three years over 6,000 students have experienced the fun of practical chemistry through the Salters' Festivals and sponsorship in support of the Festivals has been raised from over fifty companies.
The main focus of the morning is "The Salters' Challenge", which is common to all the Festivals. This is a competitive, practical activity, for which no advance preparation is required. In the afternoon students tackle "The University Challenge", which is a practical investigation chosen by the University. This is usually followed by a "fun" lecture or "pops and bangs" demonstration. The day ends with a short prize giving at which the winning schools receive cheques and prizes and all participants receive fun prizes and certificates.

CREST Awards

Celebrating **CRE**ativity in **S**cience and **T**echnology
BA CREST is a nationally recognised accreditation scheme for project work in the fields of science and technology. Aimed at students aged 11-19, the awards encourage students to develop their scientific curiosity, problem-solving and communication skills. Through a mentoring system, the scheme facilitates links between schools and industry or higher education. It enables students of all abilities to explore real scientific, engineering and technological problems for themselves and promotes work-related learning. The awards are intended to motivate students, build confidence and encourage them to pursue careers in science, engineering and technology.
The awards are available in Science or Technology at three levels:

BRONZE 10 hours of project work Typically for ages 11-14	SILVER 40 hours of project work Typically for students aged 14-16 Links with industry encouraged
GOLD 100 hours of project work Typically for students aged 16+ Students linked with mentor from industry or higher education Can accredit Nuffield Bursary placements and Engineering Education Scheme (EES) project work	

Students who have completed BA CREST project work have the opportunity to display their work at Regional Finals. Outstanding projects are selected for the prestigious national BA CREST Science Fair.

The Science Ambassadors Programme

The DTI-funded Science and Engineering Ambassadors programme aims to promote STEM (science, technology, engineering & maths) by providing enthusiastic, vetted volunteers to work with young people and teachers in schools.
Science and Engineering Ambassadors are individuals who have a background in or simply an interest in any aspect of STEM, and want to help inspire and excite children and young people about the possibilities these subjects and careers can bring.
Ambassadors may volunteer as an individual or as part of a company related scheme. Either way, they will have access to the support of their local SETPOINT who can offer advice, ideas and opportunities for getting involved in exciting and enriching activities with pupils and schools.
Science and Engineering Ambassadors can get involved in a whole range of activities and events, either organised and managed by the local SETPOINT or working with other organisations and schemes aimed at enthusing school-age children in STEM.
Examples of activities which are happening include:

- Ambassadors from large multinational companies linking with schools close to their sites and taking after-school engineering clubs
- Industrial volunteers working with classes on projects for GCSE Applied Science and Engineering
- Ambassadors and young people working together on a robot entry for Technogames at a Saturday Club in an Education Action Zone
- Young IT professionals e-mentoring students in local schools
- Many individuals throughout the country

Science and Engineering Ambassadors (or SEAs) come from all walks of life and all sectors of the community. They may be practicing as scientists, engineers or technologists in a company or they may be people with a background and interest in those areas. What is important is that they are enthusiastic about STEM subjects and can communicate their interest and passion to pupils and young people.

Aimhigher

Aimhigher is a national programme which aims to widen participation in higher education by raising the aspirations and developing the abilities of people from under-represented groups. Aimhigher partnerships build cross-sector relationships which break down the barriers which institutions and systems can unwittingly create for learners.
Funded activities include summer schools to give school pupils a taste of university life, mentoring by students, and visits by staff from higher education providers to work-based training providers.
Funded projects relevant to the physical sciences are described in detail on the web pages of the RSC, IOP and SETNET and many of these have (or will have) resources available for download.

Young Engineers

Young Engineers' aim is to inspire young people to develop an interest in engineering, and, in doing so, recognise the importance and excitement of engineering as a future career. It develops and manages a national network of extracurricular engineering clubs in both the primary and secondary sectors and runs a number of engineering challenges and competitions. There is a great deal of overlap with the physical sciences.
Young Engineers clubs open students' eyes to the diversity of activities that are involved in engineering and illustrate the enormous impact that engineering has on the modern world. A wide range of activities, challenges and awards aim to encourage young people to develop an interest in all things to do with engineering and technology and hopefully then follow a career in engineering through either the higher education route or as technicians and apprentices.
Participation in Young Engineers also helps to develop club members' personal skills in communication, presentation, team working, numeracy and literacy, thereby better preparing them for entry into the workforce.

Particle Physics and Astronomy Research Council Master Classes

These take place in almost every University and form part of PPARC's overall communications strategy, involving public engagement and public accountability. The aim is to promote the understanding, appreciation and awareness of science areas so that young people's fascination for astronomy, space and particle physics is translated into an understanding and interest in all scientific areas, and a readiness to consider a scientific career.
In meeting these objectives PPARC acts as a facilitating, funding, policy making and communications centre, working closely with scientists, the media, educators, and communications professionals (e.g. in museums and science centres). One key target audience is 11-16 year olds, often reached through the education system, which is supported by providing links between research and the curriculum.

CETLs

The HEFCE Centres for Excellence in Teaching and Learning (CETL) initiative has two main aims: to reward excellent teaching practice, and to further invest in that practice so that CETLs funding delivers substantial benefits to students, teachers and institutions. There are four centres that are of interest to us and they are intending to provide a great deal in the way of resources, courses, good practice and so on which will be made freely available to all. Their contact details are to be found in the references section.

Appendix A: Summary of Outreach Recommendations

- Build on the positive attitudes to chemistry and its products
- Reincorporate modern technologies into chemistry
- Pre-empt public misunderstanding of science and technology
- Encourage science teachers to take-up and use appropriate careers materials
- Understand the career and study aspirations of 16 to 19 year old students
- Engage in the development of new curricula
- Encourage a dialogue between industry and teachers
- Understand why science undergraduates choose science
- Urge universities to co-operatively respond to university funding changes
- University lecturers should be aware of and engage in the debate surrounding 14-19 education changes

Produce resources

Teaching Resources
Worksheets
Websites
Videos or DVDs
Careers Materials

Activities and Visits to Universities

Masterclasses, Lectures, Visits and Open Days
General Open Days

Activities and Lectures in School

Lectures
Activity days (or experience days)
Competitions

Appendix B: Outreach Activity in UK University Physical Science Departments

University of Aberdeen
Chemistry Dept - http://www.abdn.ac.uk/chemistry/
WP –
Physics Dept – http://www.abdn.ac.uk/physics/
WP –

Aston University
Chemistry Dept – http://www.seas.aston.ac.uk/
WP (general) - http://www.aston.ac.uk/outreach/

University of Wales, Aberystwyth
Physics Dept – http://www.aber.ac.uk/physics/index.html
WP (general) – http://www.aber.ac.uk/en/schools/

University of Wales, Bangor
Chemistry Dept – http://www.chemistry.bangor.ac.uk/index.php
WP -
http://www.chemistry.bangor.ac.uk/schools_intro.php.en?menu=9&catid=857&subid=0

University of Bath
Chemistry Dept - http://www.bath.ac.uk/chemistry/
Physics Dept – http://www.bath.ac.uk/physics/
WP (general) – http://www.bath.ac.uk/admissions/undergrad/widening-participation/index.html

University of Birmingham
Chemistry Dept – http://www.chem.bham.ac.uk/
WP - http://www.chem.bham.ac.uk/schools/liaison.htm
Physics & Astronomy Dept – http://www.ph.bham.ac.uk/
WP - http://www.ph.bham.ac.uk/prospective/schools/index.htm

University of Bradford
Chemistry Dept – http://www.bradford.ac.uk/university/ugpros2004/chemical.php
WP – http://www.bradford.ac.uk/external/geninfo/access.php

University of Brighton
Chemistry Dept – http://www.brighton.ac.uk/scieng/
WP (SETPOINT) - http://www.setpointsussex.org.uk/

University of Bristol
Chemistry Dept – http://www.chm.bris.ac.uk/
WP - http://www.chm.bris.ac.uk/schools/
Physics Dept – http://www.phy.bris.ac.uk/
WP (general) – http://www.bristol.ac.uk/wideningparticipation/

University of Cambridge
Chemistry Dept – http://www.ch.cam.ac.uk/
WP –
Physics Dept – http://www.phy.cam.ac.uk/
WP - http://www-outreach.phy.cam.ac.uk/

Cardiff University
Chemistry Dept – http://www.cardiff.ac.uk/chemy/
WP (general) –
http://www.cardiff.ac.uk/schoolsanddivisions/divisions/prcom/wa.html
Physics & Astronomy Dept – http://www.astro.cardiff.ac.uk/
WP - http://www.astro.cardiff.ac.uk/schools/

University of Wales Institute, Cardiff
Chemistry Dept - http://www.uwic.ac.uk/sas/index.asp
WP – http://www.uwic.ac.uk/new/widening_participation/index.asp

University of Central Lancashire
Chemistry Dept – http://www.uclan.ac.uk/facs/science/index.htm
WP – http://www.uclan.ac.uk/facs/science/scibus_services.htm#schools
Physics & Astronomy Dept – http://www.uclan.ac.uk/facs/science/physastr/index.htm
WP - http://www.uclan.ac.uk/facs/science/physastr/schools/index.htm

City University
Physics & Astronomy Dept – http://www.city.ac.uk/sems/
WP - http://www.city.ac.uk/sems/schools.html

University College London
Chemistry Dept – http://www.chem.ucl.ac.uk/
WP - http://www.chem.ucl.ac.uk/schools/index.html
Physics & Astronomy Dept – http://www.phys.ucl.ac.uk/
WP - http://www.phys.ucl.ac.uk/department/department.php

University of Coventry
Chemistry Dept – http://www.corporate.coventry.ac.uk/?d=1949
WP –

De Montfort University
Chemistry Dept – http://www.dmu.ac.uk/faculties/hls/index.jsp
WP –

University of Derby
Chemistry Dept –
WP (general) –
http://www.derby.ac.uk/C1_SchoolsLiaison.asp?MenuID=2&ContentID=8

University of Dundee
Chemistry Dept –
WP (general) – http://www.dundee.ac.uk/learning/wasc/
Physics Dept – http://www.dundee.ac.uk/elecengphysics/
WP (general) – see chemistry

University of Durham
Chemistry Dept – http://www.dur.ac.uk/chemistry/
WP – http://www.dur.ac.uk/science.outreach/
Physics Dept – http://www.dur.ac.uk/physics/
WP - http://www.dur.ac.uk/physics/outreach/

University of East Anglia
Chemistry Dept – http://www.uea.ac.uk/cap/
WP – http://www.uea.ac.uk/cap/schools/welcome.htm

University of Edinburgh
Chemistry Dept – http://www.chem.ed.ac.uk/
WP – http://www.chemicalconnection.org.uk/
Physics Dept – http://www.ph.ed.ac.uk/
WP - http://www.scifun.ed.ac.uk/main.html

University of Essex
Chemistry Dept –
WP (general) – http://www.essex.ac.uk/wp/
Physics Dept – http://newton.ex.ac.uk/

University of Exeter
WP (general) - http://www.uwe.ac.uk/widen/

University of Glamorgan
Chemistry Dept – http://www.glam.ac.uk/saps/
WP (general) – http://www.glam.ac.uk/schools

University of Glasgow
Chemistry Dept – http://www.chem.gla.ac.uk/index.html
WP –
Physics & Astronomy Dept – http://www.physics.gla.ac.uk/index.html
WP - http://www.physics.gla.ac.uk/misc/teachers/index.html

Glasgow Caledonian University
Chemistry Dept – http://www.gcal.ac.uk/esd/index.html
WP (pedagogy) – http://www.gcal.ac.uk/esd/research/pedagog/index.html

University of Greenwich
Chemistry Dept – http://www.gre.ac.uk/schools/cls/cls_index.html
WP –

Heriot-Watt University
Chemistry Dept – http://www.hw.ac.uk/chewww/welcome.html
WP –
Physics Dept – http://www.phy.hw.ac.uk/
WP - http://www.phy.hw.ac.uk/events/main.html

University of Hull
Chemistry Dept – http://www.hull.ac.uk/chemistry/
WP - http://www.hull.ac.uk/chemistry/research_groups.php?group=ed
Physics Dept – http://www.hull.ac.uk/physics/
WP –

Imperial College London (University of London)
Chemistry Dept – http://www3.imperial.ac.uk/chemistry
WP - http://www3.imperial.ac.uk/chemistry/schools
Physics Dept – http://www.imperial.ac.uk/physics/
WP –

Keele University
Chemistry Dept – http://www.keele.ac.uk/depts/ch/chemhome.html
WP –
Physics & Astronomy Dept – http://www.phys.keele.ac.uk/
WP - http://www.phys.keele.ac.uk/community/commun_prog.html

University of Kent
Chemistry Dept – http://www.kent.ac.uk/physical-sciences/
WP - http://www.kent.ac.uk/physical-sciences/schools/index.htm
Physics & Astronomy Dept –
WP - http://www.kent.ac.uk/physical-sciences/schools/index.htm

King's College London (University of London)
Physics Dept – http://www.kcl.ac.uk/kis/schools/phys_eng/physics/top.html
WP (general) – http://www.kcl.ac.uk/learningteaching/liaisons/schools.html

Kingston University
Chemistry Dept – http://www.kingston.ac.uk/cps/
WP –

University of Lancaster
Chemistry Dept – http://www.lancs.ac.uk/depts/chemistry/
WP –
Physics Dept – http://www.lancs.ac.uk/depts/physics/physics.htm
WP - http://www.lancs.ac.uk/depts/physics/Physsoc/outreach.htm

University of Leeds
Chemistry Dept – http://www.chem.leeds.ac.uk/
WP - http://www.chem.leeds.ac.uk/Schools_liaison.php
Physics & Astronomy Dept – http://www.physics.leeds.ac.uk/pages/HomePage
WP – http://www.physics.leeds.ac.uk/pages/FunPhysics

University of Leicester
Chemistry Dept – http://www.le.ac.uk/chemistry/
WP - http://www.le.ac.uk/chemistry/resschools.html
Physics & Astronomy Dept – http://www.le.ac.uk/physics/index.shtml
WP - http://www.le.ac.uk/physics/outreachhome.shtml

University of Liverpool
Chemistry Dept – http://www.liv.ac.uk/university/Chemistry/
WP – http://www.liv.ac.uk/chemistry/Events/SchoolsEvents/
Physics Dept – http://www.liv.ac.uk/physics/
WP –

Liverpool John Moores University
Chemistry Dept – http://phc.livjm.ac.uk/
WP - http://phc.livjm.ac.uk/newsarticle/0000000061
Physics & Astronomy Dept - http://www.astro.livjm.ac.uk/
WP - http://www.schoolsobservatory.org.uk/

London Metropolitan University
Chemistry Dept – http://www.londonmet.ac.uk/depts/hhs/
WP –

Loughborough University
Chemistry Dept – http://www.lboro.ac.uk/departments/cm/
WP –
Physics Dept – http://www.lboro.ac.uk/departments/ph/
WP –

University of Manchester
Chemistry Dept – http://www.chemistry.manchester.ac.uk/
WP (general) – http://www.manchester.ac.uk/visitors/community/schools/
Physics & Astronomy Dept – http://www.physics.man.ac.uk/
WP - http://www.physics.man.ac.uk/generalinfo/schools.html

Manchester Metropolitan University
Chemistry Dept – http://www.chem-mats.mmu.ac.uk/home_page.htm
WP (general) – http://www.manchester.ac.uk/visitors/community/schools/

University of Newcastle-upon-Tyne
Chemistry Dept – http://www.newcastle.ac.uk/nsci/
WP - http://www.newcastle.ac.uk/nsci/about/schools/ask_a_boffin.htm

University of Wales, Newport
Chemistry Dept –
WP (general) – http://www.newport.ac.uk/sclo/index.htm
Physics Dept –
WP (general) – see chemistry

Northumbria University
Chemistry Dept – http://northumbria.ac.uk/sd/academic/sas/cfs/
WP (general) – http://northumbria.ac.uk/brochure/visit/el/visits/

University of Nottingham
Chemistry Dept – http://www.nottingham.ac.uk/chemistry/
WP - http://www.nottingham.ac.uk/chemistry/general/outreach.php
Physics & Astronomy Dept – http://www.nottingham.ac.uk/physics/
WP –

Nottingham Trent University
Chemistry Dept – http://www.ntu.ac.uk/science/index.html
WP - http://www.ntu.ac.uk/cels/
Physics & Astronomy Dept – http://www.ntu.ac.uk/science/
WP – http://www.ntu.ac.uk/science/school_news/index.html

Oxford University
Chemistry Dept – http://www.chem.ox.ac.uk/
WP (general) – http://www.ox.ac.uk/business/rlo.shtml

University of Paisley
Chemistry Dept – http://www.paisley.ac.uk/es/index.asp
WP (general) – http://www.paisley.ac.uk/guidancestaff/education-liaison/index.asp
Physics Dept – http://www.paisley.ac.uk/es/physics/index.asp
WP - http://www.paisley.ac.uk/es/physics/schools.asp

University of Plymouth
Chemistry Dept - http://www.plymouth.ac.uk/pages/view.asp?page=6193
WP –

Queen Mary, University of London
Chemistry Dept – http://www.sbcs.qmul.ac.uk/
WP (general) – http://www.qmul.ac.uk/undergraduate/educationliaison/index.html
Physics Dept – http://www.ph.qmul.ac.uk/
WP - http://www.ph.qmul.ac.uk/~adams/schools/

Queen's University, Belfast
Chemistry Dept – http://www.ch.qub.ac.uk/
WP – http://www.ch.qub.ac.uk/schools.html
Physics Dept – http://www.qub.ac.uk/schools/SchoolofMathematicsandPhysics/
WP (general) –
http://www.qub.ac.uk/home/QueensintheCommunity/OutreachtoSchools/

University of Reading
Chemistry Dept – http://www.chem.rdg.ac.uk/
WP - http://www.chem.rdg.ac.uk/teachers/teachers.html
Physics Dept – http://www.rdg.ac.uk/Physics/
WP (general) – http://www.rdg.ac.uk/wideningparticipation/

Royal Holloway, University of London
Physics Dept – http://www.ph.rhul.ac.uk/
WP - http://www.ph.rhul.ac.uk/schools/schools.html

University of Salford
Physics Dept – http://www.cse.salford.ac.uk/
WP - http://www.cse.salford.ac.uk/schools/

University of Sheffield
Chemistry Dept – http://www.shef.ac.uk/chemistry/
WP - http://chemistry-schools.dept.shef.ac.uk/
Physics & Astronomy Dept – http://www.shef.ac.uk/physics/
WP – http://www.shef.ac.uk/physics/contacts/schools-information/talks.html

University of Southampton
Chemistry Dept – http://www.chem.soton.ac.uk/
WP - http://www.chem.soton.ac.uk/
Physics & Astronomy Dept – http://www.phys.soton.ac.uk/
WP –

Staffordshire University
Chemistry Dept – http://www.staffs.ac.uk/schools/sciences/
WP - http://www.sciencelearningcentres.org.uk/WebPortal.aspx?page=10

University of St. Andrews
Chemistry Dept – http://ch-www.st-andrews.ac.uk/
WP – http://ch-www.st-andrews.ac.uk/outreach.html
Physics & Astronomy Dept – http://www.st-andrews.ac.uk/physics/
WP - http://www.st-andrews.ac.uk/physics/pandaweb/outreach/outreach.htm

University of Strathclyde
Chemistry Dept – http://www.chem.strath.ac.uk/
WP –
Physics Dept – http://www.strath.ac.uk/physics/
WP –

University of Sunderland
Chemistry Dept – http://hnss-web.sunderland.ac.uk/
WP –

University of Surrey
Chemistry Dept – http://www.surrey.ac.uk/Chemistry/
WP – http://www.surrey.ac.uk/SBMS/schools/
Physics Dept – http://www.ph.surrey.ac.uk/
WP - http://www.ph.surrey.ac.uk/outreach/schools

University of Sussex
Chemistry Dept – http://www.sussex.ac.uk/lifesci/index.php
WP (general) – http://www.sussex.ac.uk/wp
Physics & Astronomy Dept – http://www.sussex.ac.uk/physics/

University of Wales, Swansea
Physics Dept – http://www2.swan.ac.uk/physics/
WP – http://www.einsteinyear.org/

University of Teesside
Chemistry Dept – http://www.tees.ac.uk/schools/SST/
WP (general) – http://www.tees.ac.uk/depts/SchoolsColleges/
Physics Dept – http://www.tees.ac.uk/schools/SST/

University of Warwick
Chemistry Dept – http://www2.warwick.ac.uk/fac/sci/chemistry/
WP –
Physics Dept – http://www2.warwick.ac.uk/fac/sci/physics/
WP - http://www.physocwarwick.co.uk/

University of the West of England
Chemistry Dept – http://science.uwe.ac.uk/
WP –

University of Wolverhampton
Chemistry Dept –
WP (general) – http://www.wlv.ac.uk/Default.aspx?page=7965

University of York
Chemistry Dept – http://www.york.ac.uk/depts/chem/
WP – http://www.uyseg.org/
Physics Dept – http://www.york.ac.uk/depts/phys/
WP - http://www.york.ac.uk/depts/educ/projs/CIRSE%20homepage.htm

Notes: These references have been collected by an intelligent non-specialist. If a particular University and/or Department is not mentioned, then this is because it cannot be found easily!
WP is Widening Participation.
The list was prepared in June 2006.

Selected References

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http://www.bbc.co.uk/schools/communities/onionstreet/liveguests/profiles/averilmacdonald.shtml

"Getting Started in Pedagogical Research in the Physical Sciences", Norman Reid
http://www.physsci.heacademy.ac.uk/publications/practiceguide/gettingstarted.pdf

"Students & Science Report", OCR
http://www.gcse-science.com/file_downloads/pgd_files_218_2.pdf

"Science and the Public: A Review of Science Communication and Public Attitudes to Science in Britain" OST and the Wellcome Trust, 2000

"Science in Society", OST and DTI, 2005

Research and Information in Forensic Science: Implications for Higher Education, 2004
http://www.physsci.heacademy.ac.uk/publications/forensicscience/forensicsciencereport2004.pdf

BBC report summarising the state of Physics education
http://news.bbc.co.uk/1/hi/education/4450208.stm

"The Right Chemistry: The choice of chemistry courses and careers", Nick Jagger, Institute for Employment Studies, 2004

Centre for Effective Learning in Science (CELS). Nottingham Trent University
http://www.ntu.ac.uk/cels/

Centre for Open Learning in Mathematics, Science, Computing and Technology. Open University
http://cetl.open.ac.uk/colmsct/

Centre for Excellence in Innovative Physics Teaching. Open University
http://cetl.open.ac.uk/picetl/

Bristol ChemLabS CETL (Bristol Chemical Laboratory Sciences). University of Bristol
http://www.chm.bris.ac.uk

The Higher Education Academy
Physical Sciences Centre

...enhancing the student experience in chemistry, physics and astronomy within the university sector.

Physical Sciences Practice Guides are designed to provide practical advice and guidance on issues and topics related to teaching and learning in the physical sciences. Each guide focuses on a particular aspect of higher education and is written by an academic experienced in that field.

In the Physical Sciences, whilst reaching out to widen access is an important part of our agenda, we see Outreach activities as primarily being targeted at improving the recruitment and retention of students and more recently, playing a key role in promoting “strategic and vulnerable subjects” e.g. Physical Sciences, Engineering and Mathematics.

This document summarises the published information both in print and on the web which deal with the questions: “Why are students turning away from the Physical Sciences” and “How can we reverse this trend”. We also look at a selected number of initiatives that are actively generating materials and methods that might change the current situation.

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