

Outreach

A guide to working with
schools and colleges

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Averil Macdonald

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Glossary of Terms

Key Stages in England and Wales

The school career is divided into Key Stages dependent upon pupil age as follows:

- Key Stage 1 - School Years 1 + 2 - Ages 5 - 7 (infant school)
- Key Stage 2 - School Years 3 - 6 - Ages 7 - 11 (junior school)
- Key Stage 3 - School Years 7 - 9 - Ages 11 - 14 (lower secondary school)
- Key Stage 4 - School Years 10 + 11 - Ages 14 - 16 (GCSE years)

Beyond GCSE students move to Years 12 and 13 (equivalent to old Lower and Upper Sixth respectively)

In Year 12 most students in schools and colleges study 3 - 5 AS levels. These are one-year courses that can be modular or examined at the end of the year (linear). Some students will leave with AS levels as their highest qualification.

In Year 13 most students in schools and colleges study 3 - 4 A2 levels. These are the second year following the AS year course and students are awarded an A - level at the end of Year 13 based upon their combined performance during the AS and A2 course.

QCA

The Qualifications and Curriculum Authority (QCA) specifies the content of material taught at all key stages in England and Wales and the 'core material' required for GCSE, AS and A2 examinations.

Guidelines in Scotland

There is no prescribed national curriculum in Scotland however there are guidelines published by the Scottish Executive Education Department and Learning and Teaching Scotland to indicate the recommended content and levels in a range of subjects including science from age 5 - 14. Science is incorporated into Environmental Studies and content is defined in levels.

Typically the school sequence is as follows:

Level A	P1 & P2	(Ages 5 & 6 - Lower Primary School)
Level B	P3 & P4	(Ages 7 & 8 - Upper Primary)
Level C & D	P4 - P6	(Ages 9 - 11 - Upper Primary)
Level E	P7 - S1	(Ages 12 - 13 - Top Primary - 1 st year Secondary)
Level F	S1 - S2	(Ages 13 - 14 - Lower Secondary School)
	S3 - S4	(Ages 15 - 16 - Standard grade)
	S5	(Age 17 - Highers and Intermediate)
	S6	(Age 18 - Highers and Advanced Highers)

Advanced Highers are the re-named form of the Certificate of Sixth Year Studies.

SQA

The Scottish Qualifications Authority specifies the content of Standard Grade, Higher and Advanced Higher Examinations in Scotland.

Specifications

GCSE, AS, A2 Standard Grade and Higher examination requirements (content, skills, assessment methods etc) are detailed in the examination specification (once referred to as the syllabus). This comprises the core as defined by QCA plus additional material that varies with examination for England and Wales. SQA is responsible for defining the exam specifications in Scotland

Awarding Bodies

The Examination Specifications are defined by the Awarding Bodies (once referred to as the Exam Boards). In the UK the Awarding Bodies are:

Edexcel : www.edexcel.org.uk

AQA : www.aqa.org.uk

OCR : www.ocr.org.uk

WJEC: www.wjec.co.uk (mostly Wales)

SQA www.sqa.org.uk (mostly Scotland)

CCEA www.ccea.org.uk (mostly Northern Ireland)

Part 1: Outreach

First some data from England and Wales:

- At present around half a million students in England and Wales take Balanced Science GCSE double award (worth 2 GCSEs) or triple award (3 GCSEs in the separate sciences) every year. About 75000 take Single Award which still covers the three sciences but with reduced content.
- Some 50% of these students gain grades A* - C and may be eligible to go on to take AS and A - levels in *any* of the sciences.
- Less than 40,000 of these students choose to take AS level in Physics. About the same number take AS Chemistry each year
- Around 30,000 students pass A - level Physics or Chemistry each year
- Around 3,000 students in England and Wales go on to degrees in Physics or Chemistry each year
- Around 4,000 secondary schools and colleges offer A - levels in science in England and Wales. 600 offer Highers in Scotland.
- The number taking A - level in Physics has dropped from 33,000 in 1996 to 30000 in 2003.
- The number taking A - level Chemistry has dropped from 40000 in 1996 to 36000 in 2003.

Pause for Thought:

In England and Wales less than 10% of those eligible go on to take Physics or Chemistry at A – level.

Around 10% of 18 year old physical science students go on to take degree level in the physical sciences.

- the drop out is 90% at each exit point.

Also

Around 3,000 students from the 4,000 schools and colleges offering A - level sciences go on to take degrees in Physics or Chemistry each year.

Pause for Thought:

Each school or college in England and Wales sends on average fewer than 1 student per year to study Physics or Chemistry each year.

More detailed statistics are available on the websites
www.chemsoc.org/networks/learnnet/statistics.htm
policy.iop.org/Policy/Statistics

Other Useful Information

There are ~5500 secondary schools covering age 11 - 16 in England and Wales most with between 500-2000 students.

There are ~25,000 primary schools in England and Wales most with around 100-400 students.

The Science Curriculum in England and Wales

All state schools in England, Wales, Scotland and Northern Ireland follow their respective national curricula from ages 5 - 16. This means that all children study science from age 5 including doing experiments and investigations.

In England and Wales the National Curriculum is defined by the Qualifications and Curriculum Authority in terms of Key Stages:

- Key Stage 1 covers ‘infant school’ which comprises Years 1 & 2 (age 5 - 7)
- Key Stage 2 covers ‘junior school’ which comprises Years 3 - 6 (ages 7 - 11)
- Key Stage 3 covers lower secondary school and comprises Years 7 - 9 (ages 11 - 14)
- Key Stage 4 covers GCSE and comprises Years 10 & 11 (ages 14 - 16). Most students take Double Award (three sciences but equivalent to 2 GCSE passes). A few will take Single Award which still covers 3 sciences but with reduced content and is worth 1 GCSE pass. A few take Triple Award (equivalent to three science GCSEs)
- AS levels are usually taken in Year 12 (old lower sixth) - typically 4 subjects
- A2 levels are usually taken in Year 13 (old upper sixth) - typically 3 subjects

N.B. Some areas transfer students to secondary school at age 12 (after year 7) thus students cover the first year of Key Stage 3 in their Middle school.

The National Curriculum OnLine site on www.nc.uk.net/home.html links every National Curriculum programme of study requirement to resources on the Curriculum Online site www.curriculumonline.gov.uk. This website gives an online catalogue of digital learning resources searchable by Key Stage, subject and topic and indicates whether they are free or not.

To find the section you are looking for:

=> look for Science

=> go to the appropriate Key Stage (N.B. KS4+ relates to Double Award)

=> go to Sc3 (Materials and their properties - mainly Chemistry)

=> go to Sc4 (Physical processes - mainly Physics)

N.B. Sc1 focuses on the experimental skills students have to develop and Sc2 (Life Processes and Living Things) relates to biological topics.

And some data from Scotland

- All students must take at least 1 science at Standard Grade and more able students usually take two (though a small minority will take three).
- The transfer rate from Standard Grade to Highers is better than in England and Wales at around 55% for Physics and slightly lower for Chemistry and girls are retained as well as boys!
- Most students take English and Maths at Higher grade while Biology, Physics and Chemistry are the next three most popular subjects.
- By law in Scotland a subject can only be taught at school level by those fully qualified in the discipline. There is, at present, no shortage of teachers in Chemistry and Physics (but this may change over the next decade as the profession is top heavy by age).

The Science Curriculum in Scotland

There is no prescribed national curriculum in Scotland however there are guidelines published by the Scottish Executive Education Department and Learning and Teaching Scotland to indicate the recommended content and levels in a range of subjects including science from age 5 - 14. Science is incorporated into Environmental Studies and content is defined in levels.

Typically the school sequence is as follows:

Level A	P1 & P2	(Ages 5 & 6 - Lower Primary School)
Level B	P3 & P4	(Ages 7 & 8 - Upper Primary)
Level C & D	P4 - P6	(Ages 9 - 11 - Upper Primary)
Level E	P7 - S1	(Ages 12 - 13 - Top Primary - 1 st year Secondary)
Level F	S1 - S2	(Ages 13 - 14 - Lower Secondary School)
	S3 - S4	(Ages 15 - 16 - Standard grade)
	S5	(Age 17 - Highers and Intermediate)
	S6	(Age 18 - Highers and Advanced Highers)

Students often take 5 subjects at Higher level in S5 and then extra subjects at Higher level and 1 or 2 at Advanced Higher level. Advanced Highers are often seen as a valuable optional extra.

The National Grid for Learning Scotland website offers on-line resources for 5 - 14 and for Scottish National Qualifications (NQ). The complete guidelines for science can be found at www.ltscotland.org.uk/5to14

To find the section you are looking for

=> Click on 5 - 14 Guidelines

=> Click on Environmental Studies - Society, Science and Technology for the pdf

=> Scroll down to the green pages (science) for details of content and depth required at each level A - F

The Scottish Qualification Authority specifies content for all national qualifications (standard grade, highers and advanced highers)

See www.sqa.org.uk

Pause for Thought

In Scotland there is less potential for increasing the numbers taking Physics and Chemistry post-16. However, most who do these subjects are using them as a stepping stone to other areas such as medicine, dentistry etc. There may, therefore, still be mileage in projects that encourage these students to take Physics and Chemistry with a view to studying them at university.

BEST ADVICE

Don't start anything without asking a teacher for their advice. In the absence of a teacher then approach the Education Department of your University or the Local Education Authority or the relevant professional body.

What can outreach do for us?

- Increase the number of students applying to your department?
- Increase the number of students taking science to A - level/Higher level (from whom to draw your students?)
- Improve the perception of science among the population?
- Development for academic staff

All are worthwhile but what you wish to achieve will affect what you do and how you do it. Get it wrong and you are wasting your time.

Getting it right

To increase the number of applicants to your department

If you want to increase student applications to your department you need to raise the population's awareness of your department. If they don't know you exist they can't apply to you.

Applicants will not research every department in the country so they need to have heard of you before they start looking seriously. They also have more faith in you if they feel they have already heard of you (familiarity breeds security in this age of mass advertising). Discovering you for the first time at age 17 does not fill them with confidence that you can deliver the goods. While overt recruitment leaflets are useful they may come too late to have any impact on potential students. Conversely things they see and use around the school (over a period of time) that happen to carry your logo will embed themselves in your potential applicants' minds and make them feel they know you already and are worth thinking about seriously.

Ideas:

Produce resources for use in school

Posters, worksheets, books, homework activities, question sheets, data analysis exercises, web resources, CDROMs, datasheets, formula sheets or periodic tables etc. with your logo on start to raise awareness that you exist long before the Universities and Colleges Admissions Service (UCAS) round starts. But these must all be useful, not baldly advertising your courses. Despite the modern myth that people only value what they pay for, teachers love freebies. However, above all, teachers value directly useful material and will put it on the wall or use it in class. It has to be USEFUL!

N.B.

- Refer closely to National Curriculum requirements, GCSE/Standard Grade/Intermediate and A-level/Higher specifications to guide what you target.
- Talk directly to teachers to see how they work and what works for them.

Useful Websites

The Qualifications and Curriculum Authority (QCA) oversees the whole of the National Curriculum.

See: www.qca.org.uk

The National Curriculum OnLine pages give a complete overview of content and link to useful resources from which you may derive inspiration.

See: www.nc.uk.net/home.html

Awarding bodies in England and Wales specify the course content for GCSE (based on National Curriculum requirements with additions dependent on the body) and A - level examination. There may be different versions offered by one awarding body (e.g. Physics A, Physics B) but these differ more in their approach (i.e. modular vs linear) rather than content. An awarding body may have one topic it includes that is different from the rest e.g. telecommunications. Websites of the awarding bodies can be found at:

Edexcel: www.edexcel.org.uk

AQA: www.aqa.org.uk

OCR: www.ocr.org.uk

WJEC: www.wjec.co.uk (mostly Wales)

CCEA: www.ccea.org.uk (mostly Northern Ireland)

Search on GCSE Science or A- level Physics or Chemistry to download the pdf of the specification.

The curriculum guidelines and on-line resources in Scotland are best found through www.ltscotland.org.uk

The awarding body in Scotland SQA similarly specifies the exam requirements for Standard Grade, Highers and Advanced Higher examinations

See: www.sqa.org.uk

Offer Activities and Visits to your Department

Tasterdays, Masterclasses, Opendays, Summer Schools, visits to your department and undergraduate shadowing are great ways to show students what you are like. Often students will choose to apply to a department where they had a good experience. However schools will usually only send those students who are already intending to do your subject - you are preaching to the converted. You will rarely increase the number of students overall. You will simply confirm to those attending that this is what they do (or don't) want to do.

Masterclasses and Lectures in Universities should always target a particular element of the specification - perhaps a specialist option which teachers may be less confident in delivering than the more mainstream elements of the curriculum due to lack of resources. Again refer to awarding bodies websites (above) for details.

In England and Wales there are now specialist A - level specifications including Salters Chemistry (examined by OCR), Salters Horners Physics (examined by Edexcel), the Institute of Physics Advancing Physics (examined by OCR) and Nuffield Advanced Chemistry (examined by Edexcel). These differ from the more traditional courses in their approach and focus on more up to date applications of the

science. Reference to their specifications may provide ideas of topics for masterclasses or similar. Further information on each of these can be found at:

www.york.ac.uk/org/seg/salters/chemistry

www.york.ac.uk/org/seg/salters/physics

advancingphysics.iop.org

www.chemistry-react.org

Offer Lectures in the School

Lectures/talks in schools to A - level/Higher students are often highly valued by teachers. Giving students an insight into some cutting edge science may be the key to attracting more students into HE science courses. Even if these students do not come into your department directly if these types of activities are carried out across the UK then hopefully you will receive your share of additional applicants. Again topics directly related to specifications will be more valued.

Note that at the time of writing changes to the provision at A - level being considered in England and Wales (www.14-19reform.gov.uk) which may manifest itself as a Baccalaureate type qualification (entitled a diploma) will change the way students work. It is unlikely that the basic content of this qualification will be very different from present A - levels however more students may take the lower level science requirement. Depending on your department's requirements you may find this increases the pool from which you draw your applicants. The final report is due October 2004.

To increase the number of students going on to study post-16 - targeting 14-16 year old students

Some 300,000 students are eligible to go on to A - levels or Highers in the physical sciences each year, however only around 40,000 - 50,000 choose to do so (the proportion is far higher in Scotland at 55% than in England and Wales where it is a only 10%!). There is no doubt that the majority have already decided upon their post-16 subject direction (if not the details of which subjects) by the age of 15 (end of Year 10/S3).

In England and Wales the intention of the Dearing report to increase the number of subjects to 5 in year 12 and 4 in year 13 and to encourage students to take a wider range of subjects has, in reality, resulted in the majority of students taking 4 subjects at AS level and reducing to the usual 3 for A2 level. There is no evidence that this has resulted in a broadening of subjects studied in most cases and although the number taking AS level science is more than had been choosing A - level sciences before 2000, the number taking A2 level is still falling (though the pass rate is now extremely high due to the filtering effect of the AS level examination). As more than 90 percent of those taking A-level chemistry or physics do not go on to study a chemistry or physics degree, some may argue that increasing the numbers of students studying these subjects post 16 may have limited effect on the uptake of university courses. However as students make crucial decisions about their chosen future directions at the 14 - 16 age, 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.

Ideas:

Produce resources for use in 14-16 classes (GCSE & Standard Grade)

Teaching Resources which directly target elements of the 14 - 16 specifications 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. If these resources carry your logo, then students will begin to become familiar with your institution and also begin to realise that you are associated with the high tech elements of the subject they find fascinating rather than the more prosaic topics they learn from books. Refer to GCSE / Scottish Standard grade specifications from awarding bodies for ideas (see web addresses above).

Worksheets must be photocopiable or easily downloaded from your website or a CDROM (take care with images). They should fit onto an A4 sheet. They must provide information as well as activities such as questions, quizzes, wordsearches, 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. In fact teachers often appreciate questions at two levels - more demanding (higher reasoning and numerical skills) for those who find science easy and more straightforward (all the information required is found on the sheet) for the less able. Advice should be sought from an education specialist on this. Care should be taken using humour or cartoons as some students consider this to be patronising. 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. Use bullet points not prose. Animations that illustrate a phenomenon are particularly good as they can explain the concept better than a static diagram in a book. However some schools still have limited access to the web - especially for a whole class simultaneously. Supplying the material on a CDROM allows the school to network the materials.

N.B. Websites are subject to SENDA (Special Educational Needs and Disabilities Act 2001) legislation and as such care has to be taken to make them accessible to students with a range of special needs ranging from dyslexia to motor disorders and the visually impaired. Universities are already subject to this legislation in the production of their own webpages and advice should be sought within your institution on the requirements of this legislation. For more details see section on Legislation below.

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. Assume you are consolidating their knowledge rather than introducing the topic for the first time, as teachers usually like to introduce and cover the basics in a way they know their students will respond to, then follow up with a professional overview.

Careers Materials focussing on opportunities for those with science qualifications are sadly 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. Yet research has shown that some students do consider the career (and earning) potential when selecting subjects - hence the massive uptake of Law and Medicine. Interestingly surveys have also shown that the majority who are currently doing Physics at university chose it because they liked it and that they are unaware of the career possibilities. It is possible that those who did not choose it kept away because they were similarly unaware of the career possibilities! A wide range of material is available from both the RSC and IOP.

Offer Activities and Visits for 15 year old students

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 you will almost certainly have to restrict the number of students invited from any one school. This will result in teachers sending you the best students in your subject and you end up preaching to the converted again. While this has some value, it will not increase the number of students taking Physics or Chemistry post-16. You might like to set criteria for invites based on interest.

N.B.

- Don't underestimate the cost to a school of bringing students to your department - a fund to help with travel costs where required may increase uptake and ensure you attract all schools regardless of financial constraints.
- Conversely it is often worth charging a booking fee which is refunded when the school attends. This reduces the incidence of schools failing to turn up after a teacher has made a booking then discovered they aren't allowed to bring the group (or there is insufficient interest) and don't like to admit this to you by cancelling their booking. This charge does not dissuade schools from booking. Ask for a cheque that you will return on the day.

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 old students 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. The overriding value of these events is to enable students who may never have considered your subject, or even going to university at all, to see what's on offer. Teachers report that many young minds have been changed by their experience of general university visits. University Widening Participation Offices should be approached about organising university-wide open days for 15 year old students to raise their awareness of what science at university has to offer.

Offer Activities and Lectures at the School

School-based lectures must target the specification requirements closely and be of an appropriate level - some groups will be mixed ability and not all high flyers. Lectures 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. Ensure you take everything you need though most schools can now provide dataprojectors if given notice. Others have 'interactive white boards' which act like a giant computer screen. Whatever is on your laptop is on the whiteboard and you can drag a cursor round by touching the board directly. This also enables you to show a website live to a whole class.

School-based activity days (or experience days) where students try out a range of 'experiments' you have brought in have the benefit that they can accommodate all the students in a year group rather than the chosen few. Remember though that schools are often 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 French or PE for example.

Ideally the activities you bring in 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. The crucial thing is to be flexible in how many groups can be accommodated at any one time and how many times the event may be repeated during the day. Recognise that the schools themselves cannot be very flexible but don't take that as lack of appreciation or willingness on their part.

Also be aware that many schools use their main school hall for school lunches so any apparatus you bring in for the day to be used in the hall must be able to be dismantled and removed for the lunch hour. Alternatively devise your event 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. This may be guidance notes for teachers or worksheets for students.

N.B. Never expect a school to keep students behind to participate in your event as many are constrained by the buses that transport students home at night.

Competitions are popular with universities but not so 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. Organisations such as Institute of Physics (Paperclip Physics) RSC (Top of the Bench) and The BA (CREST Awards) organise competitions nationally. It is worth contacting your local branch to see if you can offer support or host a heat rather than competing with an event that is

already working in your area. Teachers are certainly unlikely to undertake two competitions at a time.

Information can be found at:

www.the-ba.net

For information on IoP education activities visit:

education.iop.org/Schools/suptstu/paperclip.html

For information on RSC education activities visit:

www.chemsoc.org/learnnet

www.chemsoc.org/networks/learnnet/ed_activitiespp.htm

www.chemsoc.org/networks/learnnet/ed_acts_s_c.htm

Science Ambassadors/Researchers in Residence

Schemes already exist which focus on pairing a university student (undergraduate or postgraduate) with a school. The student visits on a regular basis and gets to know a particular group. The aim is that the students share their enthusiasm for their subject with their young charges and relate to them better than an older teacher or lecturer may. To be successful the student has to be carefully chosen and trained. University Widening Participation Offices often oversee these schemes. Alternatively local Setpoints participate in a national scheme (Science and Engineering Ambassadors) while a different scheme is entitled the Undergraduate Ambassador Scheme. Finally EPSRC run the Researchers in Residence scheme aimed at pairing PhD and postdoctoral students with local schools. See:

www.setnet.org.uk for details of your local Setpoint office,

www.uas.ac.uk for the undergraduate ambassador scheme,

www.epsrc.ac.uk and extra.shu.ac.uk/rinr/site for the Researchers in Residence scheme.

Healthwarning: School students may perceive that an enthusiastic visitor dressed very casually is actually talking about their hobby rather than their job (after all, most people are enthusiastic about a hobby and less so about their job and most people dress more formally when at work). The school students may then agree that science is fascinating but do not make the link with the potential for a career and therefore still fail to get the message that science is worth studying to a higher level. Care should be taken about the unspoken messages being delivered.

What Else Is Out There

The Government is keen to encourage students to continue education beyond 16 and ultimately to go to university. Aimhigher specifically targets students with ideas and information to persuade them of the value of higher qualifications. For more information see:

www.aimhigher.ac.uk/dontstop/en/home/index.cfm

See also the HEFCE funded outreach project Chemistry: The Next Generation

www.rsc.org/outreach

Improving the perception of science among the population - targeting 11-14 year olds

Working with younger students cannot guarantee an increase in UCAS applications but may result in an overall increase in the number coming through to study science as time goes on.

In England and Wales 11 - 14 year olds are in Key Stage 3 which usually covers the first three years at most secondary schools (years 7 - 9 or P7 and S1 & 2 in Scotland). Typically students are still enthusiastic during Year 7/P7, bored during Year 8/S1 and world-weary, if not cynical, by year 9/S2. Many studies have tried to ascertain why there is this drastic fall off in enthusiasm for science over these three years. Blame has variously been laid on the content of the Key Stage 3 National Curriculum and the high number of teachers teaching outside their specialism in England and Wales and the hormonal changes experienced by the youngsters. It is certainly seen by students as 'not cool' to be interested in science. We may not be able to do anything about some of these possible causes. However anything we can do to persuade youngsters that science is worth considering is helpful. Often students are persuaded that a subject is worthwhile if they perceive it offers the possibility of a secure future (a job that pays a respectable salary - if, of course, they don't make it as a pop star or footballer).

Ideas:

Any of the activities listed for 15 - 16 year old (GCSE/Standard grade) students work for the 11 - 14 age range too e.g. *worksheets, web based resources, careers materials, CDRoms, lecture demos and activity days*. There is no doubt that teachers perceive that activity days for late Year 8 /S1 (age 13) and Year 9/S2 (age 14) are a particularly good thing as they have much trouble enthusing students of this age and consider that 'enhancement activities' are, therefore, particularly worthwhile. Indeed many schools put on themed days (careers days, science days, technology days, business days etc.) at the end of Year 9 after students have taken their SATs (late May) in England and Wales. It is worth contacting local schools to link up with them for these events.

Remember that pupils no longer make their choice of sciences at Year 9 in England and Wales so influencing them at this point isn't your 'last chance'. However at the time of writing the Tomlinson Report (www.14-19reform.gov.uk) is recommending significant changes to the 14 - 19 science provision. Students may opt for a single award which still covers a balance of sciences but aims to provide science for citizenship and will not provide a suitable basis for A - level. Only those taking the additional science option will be potential A - level candidates. Deciding not to take the additional science at age 14 will then prevent the student taking A - level so this will be a crucial point at which activities may influence the numbers taking A - level science. The final report is due October 2004.

Improving the perception of science among the population - targeting Primary schools - (Key Stages 1 & 2)

Primary school science has moved on a long way over the last 10 years with pupils undertaking quite elaborate investigations and dealing with complex ideas such as electricity, forces, light, sound, materials, changing state, separating materials even basic astronomy! For England and Wales the QCA website provides a list of topics and a complete scheme of work that teachers may follow for Key Stages 1 & 2 which will provide useful information on what pupils can and do undertake, as well as being a source of inspiration. In Scotland the 5 - 14 Guidelines provide similar information. Primary schools are typically more flexible in their ability to alter their timetable to accommodate a special event. Primary school teachers are also more than happy to invite in an expert as they often underestimate their own capabilities in teaching science, many having done little science beyond age 16 themselves.

Primary school pupils are undeniably enthusiastic about anything they are allowed to get their hands on. The trick is to allow them to get their hands on something so they feel they have really done something (with little supervision) but under safe conditions. The second trick is to remember that science at this level is more about experience than delivering detailed explanations. However beware of the awe and wonder approach, which leaves them thinking that science is simply a branch of magic and that it is therefore acceptable not to try to understand it. Often a briefing sheet for teachers to go over the ideas either before you visit or after the event helps pupils to assimilate all the new ideas you have introduced.

Demonstration lectures also work at this age but keep them short and ensure there is plenty of audience participation (including putting hands up to answer questions). Small prizes e.g. rubbers, toys, slime kits, for correct answers to questions are very popular.

Evaluation

Evaluation is often seen as post hoc, but for school-focussed activities the idea has to be evaluated long before the project gets off the ground. Talking to teachers or other education professionals about the feasibility of the idea at a very early stage is essential to be sure that schools are keen and able to participate. Then be prepared to trial it with teachers and a few tame students before the big launch.

During the event students often enjoy themselves so much that organisers are convinced that the event has been an undeniable success and show photos of smiling students as the only evidence anyone could need. However questionnaires for older students, and certainly for teachers, give a better view of whether the event was well targeted, whether the content conformed to the curriculum requirements and what may be improved. Build in time for the questionnaire within the event as this greatly improves response rate.

Advertising

National mailings will bring your resources directly into the hands of the appropriate teacher if correctly addressed. Mailing Houses such as Joynson Educational Mailing (JEM) and HEIST will mail anything to any geographical area - by postcode, within a radius, between certain lines across the country. They can also select schools by age range. Costs depend upon the number of items to be included in the envelope and the size and weight of the package. Typically a light package (less than 60g) with 1 insert in an A4 envelope mailed to every secondary school in the UK (5500) will cost around £1500. Mailing a CD with a covering letter to every secondary school is nearer £4000. Costs are pro rata for smaller groups.

Do not address the package to the Head Teacher or Head of Science if your item relates specifically to Physics or Chemistry as you cannot rely on the item being passed on. It is much more sensible to address it to the 'Teacher in charge of Physics' or 'Teacher in charge of Chemistry'. An Open Day or careers event for GCSE students may be addressed to the Key Stage 4 Coordinator. An event for primary schools should go to the Science Coordinator.

It is cheaper to share a mailing with others (mailing houses will offer a shared mailing as opposed to a solus mailing). This is less reliable as it requires someone (an overworked secretary) to open the package then put the relevant papers into the respective pigeon holes - which may not happen....

Contact:

www.jem.co.uk

www.heist.co.uk

Register Your Website

To ensure that schools get to know about your website it is possible to register it with a number of organisations:

Curriculum OnLine for anything up to the end of Key Stage 4 in England and Wales.

See: www.curriculumonline.gov.uk

National Grid for Learning for any age range. See: www.ngfl.gov.uk

For Post-16 use Ferl. See: ferl.becta.org.uk

For teaching resources use the Teacher Resource Exchange. See: tre.ngfl.gov.uk

Making Contact

Making Contact with your local schools

If you want to work with your local schools (to visit or to invite them in) then your university School Liaison Office may have an address list. Finding the right person and contacting them by name is far more effective than writing to the Headteacher. A quick phonecall to the school secretary will provide this information. Alternatively address the letter to The Teacher in Charge of Physics/Chemistry (secondary schools) or The Science Coordinator (primary schools). Avoid the 'Head of Science' title as

they may see your overtures to their colleague as poaching. Contact details for all the schools in your area can be found by entering the county and ‘schools’ into a search engine. (eg EduBase on DfES website at www.edubase.gov.uk).

The University Widening Participation Office will also have a list but theirs will focus on those schools that are identified as having low participation rates in higher education so may not include the full range of schools in your area. However, through Student Ambassador or similar schemes, their contacts being with named teachers may be more robust.

University Education Departments offering PGCE or BEd courses will also have reliable contacts with local schools in which they place students for teaching practice. In addition these same students may be happy to work as go-betweens encouraging schools to get involved in your event. Working with Education Departments can pay dividends.

Working with Others in the Field

Local Education Authorities (LEAs) have close contacts with state schools in the area. Some have dedicated Science Advisors, others have Key Stage 3, Key Stage 4 and A - level advisors. In some cases there will be an advisor dealing with Gifted and Talented students who will always be interested in any special activities you might put on for this select group. It is worth getting to know the local advisor for the subject or age range you are targeting as they will be able both to provide contacts and suggest topics or activities that would be well received.

Teacher Discussion Groups and Networks or In-Service Training are a good way to develop relationships with local teachers. University Education Departments and the Regional Science Learning Centres (www.sciencelearningcentres.org.uk) may already offer In-Service training and may welcome suggestions for topics or activities you could offer. Teachers respond to offers of courses that have a direct bearing on the subject content they have to teach. Local Education Authorities may also run discussion groups for science teachers so contact with them will ascertain whether such a group exists and what input you might have.

Science Centres

Many Hands on Science Centres have been established around the country. They are keen to bring in schools and may offer you the chance to participate in one of their events. They have the advantage of purpose built accommodation and lecture theatres which may not be available in a university. This is a good way to make a good impression on schools without the headache of organising things yourself. Details of Science Centres can be found at: www.ecsite-uk.net

Education Business Partnerships (EBPs) are charged with providing events linking education and businesses. They will be keen to invite you to put on a ‘stall’ at one of their events such as ‘Chemistry at Work’ (organised by RSC). This is again a good way to make an impression on schools without the organisation. Events are likely to be targeted at younger students (often Upper Primary school or 11 - 14, occasionally 14 - 16) rather than post-16.

The National Education Business Partnership Network is the umbrella organisation through which you can make contact with your local branch. See: www.nebpn.org

Your local *SETPOINT* may or may not be associated with the local EBP. However they also aim to put on science based activities for schools and will be interested to talk to you if you have an activity they can publicise or incorporate into a bigger event. Again events are likely to be aimed at 7 - 11 or 12 - 14 year old students. However SETPOINTS are also running a Science Ambassador Scheme for which your students may volunteer. SETNET is a UK wide charity that promotes science. From their website you can find your local SETPOINT. See: www.setnet.org.uk

Working with the Learned Societies/professional bodies

Learned Societies have very effective outreach activities with schools.

The Institute of Physics runs Paper Clip Physics competitions, School Lecture Series, Physics Teacher Update Courses and an initiative Supporting Physics Teachers which has associated area Teacher Networks through which teachers support each other to improve the provision of Physics teaching. Contact with the Education Department will put you in touch with your Local Area Teacher Network Coordinator who will provide a useful link into Institute Educational Activities with which you can collaborate.

See: education.iop.org

The Royal Society of Chemistry also has a very active education department which provides support for teachers including in-service training and a range of curriculum and careers resources and events for students such as Chemistry at Work and Top of the Bench. There are also a Chemistry Olympiad and Chemistry camps for students which are organized by Salters with RSC as one of the sponsors.

See: www.rsc.org/education

Other sources of ideas include the Institute of Materials, Minerals and Mining (IoM3).

See: www.iom3.org

and the Institution of Electrical Engineers (IEE).

See: www.iee.org/EduCareers

The Association for Science Education (ASE) also produces teaching resources. Their annual conference held in different locations in January is worth going to if only to get some idea of the wealth of good ideas already out there.

See: www.ase.org.uk

Working with the Research Councils

The Research Councils support many initiatives focussed on schools. Particle Physics and Astronomy Research Council (PPARC) produces a wide range of resources for schools and provides funding for researchers who wish to undertake outreach activities.

See: www.pparc.ac.uk/Pbl/pubs.asp#Other for publications and www.pparc.ac.uk/rs/fs/pu/funds.asp for Small Awards up to £10000 and Large Awards up to £100000

Engineering and Physical Sciences Research Council (EPSRC) runs the Researchers in Residence scheme and also provides Partnership for Public Awareness Awards. For details of their Public Engagement activities including their PPA awards scheme see: www.epsrc.ac.uk. Small awards are for projects up to £20,000 and standard awards are between £20,000 and £120,000. For projects bringing together a number of groups undertaking related activities awards of between £120,000 and £250,000 are available.

Legislation

Criminal Record Disclosure (CRD)

There has been a lot of news coverage of the need for people working with children to go through the Criminal Record Disclosure and some in universities have assumed, therefore, that they are no longer able to go into schools. This is not the case.

The CRD requirement only applies to those who are in sole charge of children or likely to be alone with a child. As schools will have at least one class teacher supervising the class while you undertake your talk/activity, this is deemed sufficient to ensure the safety of the students.

However, if you are inviting students to visit the university for an extended period and therefore to stay overnight then Criminal Records Bureau (CRB) disclosure will be required for all those in supervisory roles. Some universities will arrange for CRD for any member of staff or university student. Alternatively the Undergraduate Ambassador Schemes will also undertake CRD for anyone volunteering for their schemes. Your local SETPOINT is the best point of contact if you wish to make use of this.

For details of your local SETPOINT see: www.setnet.org.uk

For more information on the disclosure process and how to find an organisation to oversee your application see: www.disclosure.gov.uk

Special Educational Needs Disabilities Act (SENDA)

Special Educational Needs Disabilities Act legislation now requires that educational material including resources available via websites should be provided in ways that facilitate access by students with disabilities. For example dyslexic students may require the stylesheet to be changeable so that they can customise the page to suit their

preferred background colour and font, for example. Those with visual disabilities may require the font size to be increased or may use a page reader which requires all images to be defined and instructions such as ‘click here’ to be avoided. Universities are already producing their own web pages to comply with this legislation therefore advice should be sought from suitably qualified individuals within your own institution.

For more details of the web accessibility guidelines see: www.w3.org/TR/WCAG

To see how a page should be designed so that students with dyslexia can get the most out of it, look at www.dyslexia.com/qaweb.htm

Alternatively web pages can be trialled for accessibility:

To demonstrate how your page appears to someone with various forms of colour blindness, run it through www.vischeck.com

To identify the various elements that comply with accessibility guidelines and those that do not, run your page through bobby.watchfire.com/bobby or alternatively use wave.webaim.org

Finally for an example of good practice Betsie is the filter program used by the BBC to create an automatic text-only version of its website. This site contains full information about Betsie as well as pointers to accessible sites and resources across the web. See: www.bbc.co.uk/education/betsie

Sources of Money

The Higher Education Funding Council for England (Hefce) has provided universities with funding specifically earmarked for Widening Participation projects. Most institutions have now set up Widening Participation Offices which are using their funds to organise a range of projects focussed on encouraging under-represented groups into higher education. Depending on how your WP office works, there may be funding available for individual departments to put on events or produce educational resources to enhance science provision.

The Research Councils are a source of funding that can be used for projects with schools. *EPSRC Partnerships for Public Awareness (PPA)*. The maximum amount available is £250,000 but most awards will be for between £20,000 and £120,000. Small awards are up to £10,000. They do emphasise the need for value for money. See: www.epsrc.ac.uk

PPARC has a similar Public Understanding of Science (PUST) scheme with small awards (up to £10,000) and large awards (up to £100,000). The PPARC site also lists a number of other possible sources of funding but has not been updated recently so these links may not be as fruitful as hoped. See: www.pparc.ac.uk

COPUS offers small grants (£3000) for local projects and larger grants (£20000 for 2 years) for more substantial projects as well as grants specifically for events for National Science Week. See: www.copus.org.uk

Part 2:

Quick Reference guide

Who?

How many?

- Assume you will work with group sizes which are multiples of 30 or half year groups (typically 125) in secondary schools (ages 12 - 16)
- Post - 16 classes are smaller but schools try to have around 20 in a class if possible
- Primary school classes usually have 30 students.
- An average Primary school will have 1 class per year group thus the infants (age 5 + 6) will typically number 60 while the juniors (age 7 - 11/12) will number 120.

N.B. Schools are reluctant to extract a few students from a class for an event that excludes the rest. It's always worth assuming you will work with a whole group or none at all.

Which Age Group?

- Post - 16 level students have usually made up their minds about the subject and are unlikely to take notice of you if this is the first time they have heard of you - make contact earlier
- 15 - 16 year old students - especially 15 year olds are ripe for persuasion - but are very street-wise and don't like to be patronised. They are looking to establish a secure future for themselves.
- Lower secondary school students (especially age 13 - 14) are very difficult to motivate. This is when the innate enthusiasm for science wears off. A challenging age to work with.
- Primary school pupils are by far the most enthusiastic but care has to be taken to encourage them without implying it is all black magic.

What?

Content should be guided by:

- National Curriculum for England and Wales - web page information
www.qca.org.uk
www.nc.uk.net/home.html
- Scottish curriculum
www.sqa.org.uk
- GCSE / A - level specifications - web pages of awarding bodies
www.edexcel.org.uk
www.ocr.org.uk
www.aqa.org.uk
www.wjec.co.uk
- Scottish examination specifications
www.sqa.org.uk
- Specific A - level courses e.g.
Salters Chemistry www.york.ac.uk/org/seg/salters/chemistry
Salters Horners Physics www.york.ac.uk/org/seg/salters/physics
Advancing Physics advancingphysics.iop.org
Nuffield Advanced Chemistry www.nuffieldchemistry.org

When?

When in the school year?

- Give schools plenty of notice of events - 1 term minimum. In some cases schools determine their whole calendar 1 year in advance so repeated events often get better attendance.
- Good times for events:
Near Christmas for secondary schools but not for Primary
Around National Science Week (late March)
Towards end of Summer term (except for 16 year olds who will have left)
- Bad times for events include:
Early in September (timetable and courses not fully established)
January (AS and A2 level module examinations for England & Wales)
May (SATs for Primary and KS3 students for England & Wales)
Late May & June (AS, A2, Higher and GCSE exams)

Precise details of examination timetables can be found on exam board websites

www.edexcel.org.uk

www.ocr.org.uk

www.aqa.org.uk

www.wjec.co.uk

www.sqa.org.uk

- Good times for mailing resources to schools
Just after the beginning of term - especially September
Late May onwards as exam classes leave and teachers have time to read stuff
- Bad times for mailing resources to schools
During or just before a school vacation including half term holidays
July for independent schools as their school year finishes earlier than state schools

N.B. Some Education Authorities in England and Wales are introducing a 6 term year with a 2 week break at the end of October and end of May and a fixed 2 week break at the end of March regardless of when Easter falls. Check with colleagues with school age children what the system is in your area.

Independent schools typically finish their school year at the beginning of July so cannot attend events beyond that time (a popular time with universities as undergraduates have left).

When in the school day for activity days?

- Keep events to approximately school lesson length : 50 - 70 mins
- Expect to start at 9.00am at the earliest
- Plan to finish at 3.30pm - though some schools now run shortened days with 20 minute lunch times and students then leave around 2.30. Running after the end of school day cannot easily be accommodated due to school buses.
- Expect school lunch to be around 12.00noon and school halls are used for lunch so cannot be left full of chairs or apparatus

Where?

Your place or mine?

- In school has the advantage that all students can attend, not just the chosen few
- In the university has the advantage that they see the science and what the university is like
- The disadvantage of bringing students to the university is the cost to the school and the difficulty of a teacher and class being given permission to come out for a full or half day
- Schools may fail to turn up to events at the university after booking. A small booking fee refunded on attendance reduces the incidence of no-shows.

Where in the school?

- In schools the school hall can be used for large events by arrangement but often has to be used for lunch which limits apparatus or chairs being left out
- School labs usually have fixed (often island style) benches but demo lectures are possible to classes of 30
- Schools may have a lecture theatre or drama studio which will accommodate a lecture. Often they are well set up with data projector and /or interactive whiteboard

How?

Resources:

Posters, worksheets, books, homework activities, question sheets, data analysis exercises, web resources, datasheets, formula sheets, periodic tables, careers materials.

Activities in university:

Masterclasses, visit days, lectures, taster days, competitions, undergraduate shadowing, Summer Schools, Open Days

Activities in schools:

Lectures, Experience Days, Themed Days, Competitions, Student Ambassadors, Researchers in Residence.

What else is out there

Other providers of school activities and information

Aimhigher campaign www.aimhigher.ac.uk/dontstop/en/home/index.cfm

QCA www.nc.uk.net/home.html

Institute of Physics education.iop.org

Royal Society of Chemistry www.rsc.org/lap/educatio/rsedhome.htm

and www.chemsoc.org/learnnet

Institute of Minerals Mining and Materials www.iom3.org.uk

Institution of Electrical Engineers www.iee.org.uk/EduCareers

PPARC printed and web based resources www.pparc.ac.uk

EPSRC Researcher in Residence www.epsrc.ac.uk

SETPOINTS and Science Ambassador schemes www.setnet.org.uk

The Undergraduate Ambassador scheme www.uas.ac.uk

EBPs as providers of local science activities www.nebpn.org

Science Centres as providers of science events www.ecsite-uk.net

CREST awards from BA www.the-ba.net

Useful people to know

LEAs (science advisors or KS2/3/4 or A - level advisors)

University PGCE and BEd departments - direct contacts with schools

University Widening Participation Offices

KS3 consultants

REMEMBER

Don't start anything without asking a teacher for their advice. In the absence of a teacher then approach the Education Department of your University, the Local Education Authority, Professional bodies or the Association for Science Education (ASE).

This practice guide is primarily written for academics in physical sciences departments of higher education institutions in the UK who are interested in student recruitment, widening participation and the promotion of the physical sciences to a wider audience.

It provides:

- advice on how to increase applications to physical sciences departments
- an introduction to evaluation of outreach activity
- ideas for promotion and advertising
- notes on the relevant legislation
- links to sources of funding for outreach
- advice on making the right contacts
- a quick reference guide