

# What should be expected of successful engagement between schools, colleges and universities?

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**ABSTRACT** Transition from school to university is a very large step for some students. This account describes how the Chemistry Department at Bristol University arranges engagement activities (workshops, practicals, lectures, tours, etc.) for school groups and their teachers. The intention is to show the students what chemistry at a university is like and enable them to work alongside undergraduate and postgraduate role models. The practical arrangements for these links are explained as well as what can be expected of both parties. Many of the ideas and activities described could be applicable to most university science departments and the schools in their surrounding areas.

Engaging with a university chemistry department brings myriad benefits to secondary school chemistry teachers and their students. In general, these benefits fall into two broad categories: curriculum support and aspiration raising. In this article we look at the range of opportunities available to engage with a university chemistry department, based on those provided by the School of Chemistry at Bristol University and elsewhere, and provide a teacher's perspective on these. The engagement will mainly fall into the category of student-aimed outreach, but will also touch upon continuing professional development for teachers.

## Communication

How do secondary schools begin to engage with a local university department? Over a number of years, Bristol has developed a number of ways of easing communication. First, on our departmental webpage (see *Websites*) we have a link taking the enquirer directly to our outreach website. Sadly, a recent survey we conducted found that only 25% of chemistry departments have such a link. If a teacher encounters a webpage that does not have an obvious link we suggest that they email or telephone the head of department of that university to find out whom to contact. In our case, the website then

provides information on whom to contact and how, lists regular events, forthcoming events, and past events and their reports, and offers the possibility of bespoke events. Second, we invite teachers to join CHEMneT, our school teacher network (see *Websites*). The teacher will automatically receive an e-newsletter twice a term, providing information on activities we run, and also, occasionally, those of neighbouring institutions such as the Science Learning Centre. New enquiries are handled by either the school teacher fellow (Shallcross and Harrison, 2007a,b) or the outreach director, and a dedicated secretary administers CHEMneT activities. For all events our website provides a description of the activity, health and safety requirements and, where possible, *PowerPoint* presentations to be used. We have the advantage of having a full-time school teacher fellow who scrutinises activities to ensure that they will be appropriate for the year group in terms of language and level.

Once you have identified the liaison officer or outreach director (an academic within the department) within a chemistry department do not be afraid to arrange a meeting with them to discuss the activity with which you wish to engage. In our experience, before we had a full time school teacher fellow (an in-house school teacher), we consulted regularly with our

school teacher network to ensure that events and activities were pitched at the right level and were what the schools wanted. University departments would welcome a proactive school teacher who would work alongside their liaison officer to develop events.

## Types of engagement

Many types of engagement are offered by universities. Those listed are the main outreach activities offered at Bristol. Other universities would put on some of these during the course of a year depending on their available resources.

### Lectures and conferences at the university

These are fairly common and are put on by the chemistry departments themselves, by the Royal Society of Chemistry (RSC) or by commercial organisations who do this as an income stream. Teachers should expect the level of communication for any such talk or demonstration to be appropriate for the target audience. The themes may be either supportive of the school examination specification or of a broadening type. Both have their place. A conference is made up of several such talks by experienced performers. At Bristol we always try to finish a conference of two or three talks with a lecture–demonstration. One advantage of students coming to a university to see such talks is that they experience a lecture theatre (and possibly more if there are tours as well) and can start to picture themselves as undergraduates in the coming years. Moreover, such visits to universities are now useful for completion of some sections of the university application (UCAS) forms!

### Lectures in schools themselves

It is not always possible to get large groups of students out of schools for an hour or even an afternoon's conference. At Bristol we provide a number of short talks and lecture–demonstrations that are portable and so can be delivered in a school hall to entire year groups during their normal lesson times. Moreover, some of the demonstrations and talks can be delivered up to five times in a single day at the appropriate levels for the students attending, so that all the school may have the experience. This can constitute over 1000 interactions in a single school day. We at Bristol have also provided school conferences held at a host school where students from neighbouring schools can attend more easily.

This cuts down the time and cost of transport for students and teachers but does lose the 'university visit' element.

### Workshops and aspiration-raising days

On many Wednesdays throughout the year we at Bristol make our undergraduate teaching labs available to school groups ranging from year 5 to year 13 (ages 9–18) through our Schools Laboratories Programme (see *Websites*). These sessions give an insight into what it would be like to read for a science degree in a modern university department. The students spend around two and a half hours in the practical labs working with postgraduate chemists (who are enrolled in the STEM Ambassadors programme – see *Websites*) undertaking, for example, circuses of experiments, a lengthy synthesis or a natural-product extraction. The practical work typically involves materials, techniques or equipment not normally available to the majority of schools. Examples include extraction of caffeine from tea or the synthesis of biodiesel, amongst many others. In the afternoon students experience the lecture-theatre side of the life of an undergraduate. They receive a talk from the Widening Participation and Undergraduate Recruitment Office (see *Websites*) on 'What it is like to be a student', followed by an appropriate talk from a postgraduate on an aspect of his/her research suitable for the audience, and finally a lecture–demonstration again reinforcing some aspect of the scheme of work appropriate for the age of the students.

### Competitions

Bristol, along with many other UK universities, hosts competitions organised by both the RSC and the Salters' Institute to promote chemistry to several different age groups (see *Websites*).

### Spectroscopy tours

To support teachers and post-16 students with their understanding of spectroscopy we hold several morning and afternoon sessions for groups of up to 50 students at a time. Here the school students are split into small groups and are guided around the department, visiting five different areas of analytical chemistry. All tours have sessions in mass spectrometry, infrared spectroscopy and nuclear magnetic resonance, and two from ultraviolet-visible spectroscopy (UV-Vis), X-ray crystallography and scanning electron microscopy. Each 20-minute session

is given by a technician, postgraduate chemist or an academic member of staff who is used to interacting with school students and knows what elements are covered within examination specifications. Where possible, students gain hands-on experience through running spectra on infrared and UV-Vis spectrophotometers. Whilst being guided around the labs, students get to talk informally with the postgraduate chemistry guides. We usually accommodate 550–700 students and their teachers per year on these sessions. If your local university chemistry department does not already run such sessions, they are quite straightforward to set up at a basic level and this would be an excellent way to begin a partnership between a school and university department.

National provision to support such visits is available from the RSC *Chemistry for our future* (CFOF) initiative through the ‘Spectraschool’ resource and, in some areas, ‘Spectroscopy in a suitcase’ (see *Websites*).

### Summer schools

Summer schools are a compendium of other outreach engagements. They are heavily based on practical work with talks, lectures, lecture–demonstrations and cultural activities completing the jigsaw. Attendees at summer schools should have their aspirations raised and be more aware of what their potential futures as undergraduate scientists will entail. Bristol has for many years hosted summer schools for the Salters’ organisation as well as running its own. Increasingly, summer schools at Bristol see parties of overseas students joining the programmes, which adds a further dimension to the cultural aspects. Organisations such as Salters, together with the RSC, organise a number of 2.5-day Salters Chemistry Camps throughout the UK for year 10s (ages 14–15) with a limit of two students per school.

Bristol is unusual in that some of its summer schools are hosted by two different chemistry departments. These involve half a week spent at Trinity College Dublin as well as at Bristol.

### Timing

We have noted that good outreach activities are put on at the appropriate times of the year, avoiding exams and so on. Notification is sent out to schools as early as possible and at least a term, preferably several months, before the event. Care is taken to

ensure that the activity does not start before 10 am, to allow schools time to travel; liaison and some flexibility on start times is important for schools that have to travel long distances. At Bristol, UK groups regularly travel up to 2.5 hours each way for activities.

Of course, a university department’s prime activity is to teach undergraduates. Consequently it is not possible to undertake activities in a university department at all times in the year; school teachers need to take this into consideration. University departments also need notice for requests to engage; they cannot put activities together at short notice with the possible exception of departmental tours. Laboratories and other teaching spaces are booked out at the beginning of the year. In Bristol, the university policy is to have no lectures on a Wednesday afternoon, to allow undergraduate students to play sports. Since the teaching laboratories would be open for only 1–2 hours on a Wednesday, the School of Chemistry do not run undergraduate practical teaching on these days. Therefore, we open our laboratories for use by schools on Wednesdays in term time; this may not be the case for other departments. Sheffield has a dedicated school laboratory that was originally funded by *Chemistry for our future* and can be booked at any time of the year.

Staff from the department can, however, visit schools with less restriction on their time and this may be an important consideration when designing an outreach event. For example, a secondary school could run a mini conference on its own premises, populated by academics from different departments or from different universities (probably covering travel and subsistence costs).

The numbers engaged by university departments will vary enormously depending on the event and hence availability of equipment, and so on.

### Finance

All outreach activities cost the university department money and in a practical subject such as chemistry this is considerable. For example, a day spent by a school student working in a university laboratory will typically cost around £50, covering chemicals, other consumables and staff costs. There is no pot of money (no matter how small) provided to departments by

Government or other groups to support outreach activities on a continual basis. There are initiatives from time to time, such as one run by the Higher Education Funding Council for England, which ended in June 2009. In chemistry this scheme (called *Chemistry: the next generation* and later CFOF) was brokered by the RSC, but the money available was insufficient to support all university chemistry departments and, indeed, Bristol received none specifically for outreach. Consequently, departments must cover the cost of these activities by applying for grants from various funding agencies (time consuming and not guaranteed to succeed), absorbing the cost into the departmental budget (a reason why many departments are reluctant to engage in a lot of outreach) or charging the recipient at least part of the cost of the activity.

In our experience, making a charge, no matter how small, for the activity has two main benefits. First, it allows us to recoup some of the very real costs. Second, school teachers and their students value the activity and the number of cancellations drops dramatically. Given that we often have a waiting list for our activities, a last-minute cancellation is a most unwelcome occurrence for us and for schools who could have taken up the place. We engage with around 30 000 school students a year and this presents a very significant cost to us in resources. Once again, a proactive school teacher who engages with the liaison officer in the development of the event should expect a reduced cost for their school.

We have assembled a list of possible sources of funding a school can approach (see *Websites*). One often-untapped source is the school's local section of the RSC. You can find out details of who the secretary is from the RSC website and write to them. Depending on the time of year a response may take several weeks so be patient, but most sections are delighted to support this kind of activity.

### Departmental tours

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At Bristol, when time permits, all visitors from secondary schools are taken on a tour of the department. Typically the tour will last about 20–30 minutes and, depending on the activity that the school has come to take part in, will include visits to a lecture theatre, the library, social areas, the teaching laboratories and some research laboratories. The tour will be conducted

by an academic or a postgraduate research student (someone who has completed a first degree in chemistry), so that they can answer questions about a university degree and university life. These tours allow the school students to see what a university chemistry department is like and to contrast this with their school environment. The tours also give teachers the opportunity to experience university – for some this may be the first time for a while – and to ask questions. All departments run tours during UCAS interviews (all chemists together) and open days (possibly with parents), where students are not with their classmates and teachers. We often find that groups on school class tours ask a lot more questions and the scope of these questions is wider, quite possibly because they are with a familiar group. Therefore, if a school visits a university department for an activity they should ask to have a tour of the department. This is an easy thing to arrange and most departments will be happy to accommodate such requests.

### Postgraduates trained to work with school students

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At Bristol we recognise the importance of training postgraduate students who take part in the large array of outreach activities we run. To this end, all our postgraduate students involved in outreach take part in the STEM Ambassadors programme (see *Websites*). This is a national scheme that recruits students and others working in science, technology, engineering and maths and trains them to work with school-age students. The training includes appropriate communication, an understanding of the UK school education system and the roles and responsibilities of a STEM ambassador going into a school. It undertakes Criminal Records Bureau (CRB) checks on all scheme members and those who are part of the scheme are insured by it. In addition to this nationally recognised scheme we also provide additional informal training for our postgraduates depending on the activities they are working on. The advantage of using postgraduate students is that they are excellent young role models for school students, coming from a variety of backgrounds and being at most 10 years older – and often much less – than the secondary school students with whom they engage. This is a welcome contrast to even the youngest academic member of staff, likely to be in their 30s, and the stereotypical academic who will be

similar in age to the school student's own parents. On many occasions we have observed excellent interactions between postgraduates and school students, with the students feeling more confident asking the postgraduates questions than they would an academic.

### Risk assessments

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Academic staff should be aware that schools are now requesting risk assessments for activities to be collected as part of the paperwork trail leading up to a visit. The risk assessments for the parts of the premises to be used, such as lecture theatres, as well as for the individual practical work undertaken should be made available to teachers. This process is a two-way street. Part of the risk assessment for those who wish to be in the undergraduate teaching laboratories includes the need for participants (including supervising teachers) to wear trousers and totally enclosing shoes. Unlike schools we like trainers! Too often students are not made aware of this by the organisers and, embarrassingly for those concerned, on occasions accompanying staff are not made aware before crossing the threshold of the department. However, risk assessments should not be a barrier. Once a teacher has made contact with the department it is wise to request all relevant information. Even better is to have a planned meeting where these data can be sourced and risk assessments completed together. Once again, we have developed a number of risk assessments for different types of event and would be happy to share these exemplars with departments and schools.

### Continuing professional development

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Continuing professional development (CPD) for science teachers is a very necessary task that university chemistry departments should aspire to deliver. Large numbers of school students below A-level have their chemistry delivered by non-chemistry specialists. In order to support these non-chemistry scientists, departments should seek to assist in the CPD of local teachers. At Bristol the teachers who attend any of the suite of outreach activities benefit from the same

instruction, lecture–demonstrations and informal education that their students receive – if they so wish. Bristol ChemLabS also strives to run CPD for teachers on leading-edge science such as climate change, nanochemistry and spectroscopy. We have also run ‘show and do’ days, which concentrate on practical skills for less experienced teachers of chemistry. Many of these courses are free of charge to members of our chemistry network (CHeMneT), but other courses are run through the network of Science Learning Centres.

### Feedback

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In order to further improve our outreach events we solicit feedback from teachers and/or students. The feedback can be in a number of forms, the most frequently used being questionnaires, either paper or through electronic voting systems (‘zappers’). However, verbal and email feedback is also desirable. Other forms of feedback that are routinely collected at Bristol include newspaper articles generated by the schools themselves, references to activity within school websites, newsletters, postcards and letters sent by the students themselves. There is a second value to some of the feedback in that comments can also be used in grant applications or reports to secure future funding.

### Summary

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A great number of activities can be provided by university chemistry departments such as Bristol (Harrison and Shallcross, 2006) that would be of benefit to both secondary-aged school students and their teachers. The first hurdle that any teacher needs to overcome is finding the right person to contact within a given chemistry department. All chemistry departments have liaison officers but finding out about the activities that they provide may take a few phone calls as it is not always obvious from departmental websites.

Any teacher of chemistry who would like to join CHeMneT to find out about the activities being provided at Bristol University's School of Chemistry (Bristol ChemLabS) should email [sue.williams@bristol.ac.uk](mailto:sue.williams@bristol.ac.uk). There is no charge.

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### References

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Shallcross, D. E. and Harrison, T. G. (2007b) The impact of school teacher fellows on teaching and assessment at tertiary level. *New Directions*, **3**, 77–78.

### Websites

Bristol Chemistry Department: [www.chm.bris.ac.uk](http://www.chm.bris.ac.uk)

Chemistry for our future (RSC, 2007): [www.rsc.org/images/110714-CFOF\\_tcm18-65221.pdf](http://www.rsc.org/images/110714-CFOF_tcm18-65221.pdf)

CHeMneT: [www.chemlabs.bris.ac.uk/outreach/chemnet](http://www.chemlabs.bris.ac.uk/outreach/chemnet)

RSC: [www.rsc.org](http://www.rsc.org)

Salters' Institute: [www.salters.co.uk/institute](http://www.salters.co.uk/institute)

Schools Laboratories Programme: [www.chemlabs.bris.ac.uk/outreach/chemnet/Chemnet\\_Bristol\\_ChemLabS\\_Schools\\_Laboratories\\_Programme.html](http://www.chemlabs.bris.ac.uk/outreach/chemnet/Chemnet_Bristol_ChemLabS_Schools_Laboratories_Programme.html)

Sources of funding: [www.chemlabs.bris.ac.uk/outreach/resources/Sources\\_of\\_funding.pdf](http://www.chemlabs.bris.ac.uk/outreach/resources/Sources_of_funding.pdf)

'SpectraSchool' resource: [www.le.ac.uk/spectraschool/home.htm](http://www.le.ac.uk/spectraschool/home.htm)

'Spectroscopy in a suitcase': [www.le.ac.uk/spectraschool/sias/index.htm](http://www.le.ac.uk/spectraschool/sias/index.htm)

STEM Ambassadors programme: [www.stemnet.org.uk/ambassadors.cfm](http://www.stemnet.org.uk/ambassadors.cfm)

Widening Participation and Undergraduate Recruitment Office: [www.bristol.ac.uk/wideningparticipation](http://www.bristol.ac.uk/wideningparticipation)

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