

## THE SWEET SMELL OF SUCCESS: PRIMARY PUPILS STUDY FRAGRANCE SCIENCE AT A LEADING UNIVERSITY CHEMISTRY DEPARTMENT

Timothy G Harrison<sup>1</sup>, Dudley E Shallcross<sup>2</sup>, Amanda J Shaw<sup>3</sup>,  
Marcus I Medley<sup>4</sup> and Zoe Bell<sup>5</sup>

**Abstract:** The effect that a visit to a modern university chemistry department has on even the youngest of school pupils cannot be underestimated. This case study looks at one element of a project developed with five schools near Bristol, UK to enthuse and raise aspirations of a group of ten year old girls who have been identified as being disillusioned with science and mathematics at school. This outreach event involved the pupils visiting a university chemistry department and getting an insight into tertiary education whilst learning about perfume chemistry from both a theoretical and a hands-on level.

**Key-words.** Aspiration raising, primary-tertiary outreach, perfumes, fragrances, university.

### 1. Introduction

Thirty-seven female Year 5 pupils from four South Gloucestershire primary schools visited the School of Chemistry at the University of Bristol for a full morning of activity connected to perfume chemistry. These pupils were identified by their teachers as being disillusioned by their science and mathematics and the day's workshop was created as a result of a request by a local secondary science teacher. This was the first time that pupils as young as 9 and 10 years of age have been given access to the Bristol ChemLabS undergraduate teaching laboratory facilities. Bristol ChemLabS is the UK's Centre for Excellence in Teaching and Learning in practical Chemistry and is within the School of Chemistry, University of Bristol. As part of the Bristol ChemLabS project numerous outreach activities<sup>6</sup> take place during the year with both visits to primary and secondary schools as well as school students visiting the School of Chemistry's laboratories and lecture theatres [1-3].

### 2. The Event

The day's workshop started with a welcome and talk entitled 'Smelly Chemistry; the Chemistry of Fragrances' in one of the department's lecture theatres. The talk was an opportunity to embed some key terms that would be used in the laboratory such as 'solution', 'mixture', 'gas', 'liquid', 'vapour'

<sup>1</sup> School of Chemistry, University of Bristol, UK, e-mail: t.g.harrison@bristol.ac.uk [Corresponding author]

<sup>2</sup> School of Chemistry, University of Bristol, UK, e-mail: d.e.shallcross@bristol.ac.uk

<sup>3</sup> Formerly at School of Chemistry, University of Bristol, UK.

<sup>4</sup> Formerly at School of Chemistry, University of Bristol, UK.

<sup>5</sup> Stroud High School, Stroud, Gloucestershire, UK, zbell@stroudhigh.gloucs.sch.uk

<sup>6</sup> Bristol ChemLabS Outreach website, <http://www.chemlabs.bris.ac.uk/outreach/primary/>

and 'volatile'. The interaction of fragrance molecules with the brain was also touched upon as well as the connectivity of smell with 'taste'.

The talk was illustrated by a few chemistry demonstrations that are not typically seen by such young pupils. Liquid nitrogen and dry ice experiments were used to look at changes of state. The potential dangers of the alcohol present in fragrances were discussed from both the need to add the equivalent of 'Bitrex<sup>TM</sup>' to fragrances to make the alcohol solvent unfit to drink and to the dangers of the flammability of the alcohol by a spectacular controlled explosion of alcohol vapour. Examples of fragrance component molecules that were once extracted from plants and animals that are now synthesised in a laboratory were experienced by the pupils and their teachers. These included a material called civet that is used in many expensive perfumes that originally was obtained from the anal glands of the civet cat. The idea that the children had smelt a cat's bottom was met with horrified expressions!

After leaving the lecture theatre through a crowd of 300 bemused engineering students awaiting their turn to use the lecture theatre, the students were split up into their small groups and were taken on a 20 minute tour of the department. The guides were mainly young, female research chemists who would be working with the pupils for the rest of the day. The pupils saw laboratories filled with exciting looking machines worth many millions of pounds and were taken past numerous research laboratories where research students working in glove boxes caused much discussion as several pupils in one group had seen them in use in a film. It was explained that they were employed when the chemicals being used or made were likely to be either too toxic to be in the air or that the chemicals may ignite in an oxygen atmosphere. Each group also visited the departmental library to note that it did not have any fiction books only books on sciences and mathematics! The pupils were amazed at the size of the department; Bristol has one of the UK's biggest Chemistry departments with around 1100 chemists working or studying there in term time.

A break for drinks and biscuits followed which gave the pupils opportunity to ask questions of their postgraduate guides about what they do and "What is it like to be at university?"

Practical work in the undergraduate teaching laboratories was next on the programme. The pupils were told about the potential risks present in a laboratory before being let in and given laboratory coats, safety glasses, elastic bands for long hair and disposable gloves; they looked the part of a Chemist.

There were two practical exercises so the group was again split. The first task was to make a molecular model of a fragrance compound from the selection present (Figure 1) Once the molecule was chosen for the individual or pair to make the pupils had the chance to smell the actual material that they were making the molecular model of. Once completed the young chemists were photographed with their molecule and given copies as souvenirs. The structures that the pupils were using were amongst those that Bristol had contributed to the 'www.makeitmolecular.com' website organised by Dr Graeme Jones (Keele University, UK).

The second exercise was for the pupils to prepare, bottle and package their own chosen fragrance. Five simple formulations containing three to five individual components were smelt and the pupils were given the choice of which they wanted to make individually. The pupils had to come up with a name for their fragrance. Having been shown how to correctly transfer the fragrance solutions from the stock bottles and how to use a top pan balance to weigh accurately (Figure 2) the pupils proceeded to make up their fragrances. The mixtures were then bottled, labelled and atomisers were inserted. Finally the packaging was assembled giving the pupils a professional looking product. The last thing that was needed was to write the contents on the fragrance box.

Feedback from a sample for the participating pupils (Table1) indicates a successful event with 100% of the feedback being positive. In response to the question 'How did it make you feel about science?' one pupil reported 'It inspired me to work harder not only on science but [in] every other lesson[s]. Today made me feel that science is a very great subject and I want to learn more!'. Another said 'I loved it so much..... Thank you for this amazing opportunity.'



**Figure 1:** Pupils display the models of fragrance molecules that they have made.



**Figure 2:** Pupils learn to use pipettes and to measure the masses of solutions accurately.

**Table 1:** Feedback from pupils from one school attending

Question	A lot /%	A bit /%	Not sure /%	Not very much /%	Not at all /%
I enjoyed learning about perfume chemistry	100	-			
Today made me like science more	86	14			
I learnt about what scientists do today	71	29			
I want to learn more about science after today	86	14			

Bristol ChemLabS outreach had been originally contacted to see if they could help with the project working on with local primary schools to engage disaffected young girls in Science and Mathematics. Zoe Bell, the organizing teacher said 'We were looking to organise trips and visits primarily with the identified group of pupils but also with others in the various year groups where possible under the general theme of 'natural products'. The general plan was to have an event to enthuse children in general with the amazing world of science, then to take an identified group containing some underachievers or disaffected female students in Science & Mathematics to see a university and do something hands on there. 'Narrowing the Gap' is funded by National College for School Leadership ([www.nationalcollege.org.uk/](http://www.nationalcollege.org.uk/) -) and invites schools to apply for a grant to support a joint project focusing on raising the motivation and engagement of pupils. Our project encourages pupils to learn about an application of science that is relevant to them, to hook them, and then to use this to tap into other areas of science. I remembered that Bristol ChemLabS did do a 'perfume' lecture a couple of years ago with scope to go to the labs to make some perfume/natural products and I know they can do the whiz-bang-fun chemistry sort of show too. I realised that this was for the upper Key Stages [secondary school students children], but asked if it would be possible to do something simple for the little ones? We had a little funding and this visit was the result.'

Prof. Dudley Shallcross, the Outreach Director for Bristol ChemLabS said, 'This was an outstanding event; seeing the excited looks on the students' faces was pleasing enough but hearing them enthuse about their experiences confirms the value of such events. We are delighted to now be able to welcome primary school students into our teaching laboratories and hope that this will continue.'

Simon Botten, Headteacher of Christchurch Primary School, whose pupils were involved reported 'The girls came back absolutely full of it today. I'd say it was a resounding success..... They were also treated as returning heroes by the younger girls who were queuing up to sample their perfumes!'

Some additional quotes from pupils from one of the schools involved in the day included: "It was so cool at the university - that's the university I want to go to."

"All the teachers were real scientists - and they were all girls!" Whilst this was not true the predominance of the female postgraduates, postdoctoral chemists and female technician chosen for the project had the intended 'role model' effect.

"I really want to study medicine now - I'm going to have to learn really hard at school now." [...]'and these were not our high flying girls' (teacher)]

The pupils attending this event were: Beacon Rise Primary, Hanham Abbots Primary, Our Lady of Lourdes Primary and Christchurch Primary schools.

## Conclusion

Projects such as these clearly have an immediate attitudinal and aspiration raising effect on the youngsters and, possibly, their peers. Even at this young age pupils can benefit from getting an insight into tertiary education whilst learning about fragrance chemistry from both a theoretical and a hands-

on level. Bristol ChemLabS will continue to offer these workshops and will assist other chemistry departments in doing the same if asked.

### Literature

1. A Griffin A., Harrison T.G. and Shallcross D.E. '[Primary circuses of experiments](#)' 2007. Science in School, **7**, Winter. Also available at <http://www.scienceinschool.org/2007/issue7/primarycircus/> (last accessed May 2009).
2. Shallcross D.E., Harrison T.G., 'Why bother taking university led chemistry outreach into primary schools? Bristol ChemLabS Experience.' (2007). New Directions in the Teaching of Physical Sciences, Higher Education Academy Physical Sciences Centre, **3**, October, 41-44. Available within [http://www.heacademy.ac.uk/assets/ps/documents/new\\_directions/new\\_directions/newdir3.pdf](http://www.heacademy.ac.uk/assets/ps/documents/new_directions/new_directions/newdir3.pdf) (last accessed April 2010).
3. Shallcross D.E., Harrison T.G., Wallington S and Nicholson, H. (2006) 'Reaching out to primary schools: the Bristol ChemLabS experience' Primary Science Review, Association for Science Education, **94**, Sept Oct 19-22 available at: [http://www.ase.org.uk/htm/members\\_area/journals/psr/pdf/psr-94/reaching.pdf](http://www.ase.org.uk/htm/members_area/journals/psr/pdf/psr-94/reaching.pdf) (last accessed April 2010).

