

Evaluation of the Chemistry at Work events programme

Final Report

Pam Hanley and Mary Ratcliffe University of Southampton
April 2009



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EXECUTIVE SUMMARY

Aims and methods of the evaluation

The evaluation examined whether, and how, the aims of Chemistry at Work (CaW) are recognised and fulfilled through exploring the opinions of stakeholders involved in the events. The aims of CaW are:

1. 'to present a positive image of chemistry and the chemical sciences to young people at school or in college
2. to show the variety of what chemists do and how chemistry can be part of some jobs where it may not have been expected
3. to show that chemistry is an important part of the economy of the country
4. to show that chemistry is an interesting and exciting way to earn a living
5. to show that chemists are real people.'

CaW events are varied. There is an indication in the CaW organisers' handbook that the 'typical' event as far as pupils are concerned is a half-day circus of CaW presentations at a regional venue. However, there are variations on this – with some events focusing on a whole day for one school or incorporating aspects of other sciences as well as chemistry. Eighteen of 25 CaW events during the period June – November 2008 were the main subjects of this evaluation.

The main questions for the evaluation focused on themes relating to: achievement of aims; impact of events; barriers to participation; opportunities from participation:

1. What are **attendees' views** of the CaW events? To what extent are the events seen to be fulfilling the aims of the programme? What impression and understanding of Chemistry do attendees gain and what impact does this seem to have on immediate future behaviour?
2. What are **organisers' and presenters' views** of the CaW events? To what extent are the events seen to be fulfilling the aims of the programme? What is the impact of the event on future involvement in CaW events?
3. What are **gatekeepers' (those assisting attendance by presenters and audience) views** of the CaW events? To what extent are the events seen to be fulfilling the aims of the programme? What is the impact of the event on future involvement in CaW / RSC events?

4. What are **potential attendees' views** of CaW events? What are the barriers to participation and how might they be overcome?
5. What are **potential contributors' views** of the CaW events? What are the barriers to participation and how might they be overcome?

Attendees, organisers, presenters and gatekeepers were sampled through focusing on events and by collection of data through evaluation questionnaires, focus groups, individual/paired interviews and observations.

Potential attendees and potential organisers and presenters were sampled outside events and by collection of data through focus groups.

Key outcomes

There was strong evidence that the events **met the declared aims**. In particular the 'variety of what chemists do' was perceived to be met most strongly with the positive image, with 'chemists as real people' and 'with interesting jobs' also featuring highly.

In general, the CaW events were seen as **very positive and successful** by all participants, exceeding pupils' expectations of the event and modifying their view of chemistry. This evaluation had very little opportunity to explore any follow-up work in schools, but there was some evidence that follow-up was limited, perhaps because of attendance of part classes at many events, and dependence on the enthusiasm of the pupils. At several events, the lack of a good handbook for pupils, which provided information about the particular Chemistry at Work event, limited the tangible impact of the events.

As CaW events are not principally career events, the short and longer term impact on career choice was not explored in this evaluation. However, there is some limited evidence of the impact of the event on **widening the views of pupils** in terms of their decision-making about career opportunities, and making them more aware of a broader range of where chemistry is used.

There were differences in how the events were received **across the age range**, although these tended to be a question of degree rather than major discontinuities. Generally, the youngest participants (primary age) were the most enthusiastic about the events and chemistry itself, and 11-14s (lower secondary) the least. This could be a result of several factors e.g. how attendees were selected and age-related responsiveness as well as the nature of the events themselves. For instance, it seemed

that the events aimed at 14-16s were perceived as having a more explicit job-related focus.

Presenters were generally positively received. They pitched their presentations at an appropriate level and explained ideas well. While many were seen as enthusiastic and interesting, there was a minority who seemed to have a negative impact on pupils, especially through use of non-interactive PowerPoint presentations.

Many presentations were interactive, as desired by pupils, and interactivity was achieved in various ways from pupil practicals to imaginative use of question and answer.

Training for presentations was not always taken up by presenters but was considered necessary by teachers for those unfamiliar with speaking to school children. Training that focuses on the likely level of pupils' knowledge at the relevant stage of the school curriculum as well as presentation skills was thought beneficial by teachers. The presenters' guides produced by the RSC do include short, relevant extracts from the curriculum (e.g. 'Materials and their properties/uses') and presenters' attention should be drawn to these documents.

Given the short length of some presentations there was not always the opportunity or inclination for presenters to open up discussion about the background to the presenter's job. **Greater opportunity for discussion,** with appropriate training of presenters, could allow more chance for pupils to explore 'chemists as real people' more fully.

Knowledge of CaW is high among RSC Local Sections, although direct involvement is not as frequent. Reasons for lack of involvement include sections already organising other activities that they see as contributing to similar aims.

Teachers' knowledge of CaW events outside the locations where these happen regularly seems limited. **There is enthusiasm from teachers for activities which support the aims of CaW.**

Those who organise and attend CaW events are very positive about the worth of the activity. Many see participation as related to the declared aims of CaW and enrichment. However, there are other reasons for participation which are related to individual development and corporate interests.

Where there is a choice to be made of which pupils should attend the event, there is a **tendency towards pupils already favourably disposed or high achievers.** It is thus disappointing that the positive impact of CaW

is not more widely available to the school population. However, it is recognised that there are limited resources available for expansion.

There is a strong sense in the data that, for well-run events, there is an annual expectation of provision and a loyal audience. Thus in some parts of the country CaW has become institutionalised as an important enrichment activity, and demand from schools often outstrips the number of places available. Such valuable activity should be continued. In addition, the RSC might consider whether alternative methods could be used to realise the same aims for the majority of schools who cannot attend such events.

All stakeholders identified similar barriers to organisation and participation by chemistry-based businesses. There is a sense that current events have developed a routine and show positive outcomes that ensure continuity, despite the barriers. If the difficulties of recruiting presenters persist or get worse, then some existing events might be under threat. In those areas where events have not yet happened, there are indications from stakeholders that CaW activities would be highly unlikely to take place because there is no impetus to overcome the barriers of time and resourcing.

The biggest barrier to CaW events is finding reliable and enthusiastic presenters who are able to commit the necessary time. All participants acknowledged the importance and value of high-quality presenters and appreciate their commitment (whether personal or by their employers). The majority of organisations and presenters are hugely committed to CaW events, at least in principle.

There seems no magic bullet to avoid last-minute cancellations by presenters. However, given the frequency of these, it would appear necessary to over-book the number of presenters. This would give more organisational slack on the day – a feature which may support pupils more effectively – but potentially necessitates more pre-planning and resourcing from the organiser.

Recommendations

The RSC should **continue to support CaW events** that are seen as successful, with a record of strong presenters and high uptake by regional schools.

The RSC may wish to **reconsider the aims** of CaW events and stress them to presenters and pupils. Aim 3 - chemistry as an important part of the economy of the country – is not easily met through CaW events.

The rest are all achieved well – but would benefit from reinforcement to organisers and presenters, particularly aim 2 – the variety of what chemists do and how chemistry can be part of some jobs where it may not have been expected. Additionally, it might be helpful to make the aims clear to pupils so that they are encouraged to have their perceptions of chemistry challenged and to be active in asking questions of the presenters.

Given the difficulty of retaining good presenters, RSC should **encourage presenters to attend training** and give some consideration to promoting presentation opportunities centrally or regionally. Alternatively RSC could collaborate with other regional-based organisations working in similar fields e.g. STEMNET to make a regional network of presenters more available.

Funding in terms of **payment to presenters is not recommended**, at least for those who would otherwise be paid by their organisation. It is unlikely this would operate as a method of overcoming the barrier of obtaining reliable presenters, because time rather than direct funding appears to be the obstacle. It should be made clear to presenters, however, that their inputs are valued by pupils and teachers and that legitimate additional expenses would be paid. Perhaps it could be linked to continuing professional development, for instance providing evidence of ‘a contribution to the profession of chemistry outside your direct work environment’ in the award of chartered chemist (CChem) status.

The **provision of feedback to presenters**, as already seen at some events via pupil and teacher evaluations, could prove helpful especially for those with little experience or confidence in engaging with pupils.

A **more effective handbook for pupils is needed** at many events. Currently its form and nature varies and it is not as effective as it might be in supporting the CaW event and demonstrating the excitement and variety of jobs involving chemistry. As any handbook is the tangible outcome that teachers can use to follow up the event with pupils, it might be useful for organisers and presenters to give more attention to its format and usability. Some generic activities for teachers to use after the event could be developed.

Presenters should be drawn from a range of chemical contexts. Some organisers were able to include presenters whose work is underpinned by the chemical sciences but whose jobs would not involve immediately obvious uses of chemistry (e.g. plumbing; first aid). At these events pupils tended to get a broader view of the potential of chemistry than at those events which

focused more on traditional uses such as analysis and synthesis (e.g. pharmaceuticals). It would be beneficial to encourage the use of presenters from a broad range of careers (in terms of type and required qualifications) to show the application of chemistry in as wide a context as possible. Such presentations may counteract the narrow view of a career using science, expressed by pupils in a recent survey: ‘Typical responses saw science as a job that was based in a laboratory all day, cut off from the world and with little chance to use communication skills’ (Porter & Parvin, 2008).

It is important that **CaW events should reach a full range of pupils**. The majority of events seem aimed at 14-16 year olds and are often attended by those who already have an interest in chemistry. It could be argued that ‘preaching to the converted’ is not the best use of RSC resources, particularly when there is evidence that pupils’ views of science-based careers are formed at an early age, between 9 and 12 (Porter & Parvin, 2008). Consideration should be given to encouraging organisers to aim CaW events at primary and lower secondary pupils, with a view to broadening the context of the use of chemistry in the workplace.

For young pupils it may be necessary to **give careful consideration to how the event is badged** and how the nature of chemistry is shown. There is a question as to whether events aimed at pupils below year 7 (S1 in Scotland; year 8 in Northern Ireland) should be called Science at Work rather than Chemistry at Work, as their views of chemistry are unrefined at that age. Alternatively, if the events are called Chemistry at Work, efforts should be made to identify the nature of chemical content even at this age.

Access to CaW events is not uniform across the country. Charging schools for attendance may skew participation even further towards those schools which have pupils already positively disposed to exploring careers in chemistry. To allow a much wider access to interesting opportunities, **RSC should consider funding additional activities** which have the same aims and potentially greater reach – e.g. interactive roadshows on specific themes; examples on DVD of a wide range of people demonstrating how they use chemistry in various and unexpected ways in their jobs. The government’s STEM (Science, Technology, Engineering and Mathematics) careers programme and sites such as www.futuremorph.org may also assist in this aspect.

1. Aims and objectives of the evaluation

1.1 Aims of the evaluation

The evaluation examined whether, and how, the aims of Chemistry at Work (CaW) are recognised and fulfilled through exploring the opinions of stakeholders involved in the events. The aims of CaW are:

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CaW events are varied. There is an indication in the CaW organisers' handbook that the 'typical' event as far as pupils are concerned is a half-day circus of CaW presentations at a regional venue. However, there are variations on this – with some events focusing on a whole day for one school or incorporating aspects of other sciences as well as chemistry. Eighteen of 25 CaW events during the period June – November 2008 were the main subjects of this evaluation.

Stakeholders were organised into different categories:

- 1) attendees (principally school pupils and their teachers)
- 2) organisers and presenters (e.g. Education Business Partnerships, STEMPOINTS, RSC Local Sections, scientists, teachers)
- 3) gatekeepers in assisting attendance by presenters and audience (employers, headteachers, RSC Local Sections)

The evaluation also explored the viewpoints of those who currently do not attend or contribute to CaW events but have the potential to do so:

- 1) potential attendees (teachers who have not attended CaW events)
- 2) potential organisers and presenters (RSC Local Sections)

The main questions for the evaluation focused on themes relating to: achievement of aims; impact of events; barriers to participation; opportunities from participation.

1. What are **attendees' views** of the CaW events? To what extent are the events seen to be fulfilling the aims of the programme? What impression and understanding of Chemistry do attendees gain and what impact does this seem to have on immediate future behaviour?
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1.2 Background

In exploring people's views of the CaW events, we built on two main bodies of work:

- a) The relationship between attitudes, beliefs and actions
 - b) The principles of effective evaluation research.
- a) The relationship between attitudes, beliefs and actions

The aims of CaW can be summarised as promoting positive attitudes to chemistry with a view to encouraging behaviour which recognises chemistry as a potentially interesting employment field. Attitudes express our feelings about an object, person, issue, or behaviour (Fishbein and Ajzen, 1975). Attitudes towards chemistry are a complex mixture of what is known about chemistry objectively, what is felt about it, favourably or unfavourably, and what one's intention or behaviour towards involvement in chemistry is. Knowledge of an issue is potentially a precursor to the development of, or change in, attitude. It is thus to be expected that the knowledge that pupils gain through attending CaW events could influence attitudes towards chemistry and thence future behaviour, although the relationship is not straightforward. Early studies on attitudes and beliefs were based on the assumption that attitudes could be used to predict behaviour, and that changes in attitudes should lead to changes in practice (Jones and Carter, 2007). However, many studies have now cast doubt

on the simplicity of this linear relationship (Ajzen and Fishbein, 1980; Hungerford and Volk, 1990; Zint 2002; Jones and Carter, 2007). Attitudes are more likely to change if individuals are offered successive opportunities to engage with the object or issue, especially if this is direct experience (Fazio and Zanna, 1981). Thus, although the evaluation attempted to examine impact on future behaviour of pupils and teachers, its major focus was on knowledge gained and attitudes towards chemistry.

b) Principles of effective evaluation research

The methods follow principles of effective evaluation research (Rossi, Lipsey & Freeman, 2004). In this context the evaluation focused on the extent of the achievement of the aims of the programme, through systematic data collection and analysis. The principles adopted include:

- collection of multiple data sets with similar focus in order to support triangulation, enhance reliability and compare views of different stakeholders
- ethical principles of integrity, honesty and respect for people. Informed consent was obtained from all participants, with confidentiality and anonymity in data collection and analysis assured. Data collection and analysis complied with the requirements of ethics and governance of the University of Southampton and the Data Protection Act.

1.3 Research methods

At the time of the research being commissioned, 41 CaW events were planned across the year, 2008, with additional events awaiting confirmed dates. This formed the basis for determining the sample.

Twenty-five events took place across the period of the evaluation June-November 2008. Of these 25 events it was planned to survey c.50% through questionnaires to participants and stakeholders and to attend an additional 6 as in-depth case studies. In practice, evaluation questionnaires were distributed for 18 of the 25 events, with 6 of these being attended.

As indicated above, stakeholders were organised into different categories:

A. Attendees, organisers, presenters and gatekeepers in assisting attendance by presenters and audience

These were sampled through focusing on events and by collection of data through evaluation questionnaires, focus groups and observations.

B. Potential attendees and potential organisers and presenters

These were sampled outside events and by collection of data through focus groups.

A questionnaire was sent to all RSC Local Section committee secretaries listed on the website (34). It sought information on both current and future involvement in the CaW programme, including non-participation – exploring issues of participation in the local context.

1.3.1 Sampling through events

For most of the events between mid-June and November the evaluation was conducted through a survey seeking feedback on the operation and impact of the event in achieving the aims of CaW.

For a further 6 events, a researcher attended personally in order to acquire more in-depth data from interviews, focus groups and observation. The events were chosen to represent a spread in terms of pupils' age, type of catchment (single school versus several) and geographical location.

1.3.2 Coverage of questionnaires

The evaluation questionnaires were designed to focus on achievement of the aims of the programme and impact on pupils, through an examination of perceptions of content, accessibility, types of knowledge and understanding gained, motivation and interest. For each of the categories of respondents, there were some questions in common and some distinct to the category.

In particular, all questionnaires to those who attended the events in whatever capacity had the same question on views related to achievement of the aims and the nature of presentations.

Questionnaires are shown in appendices 1-7.

1.3.3 Sampling of participants completing questionnaires

The pupils and teachers were sampled, as far as possible, by seeking responses from at least 50% of participating schools by random sampling by school type for each of the events. Questionnaires were sent out 1-2 weeks after the event, where term dates allowed. At events which the researchers attended in person, teachers were given the questionnaires on the day and asked to facilitate completion within the next week or so. To encourage response, schools returning the survey were entered into a prize draw for £50 of book tokens. Consequently, return was logged at a school level although individual questionnaires were completed anonymously.

Organisers and presenters were emailed immediately

after the event with a prompt to a URL for an online questionnaire and the option to request a paper-based one if they preferred.

The method of contacting gatekeepers governing attendance depended on category. Headteachers were asked to fill in a paper questionnaire. Presenters were asked to provide contact details for their line managers who were then contacted by email and asked to fill in the survey online (or posted a paper questionnaire if no email address was supplied). Line managers were asked about reasons for engagement, barriers to and opportunities from participation.

1.3.4 Evaluation from observations and focus groups (6 events)

For the circus of activities, the researcher circulated with one group and observed, using an observation schedule (appendix 8). The aim was to gauge audience interest and participation, log type of content, and note expected and apparent gains by pupils.

The pupil focus groups consisted of 6 pupils and were carried out either on the day of the event or very shortly afterwards. They lasted for 20-30 minutes, and examined participants' opinions about chemistry and their perceptions of the aims of the event. Teachers were interviewed singly or in pairs at the event or afterwards. Presenters were interviewed during breaks at or after the events. As with pupils, interviews with teachers and presenters focused on their perceptions of the presentations as showing the breadth of chemistry and their opinions of the impact of the presentations. (Appendices 9-11 show topic guides for focus group and interview.)

1.3.5 Potential participants

One focus group of non-participating teachers was conducted in order to explore potential engagement with CaW and whether aims can be fulfilled in other ways. We also held a focus group of non-participating potential presenters / organisers using members of an RSC Local Section which is currently not engaged in the CaW programme. A key feature of these focus groups was a card sort exercise to prioritise those gains and barriers which arose from questionnaire data, adding some depth to the core data. (Appendices 12 & 13 show the topic guides for these focus groups.)

1.4 Data collection

1.4.1 Chemistry at Work events – questionnaire data

For a total of 18 of 25 events (from mid-June to mid-November 2008), organisers, pupils, teachers, headteachers, presenters and their line managers were canvassed through paper or online questionnaires.

Responses were received from 613 pupils and 60 teachers, representing 53% of the 64 schools canvassed. The age profile of the pupils who responded was as follows:

- 13% 11 and under (primary¹)
- 29% 11 – 14 (lower secondary)
- 58% 14 – 16 (upper secondary)

None of the respondents was in post-16 education. Just over half (52%) were female. Schools were asked to enable pupils to complete the questionnaires about a week after the event, although in a few cases the turnaround had to be much quicker to fit in with the end of term.

Most organisers (16 out of 17, ie 94%) responded to the online questionnaire, and the response rate for presenters is also high at 68% (71 out of 104 contacts).

As might be expected for individuals less directly involved, the relative return rates among gatekeepers were somewhat lower, at 44% for line managers (yielding 14 questionnaires) and 36% of those headteachers contacted (21). (Several presenters chose not to provide line manager names, either because it was not applicable e.g. they were retired or self-employed, or they were reluctant to make demands on their manager's time or – rarely – to avoid drawing attention to their involvement in the CaW event).

Although the response rate for some events was below 50%, the overall numbers are sufficient to provide good evidence of the nature and outcomes of the events collectively.

1.4.2 Chemistry at work events – attended by researchers

Six events were attended by a researcher in person, following a cohort of pupils through the events and conducting interviews and/or focus groups with presenters, teachers and pupils. Studying these events

¹ In Scotland, primary education continues to the age of 12 but none of the respondents fell into this category

in greater depth has allowed more detailed exploration of specific themes. In total, 38 sessions were observed, 14 focus groups were held with pupils, 10 interviews with teachers and 11 with presenters, as well as more casual discussions during the events. One of these events focused on 9–11 year olds (primary); two for 11–14 year olds (lower secondary); two on 14–16 year olds (upper secondary); and one event spanned the latter two categories (13–15 year olds).

1.4.3 RSC Local Sections

All 34 Local Sections were sent a questionnaire to complete electronically or on paper. 25 (74%) responded to the questionnaire and one responded separately.

1.4.4 Potential attendees

A focus group was held with potential attendees, i.e. science teachers from a range of secondary schools.

1.4.5 Potential organisers / presenters

One RSC Local Section committee of 8 people took part in a focus group discussion as potential organisers / presenters.

1.4.6 Reliability of data

Some of the sample sizes reported here are small (e.g. line managers and headteachers). However, although the response rates were uneven, all exceeded 35% - significantly so in most cases – and consequently we are confident in the reliability of the resultant samples, given the high percentage of events sampled within the timeframe.

1.4.7. Analysis

The research questions and the aims of CaW formed the framework for analysis: i.e. achievement of aims; impact of events; barriers to participation; opportunities from participation.

All questionnaire data was subject to quantitative analysis, using descriptive statistics.

All focus group discussions were transcribed. Observation data and focus group discussions were subject to qualitative analysis focusing on the key themes in the framework for analysis.

Given the variety of presentations and events, themes were examined across the data sets to establish clear findings, regardless of the detailed nature of the event. Triangulation of data through common questions to different respondents assisted identification of prominent outcomes.

1.5 Summary of data collection

stakeholder	data collection	sample size obtained
RSC local section	evaluation questionnaires	26 local sections
pupils attending	evaluation questionnaires focus groups / interviews observation	613 questionnaires six events
teachers attending	evaluation questionnaires focus groups / interviews	60 questionnaires six events
organisers	evaluation questionnaire	16 organisers
presenters	evaluation questionnaire focus groups / interviews	13 events 71 questionnaires Six events
gatekeepers	evaluation questionnaire	14 business / line managers (presenters) 21 headteachers (attendees)
potential attendees	focus group	one
potential organisers/ presenters	focus group	one

Questionnaires were sent to teachers and pupils from 18 events – returns represent 17 events.

2 MEETING THE AIMS OF CHEMISTRY AT WORK

This section outlines the extent to which the aims of Chemistry at Work were seen to be met by participants and stakeholders. Each of the aims is considered individually, drawing on the complete data sets.

Additionally, unintended outcomes, which were evident in the data, are also discussed.

2.1 Presenting a positive image of chemistry

Survey responses from the pupils about their reasons for attendance (see Table 4.2) suggest that many of them were already fairly favourably disposed towards chemistry. Many also indicated attending because of it being a different experience to school. The focus groups revealed a more complex picture.

As would be expected, pupils' views of chemistry as a subject area were heavily influenced by their school experience. Several described their chemistry lessons as 'boring' with a decidedly theoretical slant. Whilst they enjoyed doing practicals, such opportunities were reported to be infrequent and often not very exciting. These pupils had developed their expectations of the CaW event accordingly, and were pleasantly surprised:

'I thought you'd just have to sit and listen to people talking'

Pupil aged 14-16

P1: ***At school it's boring***

P2: ***You do boring experiments ...***

P3: ***Measurements and stuff rather than liquids***

Pupils aged 10-11

'Every time I go into science, I'm oh no not this lesson because you just carry on talking and talking but when she told us that story and the <demo of liquids reacting> thing, I thought that was really good'

Pupil aged 12-13

Quite a few teachers were attracted to the CaW event because it gave the opportunity to show pupils aspects of chemistry they were unable to demonstrate in the classroom, especially to communicate its more exciting side: ***'I think the atmosphere, the occasion, the surroundings were all ideal from the point of view of introducing these children to an element of chemistry being fun'*** (Primary school teacher).

Two in five pupils (41%) said their view of chemistry had

been changed by the event, including the majority of primary age children (60%). When asked how their view had changed, the most common response was that it had revealed to them the wide range of jobs which used chemistry (70 mentions) (table 2.1). (See section 2.2 for further discussion.) The second most popular answer was because chemistry had been shown to be interesting, and to a lesser extent exciting/fun/cool: ***'I used to think science wasn't that fun but we had a chance to do much more'***. Several pupils commented on the range and importance of chemistry: ***'because we saw ... chemistry is exciting and valuable in jobs'***. Other responses related to learning more about chemistry in general or in relation to specific presentations. Although gaining knowledge about chemistry is not an explicit aim of the CaW events, and certainly not a focus, learning is a key motivator for many young people (and they may not necessarily have been referring to school-related content knowledge). It was also a factor in discriminating between sessions that were enjoyed and those that were criticised (See section 3.2). Only a tiny handful of pupils now held a more negative opinion, e.g. ***'It's put me off chemistry and made me appreciate physics'***.

Table 2.1: How pupils' view of chemistry changed

Percentage of views	
28	wide range of jobs use chemistry
20	chemistry more interesting/not boring
10	chemistry can be exciting/fun/cool
14	learnt/know/understand more about chemistry (general)
3	learnt/know/understand more (presentation-specific)
7	range of chemistry
4	importance/value of chemistry

N= 246 pupils

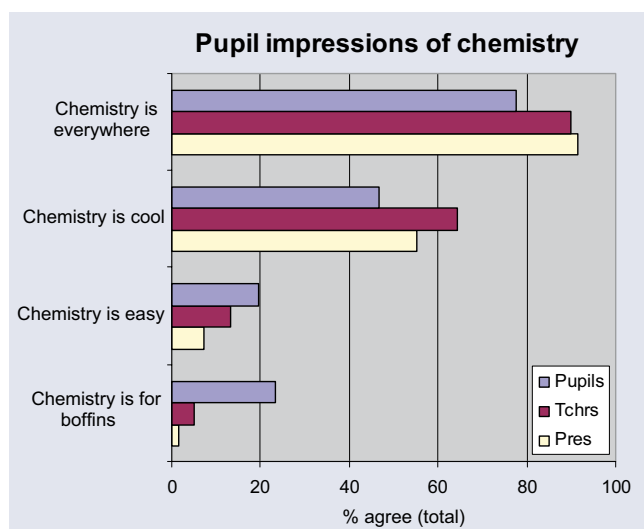
Similar feedback was received from the focus groups, with several participants saying their view of chemistry had changed, invariably in a positive way: ***'I thought it was pretty boring but then a lot of the things I saw made you think, actually I want to learn more .. about materials and things'*** (Pupil aged 14-16).

Only a minority of teachers (12 out of 60) said the event had changed their views about chemistry, and – as with the pupils – it was the diversity of chemistry and its applications that was most likely to have struck them (***'I***

was surprised at how many jobs have chemistry links'). Headteachers felt their staff had benefited from seeing the relevance of chemistry outside the classroom, gaining ideas for incorporation into their teaching, and sometimes also enhanced motivation: **'Enthusiasm for the subject, increased anecdotal information for use in lessons. Improve the practical ideas for lessons'.**

Chart 2.1 shows that the majority of pupils in the survey (78%) agreed that 'chemistry is everywhere' and there was some sense from the focus groups that this impression had been enhanced by the CaW events: **'I used to think that chemistry was just chemistry but after [CaW] I thought [it's] part of our lives, everything comes from chemistry'** (Pupil aged 15-16).

Chart 2.1



Certainly, around nine in ten teachers and presenters considered that the event would have conveyed 'chemistry is everywhere' to the pupils, as exemplified by the following comment from a secondary teacher: **'They think chemistry is what they do in a lab. Boring old test tube reactions or whatever, they don't see chemistry in the wider world. And the more events like this which actually demonstrate to the kids chemistry in the wider world, I think it's very good'.**

Almost half the pupils (47%) agreed that 'chemistry is cool', with just 15% disagreeing. The majority of them did not think it was easy (19% agreed: 42% disagreed) but neither did they think it was 'for boffins' (the 23% agreeing heavily outweighed by the 46% disagreeing).

Presenters and teachers had very similar opinions about impressions of chemistry that pupils might have taken away from the event, and broadly speaking these coincided with the impressions that pupils in fact held. Nearly all thought pupils would get the impression that

'chemistry is everywhere', although only around half thought they would be persuaded 'chemistry is cool'. Barely any of them thought the events would imply 'chemistry is for boffins', suggesting that the minority of pupils who held this view may have got it from elsewhere (Chart 2.1).

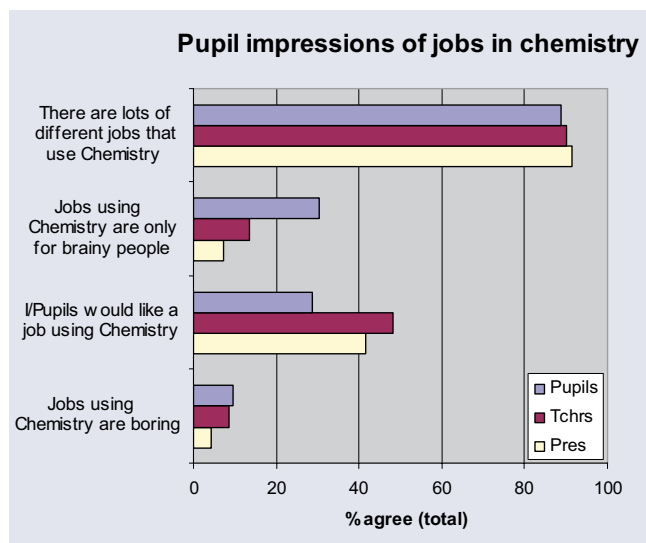
Older pupils (14-16) were more conscious of the ubiquity of chemistry, being more likely to 'strongly agree' that 'chemistry is everywhere'. They were also somewhat more likely to agree that 'chemistry is easy', a statement that the primary age children were least likely to agree with. These youngest attendees were, however, the ones most inclined to think 'chemistry is cool' with 59% agreeing compared with just 38% of 11-14s (and 46% of 14-16s). The response for 'chemistry is for boffins' was fairly consistent across the age range.

2.2 Showing the variety of jobs involving chemistry

Nearly all the pupils (89%) agreed that 'there are lots of different jobs that use chemistry' (Chart 2.2). There is considerable evidence that this was a perception conveyed – and perhaps even initiated – by the CaW events: **'there are lots of other jobs than just a chemistry teacher'; 'I realise how many jobs involve chemistry and the job isn't work in lab'; 'the jobs you least expect have chemistry'.** This theme was expanded in the focus groups, where pupils agreed that, whereas beforehand they might have envisaged chemists working in pharmacies or labs, they now had a much broader view: **'more enthusiastic about it because we know that if we do chemistry we have a vague idea of what we're going into, so it's not just sitting in a lab with glasses ...'; 'I would maybe have thought they just worked in a pharmacy and issued prescriptions to people but now I've found out about all the different careers you can do as a chemist'** (Pupil aged 14-16). In line with the survey, surprise was expressed at the range of jobs that involved the subject: **'There's loads more things to do with chemistry than I thought of. I thought things to do with food in the lab would be under biology.'** (Pupil aged 15-16).

Only one in ten pupils agreed that jobs using chemistry were boring, and half of them disagreed. Roughly equal proportions agreed and disagreed that jobs in chemistry were 'only for brainy people' – around a third opted for each. However, those events based at university centres were more likely to give this impression. Few teachers and presenters considered the events would create such a perception, although a teacher at one of the observed events felt that it would have been **'quite useful**

Chart 2.2



Almost three in ten pupils (29%) agreed that they would like a job in chemistry, around the same as the proportion (26%) who had given this as a reason for attending. This would suggest that, certainly in the immediate aftermath of the event, it had caused few if any pupils to radically re-think their career trajectory, but there was evidence that for some it had helped refine their thinking. A handful of the pupils surveyed said the event had motivated them to explore aspects of chemistry further, for example on the internet, or by checking out university courses. These findings were echoed in the focus groups: ***'I learnt more about what I want to be myself, a chemical engineer. I thought it was the same as chemistry, just using tons of chemicals, I didn't know it was designing things ...'*** (Pupil aged 15-16)

There is thus some limited evidence of the direct impact of CaW events on pupils' potential decision-making about career choices.

Analysis by age range shows that the upper secondary pupils were the most inclined to 'strongly agree' that 'there are lots of different jobs that use chemistry' (47%, with another 47% choosing 'agree'), which may reflect the nature of the events aimed at older pupils. There was more disagreement from primary age children than older ones that jobs using chemistry are boring or only for brainy people. Perhaps partly explaining their slightly less enthusiastic stance generally, far fewer 11-14s (15%) agreed that they would like a job using chemistry than younger (39%) or older (33%) pupils.

Once again, teacher and presenter views were broadly in line, with the message about the diversity of jobs using chemistry quite clearly conveyed. Only small minorities felt pupils would have gone away with the idea that jobs

using chemistry were boring. Between four and five in ten teachers and presenters thought those pupils who attended would like a job in chemistry. However, they had realistic expectations about what the CaW event alone might accomplish in this direction:

I would love to think that someone went away thinking there's nothing finer than being an analytical chemist. I don't think that will be the case. But I think in some corner of their mind it just opens up ideas ...

Teacher

... out of the hundred or so we see today, we might be lucky if we get one who walks out of here and says you know, I really fancy getting into that industry, sounds fascinating ...

Presenter

The vast majority of the pupils (86%) thought people who worked in chemistry were a mix of men and women, with the balance of the remainder (11%) thinking they were mostly men. A similarly high proportion of presenters and teachers thought the events would have supported this gender-neutral picture. This impression was least prevalent among primary age children (74%). However, it should be noted that only 37% of presenters who responded to the questionnaire were female, suggesting there might have been a male bias in reality.

Around three in four pupils agreed that all/many of the presentations showed how chemistry is used in people's jobs (75%) and that the presenters have a valuable job (71%) (Chart 2.3). A roughly similar proportion (69%) felt that all or many presentations had shown that CaW was different from what they did at school. Fewer, about half, thought all/many had helped them understand chemistry. Around a quarter thought the presentations had shown chemicals as dangerous. This figure seemed to be higher at events where the fire brigade was running a session, so was perhaps a reflection that chemicals can be dangerous if mishandled. The biggest differences between pupils and their teachers were that the latter were even more in agreement that the presentations showed how chemistry was used in jobs (97% vs 75%), and barely any of them agreed that the presentations showed chemicals as dangerous (2% vs 32% of pupils).

Older pupils (14-16) were particularly likely to agree that the presentations showed how chemistry is used in people's jobs (81% vs 65-67% of the other age groups). In conjunction with nearly all this age group agreeing that 'a lot of different jobs use chemistry' (see above) this suggests the events aimed at 14-16s emphasised the use of chemistry in specific jobs more than events

for younger pupils. Primary age pupils expressed the strongest agreement that the presentations helped them understand chemistry (perhaps reflecting their lack of exposure to it at school) and that the presenters have a valuable job. There were no age differences for the statements about CaW being different from at school or showing chemicals as dangerous.

Presenters were asked what they felt they had conveyed, and their responses were in line with pupils' in terms of being able to show how chemistry is used in their jobs (73%) and showing chemicals as dangerous (32%) (Chart 2.4). Nearly all felt they had shown they have a valuable job (93%) and they were also more likely than attendees to feel they had helped pupils understand chemistry (68%), although this is not an explicit aim of the CaW events.

Researchers also made judgements from observations of the 38 presentations (Chart 2.5). These data support the general perceptions seen by teachers, pupils and presenters. There is a tendency, however, for presenters to over-estimate their ability to show they have a valuable job and help pupils understand chemistry.

Observation at the six events suggested that the format of the supporting literature, and indeed whether any was provided, varied across events. Of the 60 teachers in the survey, 47 responded to a section of the questionnaire seeking comments on the information in any event handbook, perhaps intimating that the others were not aware of a handbook being available. Where a response was made, it was lukewarm (Chart 2.6). Although few teachers disagreed that the event handbook gave information about the jobs of presenters, showed these jobs as being accessible to pupils and presented chemistry as exciting, around a third in each case were neutral. This suggests that the event handbook is not currently as effective as it might be in supporting the CaW event and demonstrating the excitement and variety of jobs with chemistry. As the event handbook is the tangible outcome that teachers can use to follow up the event with pupils, it might be useful for organisers and presenters to give more attention to its format and usability. The RSC may wish to consider developing some generic activities to help with generating a supportive handbook.

2.3 Chemistry is an important part of the economy of the country

Of all the aims, 'chemistry as an important part of the

economy' was the most difficult to find supportive evidence for it being met. Partly this was because pupils tended to define 'importance' as value to society rather than to the economy. Consequently, when asked in the focus groups about the importance of jobs involving chemistry, they tended to single out those they had seen which related to medicine and health:

P1: ***Some are really important – like getting cures for cancer. The ones that are just like making metal ...***

P2: ***... What's the point of that? We've got enough metal***

Pupils, age 15-16

Even among teachers, the economic aspect was less prominent. However some, especially those who saw the event more as a 'careers convention', did feel that pupils would have got an impression of the world of work, perhaps even beyond just 'chemistry': ***'I think maybe a view of what the chemist does - maybe not so much the chemist as industry in <the area> and that there is a working world out there and what's going on in it.'***

For a minority of presenters, the issue of chemistry-related jobs in the British economy was a contentious one. Aware that changes in their own organisations were resulting in fewer local opportunities, for instance as some facilities moved abroad, they were worried about over-promising. They felt there was a danger that pupils might get an inflated sense of how many jobs are available in their locality.

2.4 Chemistry is an interesting and exciting way to earn a living

It is not easy to disentangle pupils' impressions of chemistry as a subject from chemistry-related jobs in the workplace. Certainly, comments from the focus groups show that they found the event more interesting than expected (see section 2.1) and this seemed to have a favourable knock-on effect on the attitude towards jobs that used chemistry.

The area of forensic science provides a good example of how the event could affect pupils' perceptions of a specific type of job in the field of chemistry. It was an area that was covered in many of the CaW events, and also one that children had high expectations of, mainly as a result of television programme such as CSI. As a consequence, it featured strongly when pupils were asked to name the 'most interesting' presentation at the event (34 explicit mentions), but it attracted even more for 'least interesting' (44). The potential detrimental effect of an uninspiring presentation was clear from the reaction of this 15-16

Chart 2.3

The presentations ...

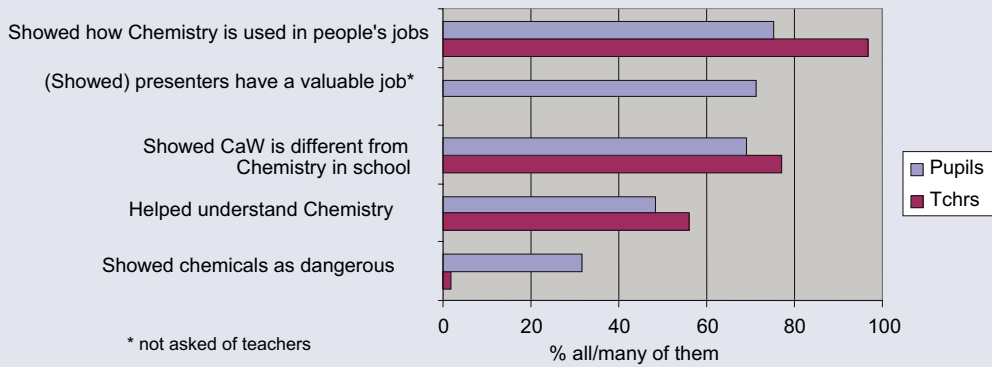


Chart 2.4

I was able to ... (presenters)

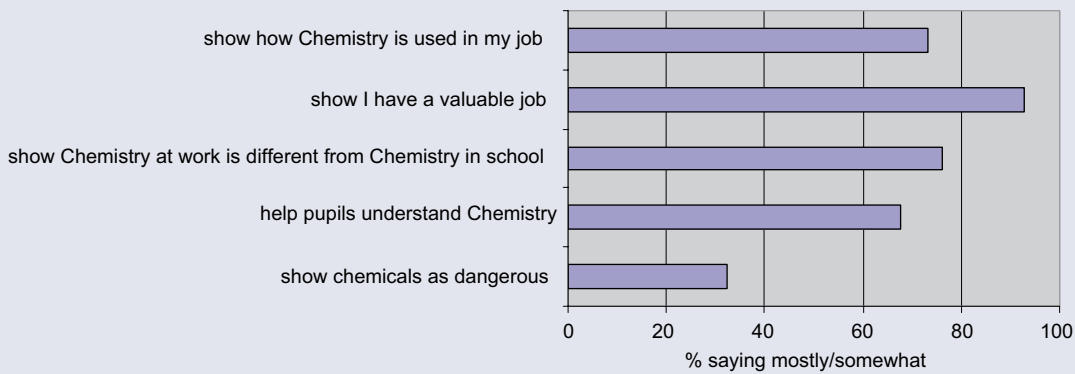


Chart 2.5

Presenters were observed to

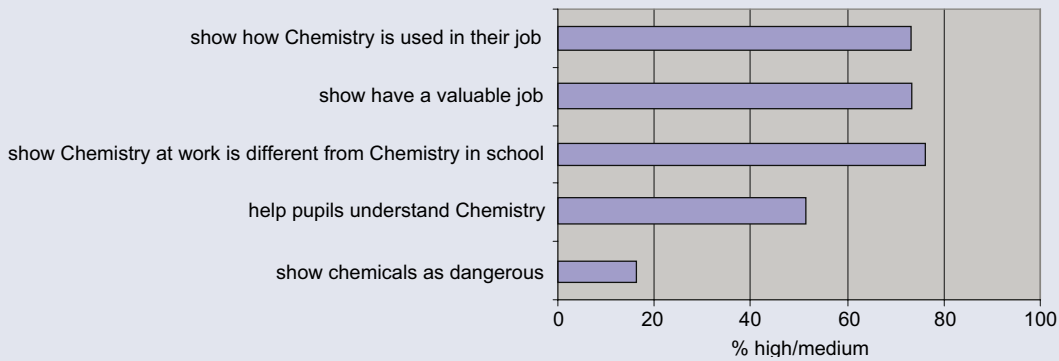
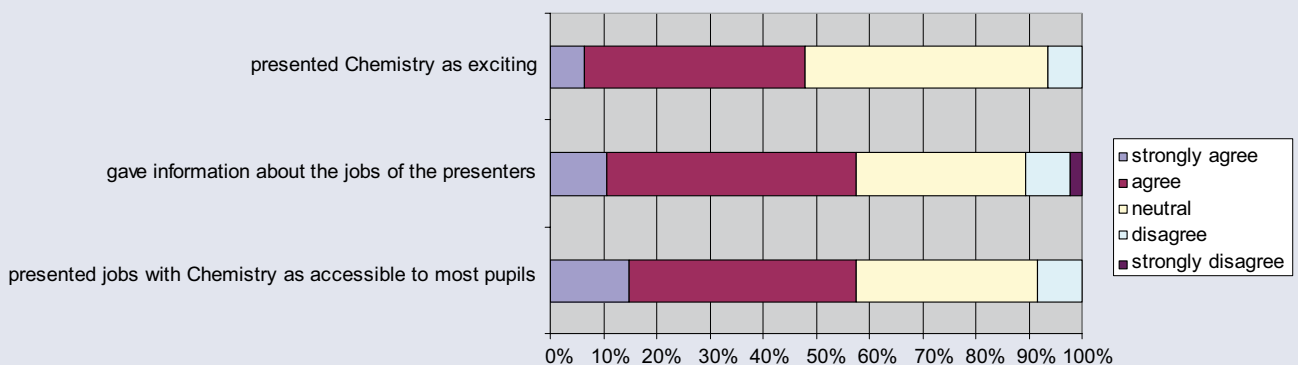


Chart 2.6

Teachers' opinions of event handbook



year old: ***'I would like a job in forensics but the woman made it sound really boring'***. Teachers were also acutely aware of the danger: ***'Most of our kids would switch onto forensics in a second and none of them were in the slightest bit interested. But that's a bit to do with the presenter'***. Fortunately, such negative experiences were not widespread.

The forensic science example raises the question of what are realistic career opportunities using chemistry for young people to consider. While forensic science featured prominently, career opportunities may be limited. Less obvious examples of the use of chemistry, e.g. in health care, seemed to show the less explored potential of encouraging pupils and organisers to think more widely about applications of Chemistry at Work.

A few pupils considered that some of what they heard at the event did not really tell them about jobs that would be available for them: ***'Some were talking more about their company whereas others were just talking about what they do, not really what we would do if we worked there'; 'They said a lot about their actual companies and what their companies do, but lots of them didn't say much about what they'd be doing and what their role would be ...'***.

As shown in Chart 2.2, very few pupils (10%) agreed that 'jobs using chemistry are boring' – 51% disagreed with the rest being neutral. The percentage of teachers who felt pupils would have left the event with that impression was equally low (9%, with 65% disagreeing). Similarly, the figures for presenters were 4% and 74%.

Prospective rates of pay was not a topic pupils talked about spontaneously, and few of them had much to contribute when probed. Some felt inhibited about something they saw as a personal issue: ***'It would be rude to ask that'***. One teacher said she had specifically encouraged her pupils to find out such information, and a separate group of pupils said they had inquired about this. However on the whole, where participants had picked up an impression of likely remuneration, it was from specific mentions in presentations or introductory talks. Those who had a concept of what constituted a reasonable salary felt it was fairly well paid:

I overheard someone saying don't want a job in chemistry because it's rubbish money, but sixty thousand pounds plus sounds good to me

Pupil, age 14-16

P1: ***It was 20 thousand from when you first start from the degree and then it went up as you got more experience.***

Interviewer: ***And do you think that's good pay?***

Ps: ***Yes***

P2: ***Soon as you start it's more than a teacher's salary and stuff***

P3: ***Yeah, but that's [a teacher's salary] a joke***

Pupils, age 14-16

A sense had also been gained of salary level increasing with qualifications and experience:

Interviewer: How much do you think they earn?

P: ***A lot – Well, you need to study and they want degrees for it, so they kind of earned it***

Pupil, age 15-16

P1: ***It seemed as though they needed brains to do it, but we asked the man and he said he doesn't get paid that well.***

P2: ***And he didn't get very good grades. He got good for science but all of the others weren't as good as what he wanted.***

P3: ***I think it depends the pay and stuff on what rank you are. You start off at the bottom and each time you get promoted it goes up a bit.***

Pupils, age 12-13

Another pupil felt it was linked to the significance of the job: ***'It depends how important the job actually is, like if you are an actual scientist discovering new diseases and stuff then yeah, you would get good pay because they rely on you to actually find the cause. But if you're a technician or something, it's important but it's not as important'***.

2.5 Chemists are real people

In all the focus groups, a common stereotype of the chemist as confined to the lab, playing with chemicals and test tubes, was in evidence. Pupils spoke of chemists ***'being kind of nerdy, boring, with lab coats and they tend to be men'; 'a guy in a lab coat with chemical in the hand' and 'glasses and frizzy hair'***. Often these images had come from the media: ***'cartoons'*** and ***'movies like Flubber'***. Several pupils claimed that the CaW event had helped to negate such preconceptions: ***'Before I thought it was just people in lab coats'***. However, pupils varied in the extent to which they bought into this stereotype, and some had already adopted a less narrow view, often because of family links with people working in chemistry-related fields, or through school experiences:

P1: ***Just like normal people, who work with chemicals and things like that***

P2: ***Working in big massive factories ... doing hundreds of different things***

Posters in school labs were mentioned in a number of focus groups: for example, pupils in two different focus groups referred to the RSC poster series 'not all chemists wear white coats', one boy explaining that chemists are people who ***'do different jobs and go around the world'***.

2.6 Unintended outcomes

2.6.1 Chemistry vs science

One of the issues that arose as the evaluation was conducted was how participants viewed the nature and scope of chemistry, particularly with respect to the nature of what was demonstrated in presentations.

At the six events attended, a total of 38 presentations were observed. These do not represent the totality of presentations at the events but a representative sample – as not all pupils saw all presentations at each event. The six events between them encompassed attendance by pupils between the ages of 10 and 16. The younger the pupils, the more likely they were to see presentations in which the chemical content was not articulated or not present (7 of the 38 presentations had tenuous links with chemistry).

Some pupils had more coherent views than others about what actually constituted chemistry. Those who were not clear – often younger children – could be further confused by CaW events that included presentations that were not focused exclusively on chemistry, or were sometimes about a totally different area of science. This lack of clarity is reflected in the following exchange amongst pupils who had attended the same sessions at a CaW event, one of which was about microbiology:

P1: ***I also think they shouldn't have just done chemistry, they should have done biology and physics***

P2: ***Yes, all 3***

P3: ***They did do it, you looked at all biology***

Pupils aged 10-11

There is a genuine question as to what should constitute the chemistry in CaW events. While some seek to show how chemistry features in applied and, to pupils, unexpected contexts, e.g. chemical archaeology and tackling super-bugs, there is a tendency to show chemistry as synthesis and analysis in more traditional industrial contexts where they exist. Thus when some organisers, particularly Local Sections, bemoan the lack of chemical industries in their

region, they are perhaps ignoring the potential of small businesses and those which many pupils will enter.

For example, an exchange in the RSC Local Section focus group seemed to show that those present (from business, school and university sectors) intuitively went for traditional chemistry at work contexts before thinking more widely:

A ***The lack of chemical industry in region means pupils can't identify with what a chemist does. You have to be very brave in a school to say I want to be a chemist.***

This needs to be tackled. I'm not sure that we'll ever change people's perception of a 'chemical' – a word to be avoided.

B ***I think it would be good for pupils to go in and see chemists doing work in a lab – that's what we did. You need the contacts but when I did it they really see it. I know you'd have to pay the industry to do it.***

A ***Is it feasible to do it, these days? Industries have disappeared – lot of them in the region have gone.***

B ***But there are industries that use chemicals – e.g. named contact lens manufacturer – and it's better for pupils to see these sorts of things***

A ***Yes but they're all small and dispersed.***

RSC Local Section focus group

If this behaviour is replicated in many events, and the evidence suggests that there is a tendency in this direction, then the real breadth of potential opportunities of using chemistry in the workplace may be missing from some CaW events.

Equally in some events for younger pupils, the links with chemistry were so tenuous as to be denied by some presenters e.g. in one presentation the presenter started by declaring that he knew nothing about chemistry so he shouldn't be asked technical questions. This was despite the presentation having the potential to show the application of science. Although these were fairly rare occurrences, there is an issue with the younger pupils of whether the events are 'chemistry at work' or 'science at work'.

Some organisers were able to include presenters whose work is underpinned by the chemical sciences but whose jobs would not involve immediately obvious uses of chemistry (e.g. plumbing; first aid). At these events pupils tended to get a broader view of the potential of chemistry than at those events which focused more on traditional uses such as analysis and synthesis (e.g. pharmaceuticals). It would be beneficial to encourage the use of presenters from a broad range of careers (in terms of type and required qualifications) to show the application of chemistry

in as wide a context as possible. Such presentations may counteract the narrow view of a career using science, expressed by pupils in a recent survey: ***'Typical responses saw science as a job that was based in a laboratory all day, cut off from the world and with little chance to use communication skills'*** (Porter & Parvin, 2008).

The majority of CaW events seem aimed at 14-16 year olds and are often attended by those who already have an interest in chemistry. It could be argued that 'preaching to the converted' is not the best use of RSC resources, particularly when there is evidence that pupils' views of science-based careers are formed at an early age, between 9 and 12 (Porter & Parvin, 2008). Consideration should be given to encouraging organisers to aim CaW events at primary and lower secondary pupils, with a view to broadening the context of the use of chemistry in the workplace.

It may be useful to consider the breadth of contexts and encourage more applied contexts for CaW events. There will still be a need to make the underlying chemistry overt.

For young pupils it may be necessary to give careful consideration to how the event is badged and how the nature of chemistry is shown. There is a question as to whether events aimed at pupils below year 7 (S1 in Scotland; year 8 in Northern Ireland) should be called Science at Work rather than Chemistry at Work, as their views of chemistry are unrefined at that age. Alternatively, if the events are called Chemistry at Work, efforts should be made to identify the nature of chemical content even at this age.

2.6.2 CaW as an external event – intrinsic motivation for novelty

There was a general positive feel associated with going on trips or having a break from the regular school timetable which was widely recognised by teachers and pupils alike. Pupils tended to focus on it being a change from school: ***'Something different from normal lessons'; 'Different – in a good way – not that the chemistry we do in school isn't good but this was more relaxed'***. Teachers spoke more about it offering them a different environment in which to observe and interact with their pupils: ***'I also enjoy interacting with the kids in a slightly different way and we usually enjoy going off for the afternoon together'; 'I think trips are quite important for a whole variety of reasons for children in that they are given some sort of responsibility to get themselves there, to behave well, to work cooperatively together and if we consider education to be holistic that is possibly as important as the actual chemistry side of it which was valuable as well'***. One teacher appreciated seeing another dimension to her

pupils: ***'I saw a different side of some of them, that would be very quiet in class .. and yet when they were in that environment and they had the opportunity to go for it and show off a little bit, they did. So it was very good'***.

Where the venues were universities, some young people were being exposed for the first time to higher education facilities and this was seen by teachers as a benefit for all ages: ***'young people [14-16] did enjoy the adult education. They enjoyed tour of university laboratory'; 'The university campus impressed the children [10-11], they enjoyed going to the laboratories and things like that, dressing up in white coats'***.

2.7 Summary – achievement of aims

There was strong evidence that the events met the declared aims. In particular the 'variety of what chemists do' was perceived to be met most strongly with the positive image, with 'chemists as real people' and 'with interesting jobs' also featuring highly.

In general, the CaW events were seen as very positive and successful by all participants, exceeding pupils' expectations of the event and modifying their view of chemistry. This evaluation had very limited opportunity to explore any follow-up work in schools, but there was some evidence that follow-up was limited, perhaps because of attendance of part classes at many events, and depended on the enthusiasm of the pupils. At several events, the lack of a good handbook, which provided information about Chemistry at Work, limited the tangible impact of the events.

As CaW events are not principally career events, the short and longer term impact on career choice was not explored in this evaluation. However, there is some limited evidence of the impact of the event on widening the views of pupils in terms of their decision-making about career opportunities.

There were differences in how the events were received across the age range, although these tended to be a question of degree rather than major discontinuities. Generally, the youngest participants (primary age) were the most enthusiastic about the events and chemistry itself, and 11-14s (lower secondary) the least. This could be a result of several factors e.g. how attendees were selected and age-related responsiveness as well as the nature of the events themselves. For instance, it seemed that the events aimed at 14-16s were perceived as having a more explicit job-related focus. This section examines the nature of the presentations, their quality and impact. Again evidence from all data sets is drawn upon.

3 NATURE OF PRESENTATIONS AND THEIR IMPACT

3.1 Nature of presentations

The CaW events encompassed a variety of sessions, differing widely in content and delivery. Although the term ‘presentation’ has been adopted in this report for ease of reference, attendees differentiated between ‘presentations’, ‘lectures’ or ‘talks’ and more interactive ‘workshops’, ‘practicals’ or ‘experiments’. In general, the latter tended to be more popular, but this was not an inviolable rule: ‘talks’ delivered in certain ways could prove equally engaging.

As a representative overview of the nature of the presentations, table 3.1 shows the nature of the 38 presentations observed at the six case study events. Although the dominant activity as part of most presentations was the presenter talking, in over half (21) of the presentations there was a good degree of activity on behalf of the pupils. The observations of the sessions gave the opportunity to gauge the extent of attention and involvement of the pupils. As table 3.2 illustrates, for most presentations pupils paid full attention or were actively involved when the opportunity presented. It was more likely to be a selection of pupils, however, who responded to questions that presenters posed, and in 8 of the 38 sessions there were no questions asked at all by presenters. There was limited opportunity in many presentations for pupils to ask their own questions. However, observations suggested that where this occurred there was very fruitful interaction for curious pupils. The observations suggested that it would be beneficial to create additional opportunities for pupils to explore with presenters the nature of their work and career development. It could be productive for pre-event literature to urge teachers to encourage their pupils to ask questions and to prompt presenters to facilitate such interaction.

Table 3.1 - Nature of observed presentations

Instances of activities within the 38 presentations (total adds to more than 38 as some sessions included more than one activity)

talk (non-interactive)	practical demon (non-interactive)	practical demon Interactive)	pupil expt	written activity
24	9	13	8	1

Table 3.2 - Pupils’ involvement in presentations

	all pupils	most pupils	some pupils	few pupils	none	not applic
listening	24	10	3		1	
answering questions	6	9	13	1	1	8
asking questions		6	10	6	16	
involved in practical	10	5	1	4		18
appear interested	7	21	9	1		

Most pupils were positive about the presenters, with 86% judging that all or many of them knew a lot about chemistry, and almost three-quarters thinking they were enthusiastic about their job and explained things well (Chart 3.1). However, only half the pupils found all or many of the presentations ‘exciting’. The teachers were somewhat more positive than the pupils, and this was especially noticeable on the ‘exciting’ dimension, with 68% of teachers saying all or many of them were – although even amongst them, it was the lowest rated of the five statements. Primary age children were the most positive about the presentations across all the dimensions, especially ‘exciting’. There was no real difference between the two older groups of pupils except the 11-14s were less likely to think all or many of the presenters ‘knew a lot about chemistry’, although it was still a majority (75%).

If anything, presenters had a more favourable view of their sessions than did attendees, with virtually all of them feeling they had managed to be enthusiastic about their job and explain things well, and almost as many (90%) thinking their presentation had been mostly/somewhat exciting (Chart 3.2). Whereas 96% of presenters felt they had pitched it at the right level, rather fewer teachers (78%) thought this had been true in all/most cases. However, presenters were much less confident that they had been able to show they knew a lot about chemistry (65%), whereas a much higher proportion of attendees (well over 80%) considered they had achieved this.

As observers, we also made judgements about the quality of the 38 presentations we observed (chart 3.3). These presenters were seen as being able to explain things well and to pitch the presentation appropriately. A minority of observed presenters were relatively unenthusiastic and knowledgeable, and limited in their ability or opportunity to make the presentation exciting.

Chart 3.1

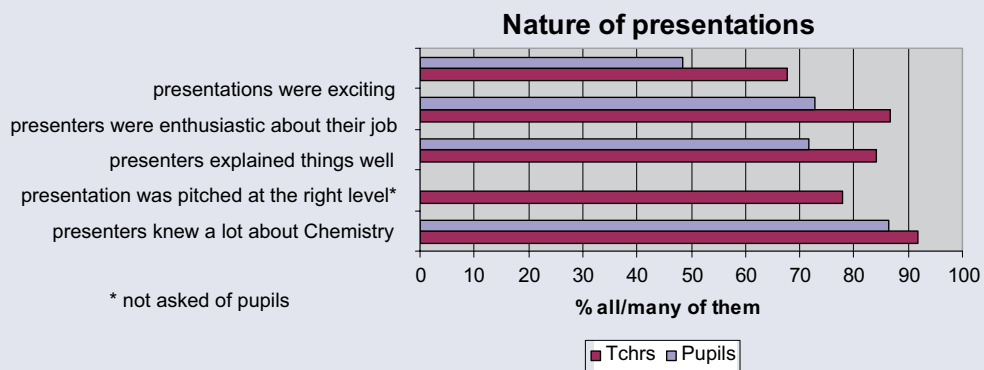


Chart 3.2

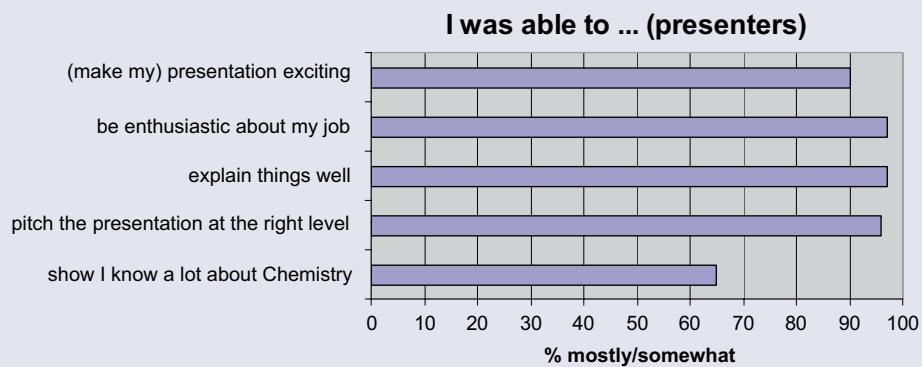
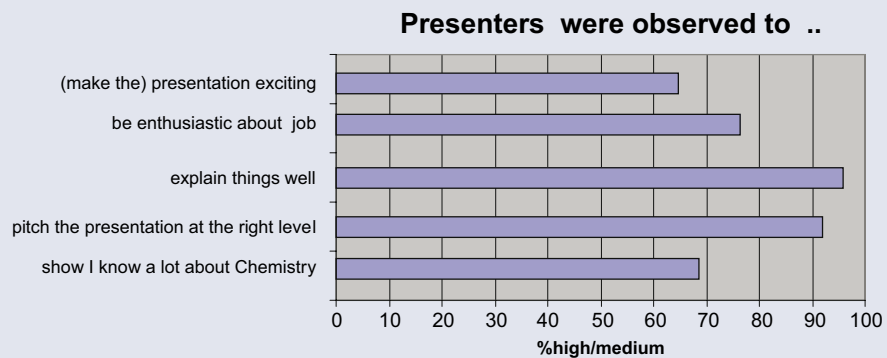


Chart 3.3



Taken together, the observations and views of participants and presenters indicate that there is a high level of professionalism amongst presenters and that they are perceived very positively by all participants.

3.2 Training for presenters

Around a third of presenters said they had been offered a training session but, for whatever reason, one in three of them had not attended. This leaves only a very small sample of those who had (17), most of whom found it 'very' (5) or 'somewhat' (10) useful. Only one of the presenters spoken to at the attended events mentioned the training. It was his first time at CaW and he had found the advice and guidance given (e.g. what was appropriate to emphasise for his audience) very helpful in constructing his presentation and building his confidence. Other presenters tended to have honed their sessions over the years: ***'The very first year we did it, we did an entire sit-down presentation and everyone was yawning away ... so we have hands-on things to make sure maybe we break that tedium'***.

A few had wider experience of communicating with the age group, but for most, presenting to young people – or at all – was not part of their job description. This made some feel uncomfortable, and they felt they would like to know more about what the pupils would have covered in the curriculum, so they could be more certain they were targeting their talk appropriately. This was a theme that some teachers also raised. Pupils too identified specific presentations, or parts thereof, where they had felt baffled, and it is important to avoid pupils being turned off by language and concepts that are at an inappropriately high level: ***'there were a few who were a bit monotone and sort of drifted off, and you didn't have a clue what they were talking about and we were a bit bored by some of them'***. Conversely, pupils could be dismissive of presentations where they felt they had not 'learnt' anything, and although they were not necessarily alluding to the acquisition of subject knowledge, this was sometimes a valued by-product:

P1: ***I found some stuff about it that I didn't know before***

P2: ***You learnt loads of stuff***

Pupils aged 10-11

3.3 Qualities of effective presentations

The qualities pupils looked for in a good presentation were remarkably consistent and did not even vary significantly by age, although having a 'hands-on' aspect and a 'wow' factor was even more important for younger children. Pupils wanted interaction, something that was most easily and obviously achieved by incorporating a physical activity that they could

participate in:

P1: ***You got to make goo***

P2: ***... you got involved***

P3: ***... you weren't just sitting there staring at this PowerPoint***

Pupils aged 12-13

However, where that was not possible, engagement could be established through demonstrations, imaginative use of question and answer, or incorporation of props/samples. Prizes or free gifts also proved popular across the age range, so long as they were appropriately targeted, and often helped to break the ice:

P1: ***If I'd just had to sit in a presentation I'd have got a bit bored. But ... they had questions***

P2: ***And they were funny***

P3: ***... they asked you questions and they didn't just babble on about blah blah blah***

Pupils aged 10-11

Failing to include any interactive element meant death by PowerPoint was a very real danger.

P1: ***Boring***

P2: ***... like sitting in a double period of science***

P3: ***... it did nothing, all it did was show us slides and talk and carry on talking.***

Pupils aged 12-13

Although headteachers were on the whole very upbeat about the events, in one or two instances this negative feedback had obviously reached them: ***Too much talk - pupils were not enthused by presentations. Therefore pupils did not gain positive view of chemistry.***

Even the youngest audiences made constructive criticisms about how the event and individual presentations might be improved:

He didn't ask questions, like "why do you think you should have that?" and someone could have said "because of the ..."

I thought some people were going to come on and do experiments and call some of us up to have a go ... if they had done that in the hall at the start and made like things go all smoky, everyone would have thought that was really amazing. And then you go round the other rooms and do little experiments and they would have thought that was really good.

Pupils aged 10-11

Teachers recognised that presenters were volunteers, and appreciated them giving up their time to be involved, but they thought training was needed to tackle the lack of knowledge about addressing children in an age-appropriate manner. Suggestions ranged from spending time in the classroom to allowing teachers to sit in on presentations and provide feedback in advance, to more traditional training for the presenters: ***'I feel it is important that all presenters are given training in presentation skills as some were boring and did not know how to use the technology they had with them'***. Obviously, all these options have time implications, and it seems that many presenters already struggle to fit the event into their schedule at all.

The personality and delivery of the presenter was also crucial, especially in the less practical sessions. Primary and secondary pupils alike responded well to people they perceived as humorous, accessible and passionate:

P1: ***They didn't just sit there and say this is what we do, they were total like, 'What did you have for breakfast?' 'Toast' 'We helped make that'***

P2: ***He was funny***

P3: ***He was hyper at the start which was good***

Pupils aged 15-16

The little chap was funny and animated ... and the kids enjoyed him because he was a good presenter with lots of props.

Secondary teacher

Some of the ones that I took them into and I thought well, this won't be particularly interesting, the presenter was so captivating, even though the subject material was a little dry, the kids were still right on the edge of their seats and really responding very well, so I think it was a lot to do with personality.

Secondary teacher

Lack of enthusiasm not only turned pupils off that specific presentation, but threatened their appreciation of particular applications of chemistry:

P1: ***Some of it was a bit boring to be honest.***

Interviewer: ***Why?***

P1: ***They just kept talking***

P2: ***They didn't show much enthusiasm, they were just speaking***

Pupils aged 15-16

I came away with the impression that the job that they do is quite boring and that wasn't the idea of the day,

although it was very informative but it wasn't terribly exciting.

Secondary teacher

T1: ***There were one or two who were - I'm here under sufferance for the day. And someone else will come in to do it tomorrow thankfully.***

T2: ***And the kids saw that***

Secondary teachers

The techniques used to transform a presentation from dull to something more engaging can be simple ones. For example, presenters might underestimate pupils' desire and ability to get involved, although most acknowledge it is an important factor:

If there's no interaction from the kids, it can be hard work, 20 minutes can be tough. But if you've got a group who are interested ... you wish you had more time.

Presenter

P1: ***I'd say the majority of them don't want to interact. You get the odd one***

P2: ***It may be more our presenting style. Perhaps we don't engage them as well as we could***

Presenters

Teachers acknowledge that the need for an interactive approach reflects changes which have taken place in classroom style: ***I think it needs to be quite snappy and practical, to get the kids to do things, you know. We're very into, at schools now, cooperative learning which is involvement with the children rather than them just sitting and stuff being fired at them ... Not necessarily all the time because I totally see that there's a value in explaining what they were doing.***

Secondary teacher

Just over half the presenters said they would do something differently if they participated again (especially those doing it for the first time), and it is encouraging that many of the changes they were considering reflected pupils' criticisms. Several wanted to make their sessions more participatory, for instance by including more interactive materials and devices, introducing hands-on activities, or having more props and demonstrations. Some would tailor it more to the target age group, particularly by simplification. In the face-to-face interviews, some presenters at events which do not currently collect structured feedback (especially those with less experience) spontaneously commented that they would appreciate it so they could refine their offering if necessary.

3.4 Presentations as extra-curricular activities

For some teachers one area that was important in terms of impact was that the presentations were given by external people and showed chemicals or chemical contexts not normally shown to the age group.

Teachers' expectations of presentations were often high in terms of being opportunities that are not usually available. In some cases these expectations were met:

... taking children out as we did yesterday is an ideal opportunity to do a little bit more out of the ordinary.

Obviously there's so much health and safety for primary schools that you can't really do many exciting chemistry things – bicarbonate of soda and vinegar is about the most exciting really you can get away with. So it was the chemistry which did draw my attention which is why we went for it.

Primary school teachers

In other cases, there was some disappointment:

I know when we've been along on previous occasions we've had quite a bit of that whizz bang science which impresses children, when something spectacular happens, and that perhaps, that element was missing, that wow factor.

The 'whizz bang' element need not be terribly sophisticated: **'you can add a chemical to something and it suddenly changes colour and those sort of things'.**

Primary school teachers

Occasionally teachers felt some sessions overdid the company promotion: **'Some of them, people seem more keen to talk about their companies than they are about chemistry at work so the kids switch off at that point'.**

3.5 Logistical aspects of presentations

Different events operated under their own logistical constraints and opportunities, influenced by how the event was organised and the nature of the venue.

Session length varied widely between events, from 20 up to 45 minutes. The absolute length of session seemed to matter less than the appeal of the content and how well it had been tailored to the slot, although there were issues with some of the shortest ones not allowing time for pupil-inspired question or being rushed, and, in some longer ones, the audience becoming restless if not adequately engaged. Several pupils made comments similar to this one: **'some of them [you wanted to be longer], the ones**

you enjoyed, but the ones you didn't enjoy could have been a fair bit shorter'.

The number of pupils per group ranged from 15 to 30. The largest group sizes sometimes limited how many pupils could get involved and occasionally rooms were too small to accommodate the audience comfortably. However, such problems did not seem to be widespread. Some pupils were disappointed that they had no chance to work with other schools, but there were mixed views about this.

There were issues at some central venues with getting between rooms (either because of the distance involved or getting lost), or with some sessions over-running, causing bottlenecks and delays. In quite a few instances, timing problems (including waiting for late arrivals) meant some schools had to leave before the end of the event, causing some dissatisfaction among pupils and teachers. An innovation that worked well at one venue was the use of the host university's student ambassadors, some of whom provided support to the presenters and others to the visitors. They were proactive in keeping sessions running to time, escorted pupils safely and speedily between rooms, and helped if necessary in the sessions themselves. Less resource-intensive solutions included leaving short gaps in the timetable between sessions and having an audible signal as the end of the session approached.

One of the observed events took place in a venue where many presentations shared a large hall. Despite attempts at sound-proofing, teachers and pupils (as well as the observer) had difficulty hearing some parts of presentations especially if a more noisy session was taking place nearby. Because pupils only experienced a selection of sessions, this also meant there was disappointment if they did not get to attend those that 'sounded' exciting.

A very small minority presenters complained of poor pupil behaviour, and occasionally the lack of an effective accompanying teacher: **'Some teachers are not present with the group and do not actively monitor the behaviour of the group. This makes it difficult for me to deliver the information successfully. I expect teachers to set an example to their class and show interest in the topic'; 'I was irritated by the lack of welcome from the school staff and disturbed at the very poor discipline of some groups'.** It should be emphasised that this was extremely rare, as it would represent another barrier to participation if presenters did not feel adequately appreciated or supported (see Section 5.1).

Organisers carried out an evaluation of around half of the events attended, and although this was not an area addressed specifically in this research, it was apparent that presenters and teachers would welcome this at events

where it does not currently take place. One teacher, for instance, suggested having a feedback form that they could fill in as they circulated through the different sessions.

3.6 Summary

Presenters were generally positively received. They pitched their presentations at an appropriate level and explained ideas well. While many were seen as enthusiastic and interesting, there was a minority who seemed to have a negative impact on pupils, especially through use of non-interactive PowerPoint presentations.

Many presentations were interactive, as desired by pupils, and interactivity was achieved in various ways from pupil practicals to imaginative use of question and answer.

Training for presentations was not always taken up by presenters but was considered necessary by teachers for those unfamiliar with speaking to school children. Training that focuses on the likely level of pupils' knowledge at

the relevant stage of the school curriculum as well as presentation skills was thought beneficial by teachers. Presenters' attention should be drawn to the short, relevant extracts from the curriculum in the presenters' guides produced for CaW.

Given the short length of some presentations there was not always the opportunity or inclination for presenters to open up discussion about the background to the presenter's job. Greater opportunity for discussion, with appropriate training of presenters, could allow more chance for pupils to explore 'chemists as real people' more fully.

It is widely recognised that most presenters have little experience in engaging with pupils. Whilst pupil and teacher evaluations are already carried out at some events, it would be helpful if this practice was made more widespread. Feedback, both positive and negative, would then need to be provided to presenters in a constructive and diplomatic manner.

4 REASONS FOR ENGAGEMENT

This section addresses the knowledge that exists about Chemistry at Work events and the reasons that different participants, and potential participants, give for engagement with CaW.

4.1 Knowledge of CaW events

One key group that was expected to be aware of CaW was the RSC Local Section committees. 25 out of 34 Local Section committees (74%) responded to the questionnaire. Of these nine had a lot of knowledge of CaW and 12 claimed some knowledge, with no Section being unaware. Thus most Sections had some familiarity with CaW. 11 Sections recognised that a CaW event had occurred in the region in 2007 and nine Sections for 2008 events. It would appear that Sections claiming knowledge of events were also reasonably active participants as 10 Sections (29%) were fully involved in events in either 2007 or 2008 as co-organisers or advisers.

Thus about a quarter of Local Sections seemed actively involved in supporting CaW events. This did not necessarily mean that the majority of Local Sections were not fulfilling the aims of CaW. Local Sections were supporting a range of activities that they perceive as helping young people see a positive image of chemistry and a variety of employment. These included school outreach, school trips to university labs and employers, events in chemistry/science week, and a variety of talks and competitions (Table 4.1).

Table 4.1 Activities supported by RSC Local Sections

activities in regions (n=25)	no of mentions
supporting Chemistry at Work	10
school trip to university/employer	6
schools outreach	5
competitions/quizzes	5
chemistry/science week	4
careers fairs	3
sixth form talks	3
Salters/Crest events	2
Christmas lectures	2

Sixteen Sections expressed a desire to be involved in future events, in order to fulfil promotion of chemistry to schools, suggesting there was some untapped potential from about six Sections. (e.g. **'One of the objectives for our LS committee is to improve our interactions with schools such events would be one avenue'**) However some (5)

expressed reservations about involvement, citing limited knowledge and resourcing as potential barriers. (See also section 5 **barriers and opportunities**).

While one might expect RSC Local Sections to be aware of CaW events, it might be different for teachers. A group of teachers in the SE region participated in a focus group discussion to explore non-participants' views of CaW. Only one member of this group had heard of CaW (and happened to have participated). The others expressed interest in knowing more about CaW events considering that the aims chimed with their views of pupils' needs:

A **'To counter the perception that chemistry is completely pointless – 'I'm never going to study it, what's the use to me' and when asked what they want to do – they say hairdresser. They just don't get that chemistry is part of the everyday working world – they think it's something they've just got to do.'**

B **'It would also fit in with GCSE applied science – because of needing to address science in the workplace. Study of jobs using science not in the labs.'**

As this was a random sample of teachers, it may be that the general ignorance about, but enthusiasm for CaW aims shown in this group is replicated in many schools. (It would not be appropriate to draw firm conclusions from such a small sample.) However, if may be that government attempts to provide more information about enrichment and enhancement activities, for example via the STEM directories, may have some effect here.

4.2 Reasons for engagement

Reasons for engagement were sought from all participants – organisers; presenters and their line managers; teachers and their line managers; pupils.

4.2.1 Principles of engagement

Most of the 16 organisers indicated that they organised CaW events for reasons associated with its declared aims - notably **promoting** chemistry and its links with the world of work (9 organisers) e.g. **'To promote chemistry with real work information'**; or enthusing students (5 organisers) e.g. **'We want the students to be excited by and to have fun with science'**. However two of the organisers seemed to see their involvement as more of a contract e.g. **'Requested to by the University'**.

It is interesting to note that 9 (53%) of the 16 organisers had run more than 5 events. Only one organiser had not previously run a CaW event.

Compared with organisers there was more of a spread of previous experience of presenters, with the largest proportion attending their first event (45%) and the second largest proportion (22%) having presented at more than 5 events. Roughly 7% of presenters had presented at each of 2, 3, 4 and 5 previous events.

Reasons for presenters being involved in CaW were more varied than organisers. Three themes came out from the responses: a desire to promote chemistry as in the aims of CaW (as with organisers); a corporate or personal responsibility in terms of 'giving something back'; a corporate or personal promotion of young people into jobs with a chemical background. These themes were in roughly equal measure and seemed very dependent on the individual. Many views coincided with the aims of CaW in enthusing students e.g. ***'To promote biomedical science and highlight that scientists are not "mad scientists." Also to promote females entering science professions.'***; ***'To try to inspire the younger generation to become interested in chemistry / engineering.'***

With others it was not only their interest in promoting chemistry but an opportunity for satisfaction for them e.g.

'I have an enthusiasm to pass on the word of chemistry to all concerned'; 'I was 'volunteered' three years ago and since then have found it refreshes my passion for science. I also enjoy the challenge of trying to explain my job in an interesting, interactive way.'; ***'To challenge myself. To add to my CPD for chartership.'***

In contrast to an altruistic stance, some saw promotion of their business as an important reason for attending e.g. ***'It is an important part of our outreach work and a recruiting device'***; ***'To promote conservation, museums, chemistry and my museum.'***

It was clear that for a few presenters this was a regular event to which they expected to contribute.

Managers from 14 organisations (1 university and 13 private or public sector businesses) gave their views on reasons for the organisation's participation. Two of the 14 line managers were unaware that a presenter from their organisation had been involved. Half of the line managers had not been involved in the decision for a presenter to contribute to the event – suggesting quite a variation in corporate decision-making about the worth of attending CaW across the organisations. All the reasons given for the organisations' involvement were about promoting chemistry to pupils e.g. ***'A very good cause, promoting chemistry to the next generation of potential chemists'*** - but as in this quote there was

an underlying recruitment element in some of the comments.









Teachers' reasons for attending the CaW event fell into three main categories – enrichment, vocational or supervisory. About half of the teachers commented on CaW as an enrichment event, either extending knowledge of chemistry e.g. ***'Because it gives my children the opportunity to experience aspects of science I do not have the resources to show them back at school'*** or showing wider applications e.g. ***'In order that pupils could identify the range/scope of chemistry and its application in industrial practice'*** or being enjoyable e.g. ***'To show pupils that chemistry can be very interesting!'***. These teachers, like many of the organisers and presenters, are in tune with the declared aims of the events. Another quarter of teachers focused specifically on the potential vocational aspects in encouraging pupils to see chemistry as a career e.g. ***'Pupils gain knowledge of chemistry at work, plus to get pupils to consider chemistry as a career'***. There is thus a significant proportion of teachers who do not appreciate the RSC's declaration that CaW events are not primarily career events.

Interestingly, just under a quarter of teachers indicated that the reason they were attending was to act in a supervisory capacity, this group not seeing the impact on pupils as their rationale for accompanying them. A very small minority (about 4%) indicated that the reason for attending was to improve pupils' attainment in chemistry.

Teachers indicated their rationale for choosing which pupils should attend the event. Clearly in some events located in schools the whole year group benefited. Where teachers took small groups to events and had to select pupils, the dominant reasons for particular pupils were: a particular class; those doing well in chemistry / gifted & talented; volunteers. For CaW events which do not involve whole year groups it appears the focus is mainly on those with prior interest or attainment in chemistry. Given that the scope of the events is not solely on high achievers but to show the breadth of chemistry to all learners, it would appear that many pupils are missing an interesting opportunity.

For pupils themselves, about 28% of the reasons indicate a positive choice – through interest in science (18%) or career aspirations (10%). The majority of pupils suggested that the choice was not theirs or was not related to the topic of the event (Table 4.2).

Table 4.2 Pupils' reasons for attending CaW event

reasons for attending		% of responses	no. of responses
teacher asked me to go		21	330
I'd like a job in Chemistry		10	162
time off lessons		19	305
I had no choice		11	178
I like science		18	291
my friends were going		16	261
I'm in the science club		1	22
other		2	42

All 20 headteachers who responded to the questionnaire were aware of their pupils' participation in the CaW event, but the vast majority (84%) had little or no involvement in this participation. Decisions to participate were made by different staff in different schools. Although the decision involved science staff it was not always on their authority alone that participation was guaranteed. There is thus no uniformity for an outsider seeking engagement from different schools – knowledge of the individual school's decision-making structure is necessary.

The overwhelming reason headteachers gave for their school's participation was seeing CaW as an enrichment event and promoting the images of chemistry as expressed in the aims of the event e.g. **'Broadening curriculum Insight into wider view of chemistry'**.

Only one headteacher mentioned any vocational aspect – **'For pupils to see careers linked to science.'**

4.2.2 Perceived gains from engagement

The most common gains that organisers saw from organising the events were forging links with local business and schools. Less frequently, the opportunity to promote chemistry and satisfaction of running a successful event were also mentioned:

Sharing the excitement, fun and necessity of science related activities. Hopefully enthused and motivated students to consider science based courses and careers. Developing new industrial and other links and maintaining current industrial involvement.

Awareness, networking, prestige.

In indicating what they gained from the event, just over

a third of presenters felt their involvement was very rewarding to themselves – either in being enjoyable e.g. **'Good fun & interesting to impart information to students'** or in improving their presentation skills e.g. **'Helped to develop my presentation skills by addressing large numbers of people.'** Thus many presenters saw personal benefits to engagement. Just under a third of presenters identified the impact that they hoped they had had on pupils as the 'gain' e.g. **'Hopefully the knowledge that one pupil who saw me today may go on and do a chemistry related degree in the future'; 'I used my scientific background to convince students that chemistry is exciting and like me they can make a successful career out of that'**. Such quotes illustrate again the commitment made by many presenters to influencing young people.

A smaller group (about 15%) saw the event as an opportunity for networking, either with other presenters or in understanding schools e.g. **'A clearer view of the difficulties facing teachers in dealing with largely undisciplined classes.'**

Line managers tended to couch the impact on presenters primarily in terms of development (e.g. **'It provides them with an opportunity to develop their skills and knowledge'**), as well as being a motivational experience for them. Several saw the events as part of their recruitment strategy and therefore having a long-term rather than immediate impact on their organisation, but some anticipated PR gains in the shorter term.

4.2.3 Future involvement

Fourteen of the 16 organisers indicated that they were likely to run a future event, suggesting that there were expectations that the event was part of an annual calendar and fulfilling its aims e.g. **'We have run the event for 5 years now and despite the difficulties we have each year it is a very successful and rewarding event that is valued by local schools.'** However, there were hints from three organisers that there might be barriers, particularly financial, to future involvement e.g. **'Depending upon funding'**.

The vast majority of presenters (88%) were likely or very likely to participate in a future event. All the organisations indicated that they were likely or very likely to contribute to a future event.

Just over a half of teachers had taken pupils to CaW events in previous years – with several (17) indicating three events or more. The overwhelming majority of teachers (95%) agreed or strongly agreed with the recommendation that pupils attend a CaW event next year. Like teachers, headteachers were very positive

about the event, with all indicating that it was very likely or likely for their school to participate next year.

Additionally, pupils were very positive about the event with 89% indicating agreement or strong agreement with the recommendation that pupils from their school attend a CaW event next year. Within this consistently high figure, strength of agreement was particularly marked among primary age pupils (61% agreeing 'strongly') and more measured among those aged 11-14 (19% agreeing 'strongly').

4.3 Summary

Knowledge of CaW is high among RSC Local Sections, although direct involvement is not as frequent. Reasons for lack of involvement include Sections already organising activities that they see as contributing to similar aims.

Teachers' knowledge of CaW events outside the locations where these happen regularly seems limited. There is enthusiasm from teachers for activities which support the aims of CaW.

Those who organise and attend CaW events are very positive about the worth of the activity. Many see participation as related to the declared aims of CaW and enrichment. However, there are other reasons for participation which are related to individual development and corporate interests.

Where there is a choice to be made of which pupils should attend the event, there is a tendency towards those already favourably disposed or high achievers. It is thus disappointing that the positive impact of CaW is not more widely available to the school population.

There is a strong sense in the data that for well-run events there is an annual expectation of provision and a loyal audience. Thus in some parts of the country CaW has become institutionalised as an important enrichment activity, and demand from schools often outstrips the number of places available. Such valuable activity should be continued. However, consideration should be given to wider access or use of alternative, additional methods of realising the aims for the majority of schools who cannot attend such events.

5 ORGANISATIONAL ISSUES – BARRIERS AND OPPORTUNITIES

One of the factors this evaluation sought to explore was the barriers to participation by all relevant participants and stakeholders. An indication of the barriers and ways of overcoming them could provide some mechanisms for wider access to CaW events or similar initiatives.

5.1 Barriers to organisation

It might be surmised that the biggest barriers are those facing organisers and potential organisers, because if these are not overcome no events would happen.

For existing organisers the biggest problem was finding good presenters and ones who are reliable. Eleven of the 16 organisers indicated that supply of presenters was a problem e.g. ***'It is always a struggle for me to find presenters for the event'; 'Persuading local employers to become involved: the commitment of time and resources is a strain for many of them'***. As implied in this second quote a few organisers (4) cited inadequate funding as a barrier.

In some cases a few presenters dropped out at the very last minute (including on the day). Indeed, at five of the six case study events attended, there were very late cancellations. This seems a high frequency of unreliability for whatever reasons. For example, organisers of one event explained that this year was particularly problematic – maybe because of the economic downturn - leading to short-notice replacements being drafted in to fill the empty slots.

For the organisers problems with coping with lack of presenters had significant impact. In one case, organisers felt that presenters did not understand the impact of cancellations on pupils' experiences but recognised the reasons for them. Another event had a similar experience of last minute cancellations but indicated how they proposed to tackle the difficulty. They had found local companies were unable to commit to the event either because they were working to long time frames or had no spare capacity. Their intention was to start recruiting presenters much earlier next time, and if budget was available they would pay expenses, e.g. travel and accommodation, so that presenters can be brought in from elsewhere.

Mirroring organisers' views, the time commitment was seen as the biggest barrier by presenters. Half of the presenters commented on time as the limitation e.g. ***'The main difficulty is time as a commercial company trying to fit Chemistry at Work into our timetable'***. Although costs specifically were mentioned by just three presenters,

there is an implication that resourcing CaW events is very demanding on those presenting. More encouragingly about 15% of presenters saw no barriers to participation.

About 10% reported issues related to presentations as a potential barrier e.g. ***'Making sure the presentation is pitched at the correct level and not to assume what they already know.'*** A very small minority (3 presenters) viewed the organisation of their particular event or the behaviour of the pupils as a significant disincentive to future participation.

The time commitment was also the barrier seen by eight of the 11 line managers in organisations e.g. ***'It involves quite a bit of time away from core activity. Can delay other important work'***.

Additional information concerning the restrictions for presenters was gleaned from interviews with some of them at the six events attended. For example, in one case where extensive interviews proved possible, presenters identified that they were able to attend the event because it was either part of their job (outreach) or they were given permission as long it did not affect their ability to do their normal job. For those with an outreach perspective, they indicated that they were limited in the number of such events they were able to attend, and chose to attend at this event because of existing connections and the nature of the school. All indicated that they would be willing to attend next year, assuming their role / job allowed them to. However, presenters from the one genuine chemical company represented indicated that the quality control chemistry that they showed to pupils was no longer a part of their workplace. They commented that their labs and other chemical labs were closing with such work moving to Eastern European countries. Although they wished to encourage pupils into studying chemistry and science, they felt rather fraudulent in ***'encouraging kids to go into science and become chemists when there is not a lot in the area.'***

At another event, one presenter focused on the presentational aspects as a barrier: ***'in industry a lot of them aren't very good at delivering things like this – and I mean, who wants to talk to 14 year old kids really in industry, unless you are actually in that market. I think it's really sad. It's an area I am quite interested in, because how are the kids going to know that there are industries open to them that they've never heard of.'***

5.2 Barriers for potential organisers

The RSC Local Section committees were seen in this study as potential organisers. Advantages and barriers to their engagement were informed by responses to the questionnaire and from a focus group with a non-participating Local Section committee.

Local Sections saw two main advantages – enrichment and networking – in equal measure, for involvement in CaW events. Unsurprisingly, one advantage coincided with the aims of the events where sections saw their role as promoting chemistry e.g. **'Publicity of Local Section work/events to a wider population - opportunity to promote chemistry as a subject and career choice fulfilling educational initiatives.'**

The focus group with a Local Section committee also supported the aims of CaW as the benefits for their engagement:

A: **'Anything that promotes chemistry is good.'**

B: **'(I'd support the) Two main aims – promote chemistry as a career – and equally important promote chemistry to those who don't appear interested in it.'**

Less expected was the potential for CaW events to be networking opportunities, identified by 10 of the Sections, e.g. **'It helps to create new contacts-it is often difficult to involve members in a very large region spread over a considerable area'; 'Local knowledge of industries would aid selection of companies.'**

Local Sections gave the main barriers as time commitments (about 60%), issues of networking with other organisations, e.g. EBPs (Education Business Partnerships), to make arrangements (about 16%) and lack of knowledge of events (about 16%). The following quote encapsulates all the reasons and summarises the resource issues for those keen to further CaW aims: **'The same barriers as most RSC event work! Committee are all volunteers and cannot always take time off to help with events. Family and work come first - that is why we use a 3rd party to organise and run our CaW events for the most part. It costs more but we feel we get a better run event.'**

For a couple of Local Sections responding to the questionnaire, a major issue was the reduction in chemistry-based industries e.g. **'Venue and support from University chemistry department. There isn't one in <town X> any more. Also we have so few chemical industries here'**. The Local Section discussion echoed this view with several members bemoaning the reduction in chemical industries and the limitations on companies:

A: **'What has happened over the years is that the companies used to be based in region have disappeared e.g. company X. Pool of resources has got smaller.'**

B: **'Our company is not able to do it for that age group.'**

C: **'Companies are less willing to offer the services that would make a really good day.'**

D: **'Company X and Company Y would have had these events. But they don't see the benefits of doing it now.'**

A: **'The philanthropy has gone out of business – it's driven by finance. Companies that used to be run by technicians are now run by finance people. And health & safety aspects seem to be corroding any willingness to involve anyone outside the organisation.'**

5.3 Summary of barriers to organisation

All stakeholders identified similar barriers to organisation and participation by chemistry-based businesses. There is a sense that current events have developed a routine and show positive outcomes that ensure continuity, despite the barriers. If the difficulties of recruiting presenters persist or get worse, then some existing events might be under threat. In those areas where events have not yet happened, there are indications from stakeholders that CaW activities would be highly unlikely to take place because there is no impetus to overcome the barriers of time and resourcing.

5.4 Barriers for attendees

The views of headteachers were sought about barriers to the school's involvement.

For the following issues, 50% or more of the headteachers surveyed considered that the issue was of moderate or great difficulty: organisational load on staff; timing in the year. For other issues the decreasing order of difficulty was: disruption to the timetable; financial costs of transport; arranging transport to the venue; selection of pupils to attend. Despite the difficulties nearly all the headteachers considered that the gains from the event exceeded the difficulties.

In terms of prioritising different subjects and other issues, half of the headteachers indicated that they would not prioritise in terms of curriculum areas. However for the other half, priority was given to science, maths and technology, over humanities and languages, sport, drama and music. For other issues, headteachers' priorities were strongly related to academic performance, with some emphasis on cross-curricular initiatives and gifted and talented students. Liaison with other schools and

an emphasis on the less able pupils were not seen as priorities.

The results suggest that these headteachers are prepared to support attendance at a very worthwhile event.

For teachers who are currently non-participants (i.e. the focus group of six science teachers), although they were enthusiastic about the aims of CaW, they quickly identified difficulties they would encounter in seeking to attend such events. The barriers they identified were the bureaucracy of organising external visits, organisational time and money:

A: ***'I can imagine going back to my Head of Department tomorrow and saying there's this fantastic event – and he's going to say – yes great but who's going to pay for the cover. Ultimately, it's going to come down to money.'***

B: ***'Who is going to organise it – enough of a workload before getting involved in lots of forms – medical forms.'***

C: ***'In my school it wouldn't be the finance of it so much as the time taken to organise it – and it would end up being down to me. Enthusiasm wanes a little when you see all the admin involved.'***

When asked whether the school should pay to attend, focus group members thought this would not necessarily be a major factor but would add further to the barriers.

5.5 Overcoming barriers – some evidence

There was an opportunity in the focus groups only to explore whether paying presenters and/or charging schools would make a difference to organising the event.

The evidence was inconclusive.

As far as paying presenters was concerned, the Local Section was generally against: ***'I don't think paying presenters would make a difference because you then run the risk of getting a professional presenter rather than someone who's got a love for the subject and wants to pass it on.'***

For teachers, there were mixed views on whether presenters should be paid or not, some considering that presenters would be drawing a salary anyway and it being part of the company's outreach. However, as one participant indicated: ***'There's got to be some sort of incentive for taking part other than just outreach.'*** As indicated above, for most presenters there is indeed a personal benefit as well as potential professional progress towards Chartered Chemist status.

There is a sense from focus group data, from interviews and questionnaires, that it is not sensible to adopt a one-

size-fits-all when resourcing presentations. Presenters fall into different categories – e.g. retired volunteers (who may have travel and incidental costs); self-employed (for whom the event is a significant commitment); employees for whom the event is considered part of their job (and where it may be reasonable for the employer to pay). Thus some flexibility over payment to presenters could be adopted.

As far as payment by schools to attend the event is concerned, both the Local Section and teachers considered that this would be an additional barrier to participation – alongside other organisational barriers which teachers considered were substantial. Payment by schools was thus not recommended. Indeed the Local Section went further indicating that schools could be supported to attend:

'But if finance for the school is an issue, then they should be supported – e.g. driver and a bus – then that's that barrier removed – they might find another barrier but couldn't use this one.'

In these focus groups it was possible to explore views on activities, other than CaW events, which might be suitable to achieve similar aims but more widely. The suggestions were limited but give some ideas for potential avenues to explore:

A: ***'Fund more people to make travelling shows, where everything is set up well, can be taken into a school set up easily and quickly and may be pay school staff to use it.'***

B: ***'I wanted to set up panel of experts who would be available to answers questions when things popped up in the media.'***

Local Section focus group

A: ***'Liaise with career departments in school – e.g. if kids were asking about hairdressing – could they come in and talk about it.'***

B: ***'Maybe a list of contacts – for speakers in the area - email address / phone number. It takes time to develop links.'***

C: ***'But how you do link it to the curriculum – or do you have to? There is little time to go outside the curriculum. So you could use a theme like water – or would RSC support that / see that as chemistry?'***

Teachers focus group

5.6 Summary

The biggest barrier to CaW events is finding reliable and enthusiastic presenters who are able to commit the necessary time. All participants acknowledged the importance and value of high-quality presenters and value their commitment (whether personal or by their employers).

As indicated in previous sections, the majority of organisations and presenters are hugely committed to CaW events, at least in principle.

There seems no magic bullet to avoid last-minute cancellations by presenters. However, given the frequency of these, it would appear necessary to over-book the number of presenters. This would give more organisational slack on the day – a feature which may support pupils more effectively – but potentially necessitates more pre-planning and resourcing from the organiser.

6 ANALYSIS OF 2007 EVENTS

This section summarises the nature of 2007 events using the data supplied by RSC – feedback forms from organisers.

6.1 Limitations of the data

Pro formas listing individual school attendances were supplied for most events, but for some only an overall total was available. In such cases, more detailed analysis (e.g. type of school and distance travelled) has not been possible. Occasionally the figures given were estimates and these have been included as supplied. In the majority of cases, the age of pupils was not given so it has been impossible to provide sub-analyses beyond whether the pupils were in primary or secondary schooling.

6.2 Event attendance

Table 6.1 shows that there was a total of 55 CaW events across 2007, corresponding to 94 days. Roughly two-thirds of these days were for secondary schools, a third for primary schools. Where the information available allowed identification of single school events, all 12 of these were at secondary level. Even disregarding these one-day single school events, it is interesting to note that a primary school CaW tended to last longer: an average of 2 days versus 1.6 days for secondary events.

Table 6.1 Attendance at events

	total	primary	secondary
events*	55	11	43
days	94	32	62
schools	548	200	348
pupils	16951	6570	10381
teachers	1370	593	777

* Total is higher than primary + secondary because 3 events covered both school stages

In total, almost 17000 pupils attended an event in 2007 (16 951). This equates to an average of 180 per day. Primary events tended to be larger than secondary ones (205 and 167 pupils per day respectively). They were accompanied by 1370 teachers, 43% being from primary schools because the average pupil:teacher ratio was lower (11 versus 13 pupils per adult on average). An average of 30 pupils attended per school. This was of course higher for the single school events, at around 200 pupils, ranging from 100 to 270. This size seems to represent an entire year group. At the multi-school events, the smallest group size was 2 and the largest contingent from one school was

149. Slightly more pupils came per primary than secondary school, once single school events are excluded.

Most of the schools attending were state maintained: of the 227 secondary schools for which details were available, just 10 were in the independent sector. Of the remainder, 33 (15%) were selective - most of these (25) were in Northern Ireland.

Some schools had travelled a considerable distance to CaW (Table 6.2). The average was almost 13 miles – a little greater for secondary (15) than primary (9) schools, as would be expected from the distribution of such schools. The highest average distance travelled to an event was 42 miles.

Table 6.2: Distance travelled (miles by road)

	all events	primary	secondary
average	12.7	9.4	14.6
maximum	42*	61	87

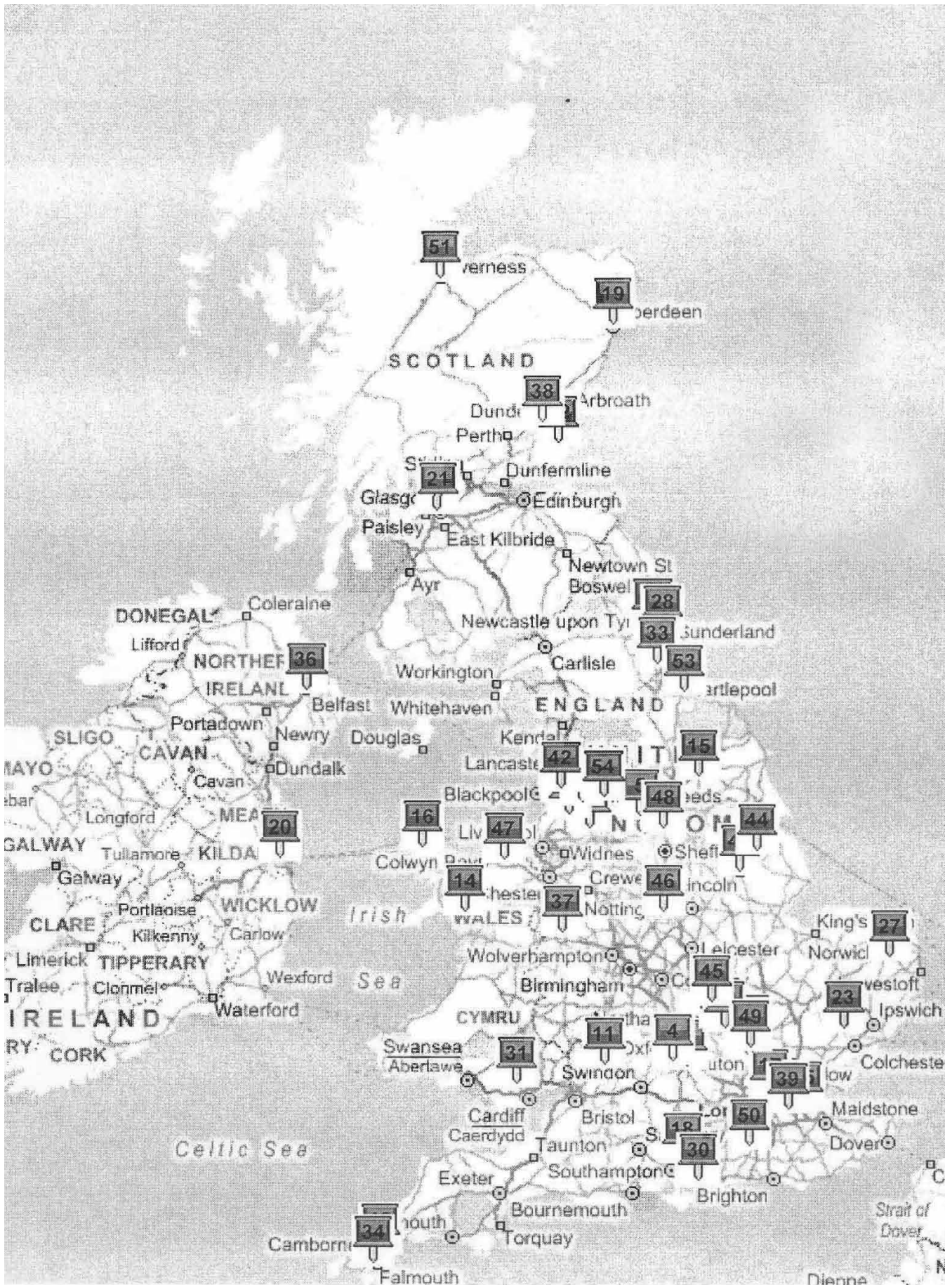
* average distance travelled to one event

6.3 Regional spread of events

The RSC regions where the most events were held were the south east, north east and north west (Table 6.3). Once the number of days is taken into account, they are joined by Scotland. Primary days were most numerous in Wales, where 8 were held compared with only one secondary day. As illustrated on the map, large areas of the UK did not have a CaW presence in 2007, for instance south west and central southern England outside Cornwall, the north Midlands, the Scottish borders/SW Scotland and SW and central Wales.

Table 6.3: Regional distribution of events

RSC region	total events	total days	primary days	secondary days
north east	10	16	3	13
north west	9	16	6	10
south east	11	16	2	14
Scotland	6	15	5	10
south west	4	10	5	5
Wales	4	9	8	1
east	3	5	2	3
midlands	3	4	1	3
Ireland	2	3	0	3



Map of 2007 events

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Evaluation of Chemistry at Work

Case studies of events attended

Pam Hanley and Mary Ratcliffe

University of Southampton

April 2009

CASE 1: HIGHTOWN

Commentary on achievement of these aims from the data collected

It cannot be claimed that the aims of the event were realised in relation to chemistry, although some of the sessions (8/18) did have a real focus on chemistry at work and specific chemistry concepts – e.g. reactivity, analytical chemistry. However, if chemistry is replaced by science in the aims above, there is evidence that aims 1, 2, 4 and 5 were achieved to a good extent. However, many had physics, biology or unspecified science as their context. The event appeared to have two titles, according to different documentation: On pupils' evaluation sheets it was entitled Science & Industry day; in communication with presenters both 'Chemistry at Work' and 'Science & Industry Day' were used.

Positive aspects of the event:

Pupils were very positive about the event – enjoying the hands-on activities; benefiting from hearing people talking about real jobs; and learning skills and knowledge that they didn't expect.

The vast majority of presenters were enthusiastic and committed to demonstrating 'science at work' to pupils. Nearly all ran highly interactive sessions, during which they pitched explanations and questions at an appropriate level for the pupils. They encouraged and dealt sensitively with the different types of questions that pupils asked (from those focused on science content, work-related to personal).

Organisers felt very satisfied with the extensive work they had put in and were starting to plan the next year's event learning from this event.

Issues concerning the event:

Two presenters cancelled at very short notice (one due to other business commitments and instructed to do so by line manager; the other on the day due to illness). Teachers stood in with interactive chemical demonstrations.

The event by itself had little impact on pupils' views of chemistry or on their intentions to pursue a career using science. There seemed a view emerging from the group interviews, evident in other studies – 'science is interesting and important but not really what I want to do'. However, as year 8 pupils they admitted that they were still making their minds up about careers and that the event had opened their eyes to a wider view of science.

While it may be difficult for teachers to follow through such an event with further activity in reinforcing the aims

above in relation to science, there seems an opportunity to develop the aims and activities further. There was a sense that the discussion about chemistry/science at work was started for pupils with this event – and that even brief discussion with pupils in science lessons about their views of chemistry/ science careers could reinforce some of the good work started by this event. It was not clear whether this would happen in any systematic way – though the impression was gained that there would be ad-hoc reference to the event in teachers' and pupils' actions next academic year.

There is an issue whether there are sufficient presenters in the locality to enable a focus on chemistry rather than science.

Other comments

Follow-up from the event: pupils were asked to write thank you letters to a presenter; complete evaluation sheets on what they had learnt at each session. No further follow-up was possible before the end of term.

Title of Event: **Chemistry at Work**

Other: **Also called Science & Industry Day**

Type of event: **For one school**/for several schools

Year Group:

6 7 **8** 9 10 11 post-16

Number of sessions each set of pupils attended:

3 4 5 **6** 7 8

Number of pupils per group:

<10 c.10 **c.15** c.20 c.25 >25

Length of sessions (hrs):

0.5 **0.75** 1 1.25 1.30 1.45 2

Number of different sessions offered: **18** (16 external 2 external presenters cancelled with very short notice – one 24 hrs before, one on the day)

Sessions pupils attended: All those offered
A selection (chosen by organiser)

Nature of sessions observed:

Making holograms; Issues in occupational therapy; Chemical archaeology; First Aid; Quality control in a pharmaceutical manufacturer; Air-powered cars

Nature of presentations:

Talk (non-interact), Practical demonstration (non-interactive), Practical demo (interactive) **4**, Pupil expt **2**, written activity

Pupils' involvement

	all	most	some	few	comments
listening	5	1			
answering questions		3	3		
asking questions		3	2	1	
involved in practical	3	2	1		
appear interested	2	3	1		

Notes: In the first session, pupils seemed a bit quiet and unused to being active participants. From the second session onwards, many had spontaneous questions – some related to the science; some related to the people's work; some unrelated to main ideas of the session.

Teacher's involvement

	comments
supervisory	X
interactive 'teaching'	initially in practical when short of technicians
interactive as pupils	
no clear role	
appear interested	X

Notes: for the vast majority of the time, the teacher or teaching assistant acted as non-participatory supervisor

Presenter's actions

Presenter	high	med	low	not at all
show know a lot about chemistry	3			
explained things well	6			
enthusiastic about job	3	2		
show have a valuable job		3		
Presentation				
was exciting	2	3	1	
showed how chemistry is used in job	1	2		
helped pupils understand chemistry	3			
showed chemicals as dangerous		1		2
showed chemistry at work different chemistry in school		2	1	
was pitched at the right level	6			

Notes: Some of the sessions were focused more on science / physics at work than Chemistry at Work.

Some aspects of the above were not shown / not applicable

It was clear from the group that was followed, that pupils were actively engaged and were increasingly curious about people's jobs and interests. Several examples were seen of individual pupils asking a number of questions of the presenter about the job they did. For example, one boy showed great interest in one of the presentations and stayed to ask questions about science and career opportunities (chemical archaeology). The presenter was very encouraging and indicated the local opportunities to take things further. The positive attitude taken by this presenter was apparent with all those seen - they all wished to encourage pupils to see the wider aspects of their job and its base in science.

Pupils' views of chemistry and of the event from focus groups / interviews

(2 extensive focus groups covering FG & interview questions each with 6 pupils; survey):

Note: the focus groups consisted of pupils who had seen some different presentations from those the researcher had attended.

Pupils saw chemists as not just 'pharmacists' but dealing with a wider range of chemicals such as rocks and 'wet chemicals'. One boy referred to the poster series 'not all chemists wear white coats' in explaining that chemists are people who **'do different jobs and go around the world'**. Comments of others, however, reinforced the stereotype of working in lab coat and with chemicals in test tubes.

Pupils indicated that they got their views of 'chemists' from the media.

There was little evidence from discussion with the pupils that the event had changed their view of chemistry. The types of skills / knowledge that they indicated that they did learn included:

There was one where nurses came in, they were good they told us how to save someone's life by giving mouth to mouth. Most of us weren't aware of mouth to mouth to save a person's life.

That you need science for many things, if you didn't have science we wouldn't the have medicines we have to. Science is a lesson in school, it is life, and if we didn't have science we wouldn't learn how we breathe or how we live our lives.

It was clear that pupils enjoyed the day, most would have liked to experience all the presentations. They enjoyed the hands-on experiences, particular where they were making and testing devices; they did feel they had learnt some things about the jobs that people did and saw a variety of science that was used in different jobs.

Some expressed surprise at enjoying the day, indicating that they thought it would be like normal science **'we sit there and are taught'** rather than hands-on.

A few showed realistic approaches to the information they received in some sessions by asking about peoples' jobs:

P1: ***It seemed as though they needed brains to do it, but we asked the man and he said he doesn't get paid that well.***

P2: ***And he didn't get very good grades. He got good for science but all of the others weren't as good as what he wanted.***

P3: ***I think it depends the pay and stuff on what rank you are. You start off at the bottom and each time you get promoted it goes up a bit.***

P4: ***It depends how important the job actually is, like if you are an actual scientist discovering new diseases and stuff then yeah, you would get good pay because they rely on you to actually find the cause. But if you're a technician or something, it's important but it's not as important.***

P3: ***I think it's like with anything, as you get promoted – I'm not saying the jobs you start off as aren't as important as anything else in the company that you're working for – I think that as you go up you do tend to get pay rises, but every job in chemistry is important because you're going to have some people with no power to do things even if they have got a tiny bit of knowledge.***

This was the only in reference to pay and conditions elicited from the interviews.

Pupils indicated that just two of the presentations were not interesting, for example:

the one where they had to do something about <aspect of chemistry>, we didn't really do anything we just listened and watched a video. Nothing was explained to the group, the slides had faults in them.

They indicated that they would like science lessons to be like the experiences that they had during the day – ie all hands-on and no writing.

Organisers' view of the event – from interview / discussion (2):

Extensive amount of work was needed to undertake the organisation, but organisers were very pleased to do it to allow the pupils to have an interactive day. This was the third year of organising such an event.

The two organisers felt that the pupils had experienced a very good day and that pupils generally showed enthusiasm towards the sessions.

They were very grateful to presenters, although irritated by the late cancellation of two. They felt that presenters did not understand the impact of this cancellation on pupils' experiences but recognised the reasons for cancellation.

Presenters' views of the event – from individual interviews (4)

The school serves a catchment area of low socio-economic status. All the presenters interviewed had a mission to support the school and raise pupils' aspirations.

All the presenters interviewed (and most of those attending) had presented at previous Chemistry at Work events at the school.

Discussion revealed that presenters were identified through individual contacts from the school or a further chain. For example, several presenters were from two of the local universities – representing the physical sciences / engineering. One of these presenters considered that it would be beneficial for the chemistry department of one of the universities to be involved in future (the other university does not have a chemistry department). This example illustrates the opportunistic way in which presenters were identified / volunteered.

Presenters identified that they were able to attend the event because it was either part of their job (outreach) or they were given permission as long it did not affect their ability to do their normal job. For those with an outreach perspective, they indicated that they were limited in the number of such events they were able to attend, and chose to attend at this school because of existing connections and the nature of the school. All indicated that they would be willing to attend next year, assuming their role / job allowed them to. However, presenters from the one genuine chemical company represented indicated that the quality control chemistry that they showed to pupils was no longer a part of their workplace. They commented that their labs and other chemical labs were closing with such work moving to Eastern

European countries. Although they wished to encourage pupils into studying chemistry and science, they felt rather fraudulent in **'encouraging kids to go into science and become chemists when there is not a lot in the area.'**

All presenters felt that there were able to present appropriately to young people, and that the pupils had responded positively to their sessions. Some had had no formal training but developed a flair for communicating over the years; others had training as teachers or in communication. They hoped that pupils had learnt something about the science presented as well as a wider appreciation of science at work. They felt the pupils were engaged and interested.

All felt the group size (16) was appropriate for their activities – and would not have wanted to work with larger groups. One presenter felt the 50 minutes allowed was rather too much time; the others all had some difficulty getting their activities into the time available.

One presenter recognised and regretted the limitations on the number of pupils that could experience such an event:

I think it is a good event, I would like to say it would be nice if more schools did it but it would be difficult for more schools to do it as there is only a fixed number of employers and people who can do these things and a fixed amount of time they can spend doing it, the university is perhaps a little bit different. It would be nice if other schools could come but then the logistics just start to become a nightmare.

The presenters were not able to assess what impact their session had on pupils in terms of their views of

chemistry. One presenter, focusing mainly on physics, was concerned to encourage pupils into Physics (rather than chemistry).

All presenters thought the event was well-organised.

Teachers' view of the event – from interviews (2 brief) & teachers' school evaluation forms (13)

The overwhelming view of teachers was that pupils had had a stimulating day, with plenty of hands-on and enjoyable activities. The words most frequently used by teachers in describing the individual sessions were hands-on (34 times); enjoyable / pupils' enjoyment (26); interesting (7); informative (7).

Several commented on the high quality of the presenters in being able to pitch at an appropriate level, particular in asking and responding to pupils (6). Only two sessions were regarded as poor, due to boring (7) and non-interactive presentations, with poor level of explanation (6).

Several teachers commented on the skills that the pupils were being encouraged to use: making/testing (6); observation (1).

Of note is the science content that the teachers focused on. Where teachers indicated spontaneously the concepts that the pupils were exploring, the majority were Physics concepts (8) e.g. Newton's 3rd Law, forces, satellites; some were biological (4) e.g. blood circulation and few were chemistry concepts (3) – reactivity series, fluoroscopy.

CASE 2: BLESSINGTON

Commentary on achievement of these aims from the data collected

The event focused heavily on chemistry, although the small number of presentations limited the variety of jobs and applications that were shown. It did, however, convey that chemistry was not confined to the lab. The event achieved aims 1 and 5, and to some extent aim 2, although the small number of presentations on offer, only one of which concerned the person's workplace directly, meant it was not possible to convey much of the breadth of jobs. Aim 4 was also achieved, although to some extent indirectly (see below).

Positive aspects of the event:

Pupils were positive about the event. They had anticipated it would be boring, as they characterised their chemistry lessons at school, and had been pleasantly surprised: they felt it had been fun and they had learnt something.

The teachers were considering follow up in school, but this tended to focus around adopting some of the demonstrations they had witnessed rather than linking specifically with any of the five aims.

Issues concerning the event:

There was some concern about the amount of pre-event planning and communication eg one presentation was cancelled and this meant the other presenters had to lengthen their slots by 10-15 minutes at very short notice. One of the rooms was inadequate for the size of the accompanied group. The event only consisted of three presentations and two of these were delivered by academics, which did not give much variety in terms of type of job (as opposed to type of activity). There could perhaps have been more interactivity – even if only more Q&A (the group followed round did not, and were not invited to, contribute much in terms of questions) - and more provision for less able pupils.

Title of Event: **Chemistry at Work** Other:

Type of event: For one school/**for several schools**

Year Group:

6 7 8 **9 10** 11 post-16

Number of sessions each set of pupils attended:

3 4 5 6 7 8

Number of pupils per group:

<10 c.10 c.15 c.20 c.25 **>25**

Length of sessions (hrs):

0.5 **0.75** 1 1.25 1.30 1.45 2 (50mins)

Number of different sessions offered: **3** (fourth – the organiser – had decided after issuing schedule not to deliver hers. 2 presenters based at the uni, one a spin-out company)

Sessions pupils attended: **All those offered**

A selection (chosen by organiser)

Nature of sessions observed:

Dentistry (practicals: making cast of tooth plus measuring fluoride in toothpaste); climate change/ carbon dioxide and waste storage; chemicals as poisons

Nature of presentations

Talk (non-interact) **2**, Practical demonstration (non-interactive) **1**, Practical demo (interactive) **1**, Pupil expt **1**, written activity

Pupils' involvement

	all	most	some	few	comments
listening	1	2			
answering questions		1	1		1xNA
asking questions				2	1xnone
involved in practical	1			1	1xNA
appear interested	1	1	1		

Notes: **The overall level of questions asked by pupils or presenters was very low for the group followed (which consisted of c15 each from 2 schools: a Yr 9 grammar fast-track and a pretty average Yr10)**

Teacher's involvement

	comments
supervisory	X
interactive 'teaching'	initially in practical when short of technicians
interactive as pupils	
no clear role	
appear interested	X

Notes: **mostly the teachers were non-participatory supervisors**

Presenter's actions

Presenter	high	med	low	not at all
show know a lot about chemistry	2	1		
explained things well	2	1		
enthusiastic about job	3			
show have a valuable job		1		
Presentation				
was exciting		2	1	
showed how chemistry is used in job		1		
helped pupils understand chemistry		3		
showed chemicals as dangerous	1	1		1
showed chemistry at work different chemistry in school	1	1	1	
was pitched at the right level	2		1	

Notes: in two cases they were academics talking about their area of interest/running practicals rather than job itself - more use of chemistry rather than at work in their job.

Some aspects of the above (esp re jobs) were not shown / not applicable

Pupils' views of chemistry and of the event from focus groups / interviews (one focus groups with 6 pupils, all top stream Yr 9 grammar; survey):

Several of the pupils already had quite a broad view of chemistry. However, they believed many people get their image from the media, for instance films which are felt to stereotype chemists:

always in the lab

... as being kind of nerdy, boring, with lab coats and they tend to be men

They generally distanced themselves from such images, and apart from the CaW event they cited school and parents as sources of a broader image of chemistry (about half of them had parents working in chemistry, mainly in school or university). School had made them aware that chemistry connected to other areas, eg geology and forensics (the latter related to a pupil-

generated poster on display in a school lab about studying blood splatters etc): ***'it's not just test tubes and making things go bang'***.

However, they found school chemistry lessons boring and, although one commented on the unexciting nature of the chemicals they were allowed to handle, they looked forward to practicals:

If it's a boring lesson or anything, you tend to get the feeling that chemistry's quite boring

... And you won't learn as much

[What would make it more interesting?]

I suppose maybe a little bit less written work and more practical

This theme applied to the CaW Day as well, with the practical workshop a particular favourite, as well as a presentation which had interesting content, was fast-paced and they judged they had learnt most from.

Many in the group felt it had changed their view of chemistry, although one said it had not: ***'I never really believed it was as boring as it is in lessons'***. However, another thought it had made him ***'more enthusiastic about it because we know that if we do chemistry we have a vague idea of what we're going into, so it's not just sitting in a lab with glasses ...'***. The introduction, which had stressed the ubiquity of chemistry, had made a particular impression:

What he said this morning ... about how [chemistry]'s already happened to us today, you don't really think about it, you don't think oh, I've already done chemistry because you drink water and things like that. You don't think about it in that way. You think more about experiments and equations and things like that.

It told you a lot about what it is used for, not just at school but what it's used for in the real world for life and things that you need

There was appreciation for one presentation bringing chemistry together with biology, another pupil adding 'biology is chemistry with fluffy bits'. Overall, they considered the day had been a lot less boring and more informative than they, or their friends back at school who had not attended, had anticipated because they had watched, and participated in, experiments not just listened to people talk:

At first, it was 'a day off school, great', but when you're here we learnt a lot more ...

... It was cool

... and I had more fun here than I would've at school

Organisers' view of the event – from interview / discussion (2):

The organisers felt that the event was being positively received by schools. Their main concern was the limited number and range of presenters. They had found local companies were unable to commit to the event either because they were working to long time frames or had no spare capacity. The intention is to start recruiting presenters much earlier next time, and if budget is available to pay expenses eg travel and accommodation so that presenters can be brought in from elsewhere. The event has experienced increased demand from schools since last year.

Presenters' views of the event – from individual interviews (3)

The presenters were enthusiastic about the event and keen to transmit their enthusiasm for chemistry and a sense of its importance to pupils. All had attended the event previously, and one had experience at a CaW event elsewhere. There was a desire to show chemistry as fun and a feeling that the event was not constrained to 'teach to the test' like schools were. All of them were either based at the venue or had a strong connection with it.

Motivations to attend included outreach to local schools by a university, showing that not just chemists work with chemistry and that it interacts with other sciences, and to bring to life issues which are current and impact on pupils now. **Discussing why it might be difficult to get presenters, one said 'in industry a lot of them aren't very good at delivering things like this, and unless you are used to presenting things, if there is a reason not to do it – and I mean, who wants to talk to 14 year old kids really in industry, unless you are actually in that market. I think it's really sad. It's an area I am quite interested in, because how are the kids going to know that there are industries open to them that they've never heard of'.**

One presenter remembered that, at the first event they ever attended, they had not known the age of the pupils in advance. They now always ascertained the age group and whether the pupils had covered relevant topics or not, in order to pitch the presentation appropriately. Initially, they based their assessment of the right difficulty level by testing it out on their own similarly-aged child, but had since honed and simplified it. A presenter with experience of being confined to a much shorter time period appreciated having a longer slot, feeling that it gave more freedom from clock-watching and allowed the content to be 'meatier'.

There were a few criticisms of the organisation or logistics, eg not being told the event spanned two year groups; lack of welcome; short or no notice of timing changes etc. One presenter claimed to have only heard about the event two days previously.

Teachers' view of the event – from interviews (one interview with 2 teachers from same grammar school)

The teachers were positive about the event, saying that it had given the pupils chance to see the point of what they learnt in school chemistry:

It gives them a chance to reflect and see what is the point of what they're studying in school and gives them the time to review. It gives them an insight into industry and a bit of interest into what they are doing.

Anything like this which shows them chemistry in the wider world ... they get up in the morning have a shower, you eat breakfast it is all chemistry, but they don't think about it like that. They think chemistry is what they do in a lab. Boring old test tube reactions or whatever, they don't see chemistry in the wider world. And the more events like this which actually demonstrate to the kids chemistry in the wider world, I think it's very good.

They themselves were particularly enthusiastic about a presentation on storage of waste because it covered a contemporary issue and included a demonstration that they were looking forward to repeating in school (they had obtained the 'end product' from the presenter). One teacher said they had gained '**A few more demos to do:**

T1: ***I think we're going to get the kids to present some material when they get back so hopefully they will pass a bit on to the other children as well.***

T2: ***We are discussing whether we get an assembly and get them up***

T1: ***They said they're keen to show the <specific experiment demonstrated at the event>***

They had attended the event once previously, and remembered it having more active workshops, but the facilitators had been less practised at giving educational talks.

They were concerned that Year 9s had been mixed with Year 10s and felt that lower ability children would have struggled. Their recommendations for improvement were to have more hands-on to engage those of lower ability, and to provide larger rooms.

CASE 3: FEATHERLEA

Commentary on achievement of these aims from the data collected

The event seemed to meet aim 2 as pupils said they had not realised chemistry was involved in certain jobs/processes, and to some extent aims 4 and 5. The amount of data is currently insufficient to be clear about the extent to which the first aim was met, although reception was generally positive.

Positive aspects of the event:

A wide variety of jobs was on show, with presenters' backgrounds ranging from those with doctorates to people who had left school at 15 with few qualifications. Most talks included a considerable amount of either chemistry or a closely-related science, eg biochemistry, although there were one or two exceptions. Taken as a whole, pupils were exposed to a broad spectrum of applications of chemistry. Some of these had surprised them. They enjoyed the hands-on elements of the day especially. Although the event was tightly timetabled, having a 5 minute gap between the finish and start times of each slot kept over-runs to a minimum. Several presenters had done such events many times before, and new ones had clearly been well briefed to make efforts to link their talk with chemistry and to illustrate their talks with examples.

Issues concerning the event:

There were two or three last minute cancellations which meant the organiser had to step in as a presenter, as did one of the teachers, and a rest period built in for presenters was lost (much to their annoyance). Pupils and teachers criticised a few of the sessions for being dull, because they were non-interactive and over-reliant on audio-visual aids.

Title of Event: **Chemistry at Work** Other:

Type of event:

For one school/for several schools

Year Group:

6 7 **8** 9 10 11 post-16

Number of sessions each set of pupils attended:

3 4 5 6 7 **8**

Number of pupils per group:

<10 c.10 **c.15** c.20 c.25 >25

Length of sessions (hrs):

0.5 0.75 1 1.25 1.30 1.45 2 (50mins)

Number of different sessions offered: **17** (but one presenter cancelled at short notice, one failed to turn up, and one left in middle of day)

Sessions pupils attended: All those offered

A selection (chosen by organiser)

Nature of sessions observed:

a career in chemistry; waste recycling; karate; gel making; hydrogen fuel cells; haematology; plumbing; making a polymer

Nature of presentations

Talk (non-interactive) **6**, Practical demonstration (non-interactive) **2**, Practical demo (interactive) **1**, Pupil expt **3**, written activity

Pupils' involvement

	all	most	some	few	comments
listening	4	2	2		
answering questions	1	1	3		3 x no Qs to answer
asking questions		2	3	2	1 x none
involved in practical	3	1			4 x not applicable
appear interested	2	4	1	1	

Notes: **range of questions asked by pupils, some suggested limited understanding of the (more technical) presentations. Some pupils fascinated by a talk about a career in chemistry from a chemist with a PhD as they clearly had little/no knowledge of university life. Another pupil, who had been restless through most of the talks, came to life during the demonstration from a plumber, asking several pertinent questions.**

Teacher's involvement

	comments
supervisory	X
interactive 'teaching'	once when year leader came in briefly
interactive as pupils	asked several questions and volunteered answers when pupils were silent
no clear role	
appear interested	X (all but one presentation)

Notes: the teacher was not a scientist but was keen to join in asking questions and attempting answers if pupils failed to provide any

Presenter's actions

Presenter	high	med	low	not at all
show know a lot about chemistry	2	2	3	1
explained things well	2	4	2	
enthusiastic about job	3	2	2	
show have a valuable job		5	1	
Presentation				
was exciting	1	4	3	
showed how chemistry is used in job	2	4		1
helped pupils understand chemistry	1	3	2	1
showed chemicals as dangerous			1	6
showed chemistry at work different chemistry in school		4		
was pitched at the right level	3	4	1	

Notes: One presenter began by saying he knew nothing about chemistry so don't ask any technical questions.

Some aspects of the above were not shown / not applicable

Pupils' views of chemistry and of the event from focus groups (one focus group with 6 pupils, mixed ability; survey):

Note: the focus group consisted of pupils who had seen a different set of presentations from those the researcher had attended.

The pupils expressed mixed views about the day. Most, however, felt it had surpassed their (admittedly low) expectations. They had anticipated it would be tedious and involve a lot of lectures:

I thought it was really boring at the beginning .. but now I think it's kind of interesting because they do loads of things like exploding things and the story X told us, that was really funny...

Yeah, I thought science, every time I go into science, I'm oh no not this lesson because you just carry on talking and talking but when she told us that story and the

<demo of liquids reacting> thing, I thought that was really good

However, they were quick to criticise sessions that they thought lacked interactivity, saying the only good thing about one was they got prizes for answering questions. Another was described as:

P1: *Boring*

P2: *... like sitting in a double period of science*

P3: *... it did nothing, all it did was show us slides and talk and carry on talking.*

In contrast, in the well-received ones:

P1: *You got to make goo*

P2: *... you got involved*

P3: *... you weren't just sitting there staring at this PowerPoint*

They expected to learn new things and were disappointed when this did not happen: *[one presentation] was okay it's just that he repeated things that you already know'.*

The event had opened their eyes to the possibilities of jobs in chemistry, which none had previously been aware of: *'I didn't know how you could use chemistry in types of jobs and now everyone's telling us how you use chemistry in, like <examples from talks>'.* Whether their behaviour will be affected is, of course, another issue.

About half the pupils were enthusiastic about the day overall, two had been impressed by a few of the presentations and one dismissed it as *'boring'*. However, this was only a small group of 6. Many of the pupils in the group observed during the day seemed quite positive about the event, and almost all those filling in the questionnaire would recommend pupils attend next year, although only a minority agreed 'strongly' with this. As in the focus group, there was some discontent with presentations that lacked activity and involvement: *'the event was interesting but some of the presenters could have included us a bit more'.*

Organisers' view of the event – from discussion (1):

The organiser had to do presentation himself because of cancellations. There was an arrangement with neighbouring region to cover for each other if presenter lets them down with enough notice.

Presenters' views of the event – from discussions

There were some feeling that presentation slots are too short (at 30 mins) and dissatisfaction that there was no break because of cancellations. Several did a number of events for this organiser; others were not able to because of the time commitment and found multi-day events impossible. A commonly expressed desire was to inspire the pupils about chemistry and associated careers, to motivate them. One new presenter had obviously been well briefed about the need to link his job to chemistry, to pitch it at the right level, and to share his own (negative) school experience and how he had been learning ever since, so that he now had his own business. This contrasted well with another presenter who spoke about his much more academic career.

Teachers' view of the event (4 questionnaires)

The teachers who completed the survey about the event were lukewarm in their response. Like the pupils, they preferred the more active sessions and raised concerns that some talks were not interactive or poorly communicated: ***'a lot of the talks were not aimed at young people and the information was not presented at their level'***. Indeed, two of the four teachers would not recommend pupils attending next year and identified the challenge as ***'ensuring that professionals in the field of chemistry can be pitched at an engaging and suitable level for students'***.

CASE 4: WESTERLAKE

Commentary on achievement of these aims from the data collected

The event achieved aim 2 and broadly achieved aims 1, 4 and 5. It covered a broad range of chemistry-related industry. However, variability in presenters highlighted the importance of their ambassadorial role – a poor presentation that lacks enthusiasm can be detrimental to their area of work and to the event as a whole.

Positive aspects of the event:

A good variety of industries and applications was covered, leaving many pupils surprised at how many jobs involve chemistry. It was pitched at an appropriate level and included some very appealing presenters and hands-on activities.

Issues concerning the event:

The timetable consisted of 20 minute slots with no turnaround time, and because timings were not strictly enforced some schools had to miss their last session, leaving a feeling of dissatisfaction among pupils and teachers. Some presenters were perceived as unenthusiastic, and there was a plea for more interactive/hands-on activities to enliven the driest presentations.

Title of Event: **Chemistry at Work** Other:

Type of event: **For one school**/for several schools

Year Group:

6 7 8 9 10 **11** post-16

Number of sessions each set of pupils attended:

3 4 **5** 6 7 8

Number of pupils per group:

<10 c.10 **c.15** **c.20** c.25 >25

Length of sessions (hrs):

0.33 0.5 0.75 1 1.25 1.30 1.45 2

Number of different sessions offered:

5 (all external, no cancellations)

Sessions pupils attended: **All those offered**

A selection (chosen by organiser)

Nature of sessions observed:

Pigment manufacture/use; pharma – analytical chemistry; agrichemicals; forensic services; drinks development/QA

Nature of presentations

Talk (non-interactive) **4**, Practical demonstration (non-interactive) **1**, Practical demo (interactive) **2**, Pupil expt **1**, written activity **1**

Pupils' involvement

	all	most	some	few	comments
listening	5				
answering questions	1	1	1	1	1 – no Qs to answer
asking questions				1	4 – no Qs
involved in practical	1	1			3 – not applicable
appear interested	1	3	1		

Notes: **The pupils were very well behaved but had minimal interaction with the presenters in most sessions, so it is hard to gauge their level of interest – or whether they were exceptional in their lack of questions etc.**

Teacher's involvement

	comments
supervisory	X
interactive 'teaching'	
interactive as pupils	
no clear role	
appear interested	X

Notes: **the teacher who was due to attend was sick, so a non-teaching member of school staff was standing in. She had very little to do, except prevent scuffles when the students had to hang around in the corridor for a considerable time between 2 presentations.**

Presenter's actions

Presenter	high	med	low	not at all
show know a lot about Chemistry	1	2	2	
explained things well	2	3		
enthusiastic about job	3	1	1	
show have a valuable job	1	4		
Presentation				
was exciting	1	3	1	
showed how Chemistry is used in job	1	3	1	
helped pupils understand Chemistry		1	4	
showed chemicals as dangerous			1	1
showed Chemistry at work different Chemistry in school	2	2	1	
was pitched at the right level	2	3		

Notes: Some aspects of the above were not shown / not applicable.

Most presenters gave a bit of background about their own route into their job. One or two had more emphasis than necessary on their own organisation. Four of the presentations had 2 clear parts to them and are therefore not straightforward to rate as a whole.

Pupils' views of chemistry and of the event from focus groups / interviews (3 focus groups covering FG & interview questions each with 6-9 pupils from 3 schools; questionnaires from 2 schools):

The pupils and schools were chosen to cover a variety of backgrounds and abilities. However, views of the presentations were fairly consistent across the board: whilst all were pitched at the right sort of level, the most popular were those with a practical or interactive element, and the least popular those which were 'just talks':

It's better when you do practical, when you get to do something

It was just a PowerPoint, it didn't really involve me at all.

I think maybe it would have been better if there was one less presentation and the other ones were slightly longer and it was made more workshop-y than presentation-y ... in the ones where we were active, there wasn't really much time to do much

Pupils were very sensitive to presenters' demeanour: they reacted well to those who drew them in, and were disappointed when the presenter seemed unenthusiastic. One presenter in particular was very popular, and one presentation (although not always delivered by the same people) proved almost universally disappointing - despite it covering an application of chemistry that several pupils found potentially interesting:

I would like a job in [area of science] but the woman made it sound really boring.

[Presenters] were quite varied standard. Some of them were quite comfortable, quite natural presenting but one or two others maybe weren't that professional, it just wasn't really flowing that well

Some of it was a bit boring to be honest.

Interviewer: Why?

- they just kept talking

- they didn't show much enthusiasm, they were just speaking

Some of the presenters need to have more energy in their presentations, make it fun.

They didn't just sit there and say this is what we do, they were total like, 'What did you have for breakfast?' 'Toast' 'We helped make that'

- he was funny

- he was hyper at the start which was good

Two activities – a practical that all could join in and a game that some pupils had chance to play whilst other watched – were especially well-received.

Several said the event had changed the way they looked at chemistry, amounting to one-third of those in the survey. Mainly this constituted a realisation that chemistry was applicable in far more job contexts than they had imagined:

There's loads more things to do with chemistry than I thought of. I thought things to do with food in the lab would be under biology.

I learnt more about what I want to be myself, a chemical engineer. I thought it was the same as chemistry, just using tons of chemicals, I didn't know it was designing things ... I want to go and work in chemical engineering now.

Those pupils who had missed a session due to others over-running were disappointed, and one suggested that there should be more presentations with students able to choose which they attended.

Asked if they would recommend students from their school to attend the event next year, respondents to the survey were evenly divided (21 agreed, 19 disagreed). Response from the focus groups was more positive (perhaps because the teachers had selected pupils who were more favourably inclined towards the event and/or chemistry in general). The range of opinion is summed up by these quotes from two different questionnaires:

It was a very interesting and eventful day and I enjoyed myself thoroughly

It was extremely rubbish [underlined twice] and boring [underlined twice]

Organisers' view of the event – from informal discussion (1):

Although all the presenters had turned up, 2 schools cancelled (across the 3 days) – one at short notice apparently because of teacher illness. The organiser felt this was more likely to happen because there is no charge for the event. The event spans 3 days and each

school attends for half a day – this makes timing very tight. The organiser is aware that this can cause problems (and did the day the researcher attended) but considers it a worthwhile compromise to maintain both a spread of presenters and high throughput of students.

Presenters' views of the event – from paired interviews (2) and informal discussion (1)

The presenters saw their role as enthusing teenagers about chemistry and potentially motivating future recruits to their own industry:

It's a different challenge isn't it – trying to engage 15, 16 year old kids and get them interested in chemistry

... out of the hundred or so we see today, we might be lucky if we get one who walks out of here and says you know, I really fancy getting into that industry, sounds fascinating ... but that's the purpose. We are part of the community and see it as part of our role.

They had no real background in communicating with such an audience, and those who had done it in previous years recalled how they had initially struggled with knowing where to pitch it. Both sets of presenters had changed their delivery to some extent – one to be more interactive, and one forced by circumstances to become less hands-on. However, none of them was confident that they had got it right, and said they would welcome feedback to help them refine their offering:

I'd say the majority of them don't want to interact. You get the odd one

- It may be more our presenting style. Perhaps we don't engage them as well as we could

We used to [get students to use equipment] and that was great, they got lab coats on and safety specs but ... it caused a mess and 20 minutes just wasn't enough time

The very first year we did it, we did an entire sit-down presentation and everyone was yawning away ... so we have hands-on things to make sure maybe we break that tedium

They all seemed to enjoy the demonstrations, they get to see the practical side of it – I'm not quite sure about the rest of it ... it seemed to be a neutral response

There were mixed views about the length of the time slot, depending on how well the session was flowing: ***If there's no interaction from the kids, it can be hard work, 20 minutes can be tough. But if you've got a group who are interested ... you wish you had more time.*** Chiming in with teachers' comments (below), one of them said it would be useful if the accompanying helper could warn

them when the end of the session was approaching to prevent them over-running.

Although all were keen to carry on doing the event, pressures of the 'day job' clearly affected what they could offer: ***We hoped to completely revamp what we did this year, just because we wanted to do something a bit different, but in the end we just didn't have the time.*** Some presenters, who travelled a lot, needed to put the event in their diaries up to 3 months in advance.

Teachers' view of the event – from interviews (4 teachers from 3 schools; questionnaires from one school)

Two of the schools had been attending the event for several years, for one it was the first time. Although the three schools were very different in nature, the teachers had a common motive for attending – to demonstrate the wider significance of chemistry to their students:

I always take them because I want them to see the relevance of chemistry, firstly to everyday life that they live and also to potential careers.

We want to encourage as many pupils as possible to take chemistry forward so this is an ideal opportunity to raise awareness of not just chemistry at school but chemistry in the wider world as well

... to see how people use chemistry in real life and why it's important in so many different areas

They were very positive about the event as a whole, but there were a few specific criticisms about organisation and particular presentations. Two out of the three schools had been unable to attend all the presentations in full because the event was running late and they had leave on time, which proved an irritation. They thought the timings should have been adhered to more strictly. Like the pupils, teachers' opinions about whether the slots were long enough depended on how they rated the presentation:

Well, the less exciting ones, it was long enough. We were lucky really, we had <hands-on presentation> at the end, so we were there for well over half an hour ... whereas one school had only had 5 minutes to go through that and wouldn't have got much out of it. [So it] really depends how good it was – I think on average it was probably about right. 20 minutes to half an hour is fine.

The main thing yesterday that could have been improved was timing, because we didn't get round to the last one ... I think [the helpers] should have a stopwatch and give people a nudge. Because I understand that the people who do this aren't professional communicators.

In general, the presentations were thought to have been pitched at about the right level. One teacher, a veteran of these events, said that this had not always been the case and felt that the local committee had been responsible for the improvement. Teachers correctly identified the two activities that had appealed most to their pupils, and reinforced the plea for more interaction, fewer PowerPoint-only presentations and in some cases less promotion of the company:

I would like it if it was done in a more exciting way so the kids were more involved in it. Some of the presentations are excellent.

We went to <presentation> and I have been to one with much more enthusiastic presenters. I think it needs to be quite snappy and practical, to get the kids to do things, you know. We're very into, at schools now, cooperative learning which is involvement with the children rather than them just sitting and stuff being fired at them ... Not necessarily all the time because I totally see that there's a value in explaining what they were doing.

Some of them, people seem more keen to talk about their companies than they are about Chemistry at Work so the kids switch off at that point.

Possibly one or two of them could have put more emphasis on the role of the chemist in the organisation.

I think it needs to be 'this is what chemists do here'. The <specific organisation> guys are always good.

They also identified the least interesting presentation as the one most pupils had highlighted, which underlined the importance of the individual presenters in either inspiring or putting pupils (and teachers) off a job:

Most of our kids would switch onto <area covered by specific presentation> in a second and none of them were in the slightest bit interested. But that's a bit to do with the presenter.

A lot depends on the presenters. I don't know how they choose their presenters but I think they need to choose people who like kids and like what they're doing.

- there was one or two who were, I'm here under sufferance for the day. And someone else will come in to do it tomorrow thankfully.

- And the kids saw that

The <specific presentation> was not very good. The presenters weren't very animated and PowerPoint is not that exciting ... the people were just not that enthusiastic about what they do. I came away with the impression that the job that they do is quite boring and that wasn't

the idea of the day, although it was very informative but it wasn't terribly exciting.

The little chap was funny and animated ... and the kids enjoyed him because he was a good presenter with lots of props.

Teachers were impressed by the broad spectrum covered by the presentations: Some of the presentations were better than others but generally it was quite a wide variety of companies in terms of the areas in which they worked. They tended to hesitate when asked what the pupils had learnt from the event, but their eventual responses were in line with the aims of Chemistry at Work:

I would love to think that someone went away thinking there's nothing finer than being an analytical chemist. I don't think that will be the case. But I think in some corner of their mind it just opens up ideas ...

I would think they've a bit more idea about ... how a company actually works and how the lab and chemistry fits in with what the company's operations are, and how important it is in so many different areas they might not have thought of.

The teachers cited more general advantages of the event, considering that taking pupils on external trips was beneficial in itself, and that the location enabled many of them to have their first experience of university laboratory and lecture theatre facilities. However, one school pointed out that they were taking pupils from a wide ability range, and it would have been ***'quite useful somewhere along the line to say, you don't have to have gone to university and got a degree in this, you can go in and work as a lab technician and do your HNC while you're there', chemistry was not just for 'the academic elite'.***

Despite some criticisms and suggestions for improvement, the teachers were generally favourable about the event:

The kids behaved though, which says a lot. They weren't switched off at all.

- No. But they were ready to go at [the end]

We wouldn't go year after year if we didn't find it valuable ... a bit more practical, if children were more actively involved, would be advantageous, and possibly a bit more slant on what the chemist is actually doing in these things – which they did mention.

CASE 5: DEERHEATH

Commentary on achievement of these aims from the data collected

The event achieved the first and last aims, and partially met aim 2 although probably led to some misconceptions as to what constitutes chemistry.

Aim 4 was met to some extent, although there was a feeling that the element of excitement could have been greater. This perceived lack of 'wow' factor was probably a consequence of last-minute cancellations by some presenters. The same explanation perhaps lay behind a lack of chemistry focus in one or two sessions. The suitability and supportiveness of the host venue was widely praised.

Positive aspects of the event:

The pupils were enthusiastic about the event, enjoying the interactive elements in particular – whether this involved hands-on activity or just the chance to answer questions. They also welcomed the opportunity to learn new facts, retaining especially ones that surprised them. Pupils were favourably impressed by the experience of a 'real' laboratory and the teachers saw it as a valuable opportunity to expose pupils to science, equipment and processes that were not otherwise accessible.

The deployment of 'student ambassadors' from the host venue helped considerably in keeping the event running to time, ensuring groups moved around the campus without problem and helping the speakers with their sessions. Ten minutes was scheduled for getting between sessions, which lessened the effect of any over-runs.

The organiser shares the evaluation findings with presenters.

Issues concerning the event:

This event is always heavily over-subscribed, which means several schools who would like to cannot attend, and those that are lucky enough to go have to limit numbers. This year it was particularly difficult to get presenters, who were reluctant or unable to spare two days away from their jobs. There was some disappointment about the lack of 'wow' factor, among both pupils and teachers, and some feeling that there could have been more 'hands-on' activity. Teachers judged that some content had been too difficult and there was a need for more age-appropriate language (although only a few pupils raised this issue). One concern of the evaluators, with one session in particular not being focused on chemistry, was that some pupils had gone away with a misleading impression of what chemistry involves.

Unfortunately, one school arrived very late, and the resulting wait meant that the first of the 4 sessions had to be curtailed to catch-up with the timetable, leaving attendees feeling short-changed (especially the school who had been there early and therefore waiting for some time).

Title of Event: **Chemistry at Work** Other:

Type of event: For one school/**for several schools**

Year Group:

5 6 7 8 9 10 11 post-16

Number of sessions each set of pupils attended:

3 4 5 6 7 8

Number of pupils per group:

<10 c.10 c.15 c.20 **c.25** >25

Length of sessions (hrs):

0.3 0.5 0.75 1 1.25 1.30 1.45 2 (20 mins)

Number of different sessions offered: 4 (2 external organisations; one student from venue; one from organising group – latter two because of presenter drop-out)

Sessions pupils attended: **All those offered**

A selection (chosen by organiser)

Nature of sessions observed:

Water purification; animal health/microbiology; chemical health and safety; forensic science

Nature of presentations

Talk (non-interactive) **1**, Practical demonstration (non-interactive) **1**, Practical demo (interactive) **2**, Pupil expt written activity

Pupils' involvement

	all	most	some	few	comments
listening	2	1			1 – not applicable
answering questions	2		1		1 – not applicable
asking questions		1	3		
involved in practical	1	1			2 – not applicable
appear interested	1	3			

Notes: **All sessions were made interactive in some way, eg the talk kept pupils involved answering and, at the end, asking questions (encouraged with chocolate**

rewards). Although there was little question/answer in another session, there was lots of practical work. In one session there were 'freebies' to take away, in another they took away material from their practical.

Teacher's involvement

	comments
supervisory	X
interactive 'teaching'	In the less directive demonstration session (see below)
interactive as pupils	
no clear role	
appear interested	X

Notes: **mostly the teachers were non-participatory supervisors**

Presenter's actions

Presenter	high	med	low	not at all
show know a lot about Chemistry	1	1	1	1
explained things well	2	2		
enthusiastic about job	1			
show have a valuable job	1			
Presentation				
was exciting		4		
showed how Chemistry is used in job	1	1		
helped pupils understand Chemistry		1	1	2
showed chemicals as dangerous	1			
showed Chemistry at work different Chemistry in school				
was pitched at the right level	2	1	1	

Notes: **there was only one session where presenters were talking directly about their job. One session was much less directive than the others – pupils moved themselves between work stations though there were 3 helpers on hand to explain/answer questions. Two sessions were primarily focused on chemistry; another was more tangentially related. The fourth was primarily (micro)biology. Pupils were not really studying chemistry at school so this dimension was not relevant.**

Pupils' views of chemistry and of the event from focus groups / interviews (five focus groups with 6 pupils from 3 schools):

The overwhelming impression of chemists was of people who worked in a pharmacy:

They're like people in Boots who prescribe you and give you a medicine

It's someone who has to deal with medicines and things. Do they have to make the medicines?

Another prevalent view was that chemistry was about 'chemicals' or 'potions' that were mixed together, sometimes with exciting results:

- they might try and mix different chemicals together to make a different ...

- ... solution

- different formulas

- it's like something you do in science. You have test tubes and potions and stuff.

- bang when you think of all the chemicals you put in and a big bang, fizz, pop

During the observation, the first pupil question after one session was in fact "What is chemistry?" rather flummoxing the presenters (whose response the teacher was not very impressed by). Most of the children in the focus groups assumed that everything they saw at the event was chemistry by definition, although a minority were aware that they had been exposed to biology as well:

P1: ***I also think they shouldn't have just done chemistry, they should have done biology and physics***

P2: ***Yes, all 3***

P3: ***They did do it, you looked at all biology***

As well as the sessions at CaW, the children had formed their opinions from television (programmes including cartoons) and, notably, trips to their potential secondary school where they had seen memorable demonstrations. These were referred to across the schools visited and had obviously made a good impression:

- secondary school visits ... you go into the lab and they let you look through microscopes and they're making stuff go bang and they were using big gas taps as well

The CaW session most commonly chosen as the favourite was closest to the traditional presentation-style format, but the children were keen to point out that it had involved them – and included freebies:

If I'd just had to sit in a presentation I'd have got a bit bored. But ... they had questions

And they were funny

... they asked you questions and they didn't just babble on about blah blah blah

Because if you asked a question you got a sweet ... and you got loads of stuff from it

Moreover, the children could still remember a lot of detail from this session: statistics that had surprised them and facts from stories they were told. This tapped into a real thirst for knowledge in many of them:

I found some stuff about it that I didn't know before

You learnt loads of stuff

This desire for information and need to be involved in some way was reflected in their criticisms of sessions:

He didn't ask questions, like "why do you think you should have that?" and someone could have said "because of the ..."

- and you didn't learn much ...

<specific session> was a bit boring because it was all talking and you didn't get to do anything, you just had to sit in a chair listening to them

More active sessions were quite popular 'because you actually were doing stuff whilst you were learning'. Putting on a white coat and being allowed in a lab impressed some children: 'I think we acted responsible so they actually trusted us going round by ourselves, they didn't sort of take us where we had to go'.

However, for others, this promised more than it delivered:

P1: ***When we went into there [labs] I was quite excited but when I started I was thinking, oh it's a bit boring ... I wanted to make things fizz and pop***

P2: ***You thought you were going to do something because you had lab coats on and everything***

Although the day was enjoyed by all the pupils spoken to, and for several it was less boring than expected as they got a chance to do things rather than just be talked at, there was some sense of disappointment. This may have been amplified by the demonstrations so many of them had seen on secondary school visits:

I would have thought it was mixing chemicals, after we'd been to one I was hoping that it would be the next one. But I still liked it.

I thought we'd do different [experiments] throughout to

show us how fun chemistry is and how you can learn from it

Most of them agreed it had changed their view of science, and chemistry in particular. They saw it as a broader area than they had expected, felt more positively disposed towards it, and were looking forward to coming across it at secondary school. However, this will be influenced by the event including areas of science that were not strictly chemistry:

I thought chemistry was only when you pour stuff from one bowl into the other and so there can be an explosion ... and it's just like everything really. Everything's sort of chemistry

P1: ***I think that Chemistry at Work will actually be quite useful when we go to secondary school because we'll have a headstart ... it's like a taster***

P2: ***They made it fun so you're going to look forward to it, like oh yes, I've got science or chemistry this year.***

Several felt quite constrained by primary school science, acknowledging that they lacked the space and equipment:

We normally just do forces

- and we do little experiments

- but it's nothing to do with chemicals

We've got an art block we should have a science block

At school it's boring

- You do boring experiments ...

- Measurements and stuff rather than liquids

The improvements children suggested to the event took up the themes outlined above – having something more spectacular and increasing the opportunities for participation:

- more things to do rather than just watching things maybe doing something that we can really get stuck into

- so we can get messy or ...

I think it would be really good if they had chemicals mixing, I know it would be a bit hard to do that, but I would like to do that ... it would be quite fun.

... if they had done that in the hall at the start and made like things go all smoky, everyone would have thought that was really amazing. And then you go round the other rooms and do little experiments and they would have thought that was really good.

The other main complaint concerned having to wait

around at the beginning for a late school (although they appreciated the provision of drinks and biscuits), which also meant the first session was very rushed for one school.

On the whole, the response was very positive, with adjectives such as ace, good, recommended, awesome being used to describe the event. There was a plea for the event to last longer, perhaps all day (with an ingenious suggestion about making lunchtime an opportunity to analyse the healthiness of the food), and concern expressed for those who had not been allowed to attend:

I think the only bad thing is that not everyone got to go ... we came back and we'd had chocolates and that ... X in our class, he's not one of the brightest but he loves science, and he didn't get to go

Organisers' view of the event – from conversation/questionnaire:

There is a high demand for attendance at this event, which is advertised to schools in the area by flyer. So the numbers from each school are restricted, and there was a long waiting list. As a rural location with predominantly small/medium size businesses, it is often difficult to find presenters. Unfortunately, this year was particularly problematic – maybe because of the economic downturn - leading to short-notice replacements being drafted in to fill the empty slots. There was a new venue, a higher education campus, this year. The staff had proved extremely helpful and supportive, eg providing a last-minute presenter and having students on hand to accompany pupils and help presenters. The students were part of a team who are regularly involved in liaison with local schools.

Presenters' views of the event – from interview (1 organisation)

These presenters had been drafted in at fairly short notice but all said they had enjoyed the event. Although they had no experience with this age group (their audiences tend to be mid-teens at the youngest) they had received advice from the organiser and were confident that they had targeted it appropriately:

You can aim <subject area> at any level really, all you do is just either tone it down for younger age groups or you wind it up a bit more for older age groups

They felt their session gave a slightly different angle on 'Chemistry at Work' but that if they were asked to participate again next year – which they were keen to do – they might introduce more specific links with chemistry

and chemicals.

Teachers' view of the event – from interviews (interviews with 2 teachers from 2 schools)

The teachers were hoping the event would enthuse children by showing them new aspects of chemistry and introducing them to a more specialised environment:

That the children could see other aspects of science that I can't offer them in the classroom, an opportunity to go to [...] the chemistry labs and things like that that they don't see in a primary classroom

... taking children out as we did yesterday is an ideal opportunity to do a little bit more out of the ordinary.

One teacher felt less likely to attend a more generic 'science' event, as it was the word 'chemistry' in the title that had attracted her: obviously there's so much health and safety for primary schools that you can't really do many exciting chemistry things – bicarbonate of soda and vinegar is about the most exciting really you can get away with. So it was the chemistry which did draw my attention which is why we went for it.

Within the primary school environment it is quite limited in what we can do so this is why the RSC workshop like that is a very valuable resource from our point of view.

One had attended in previous years so knew the type of thing to expect, whereas the other was basing her expectations on the flyer. As a result, both were a little disappointed that certain organisations/activities were not available – for instance, one teacher had hoped to gain the necessary confidence to undertake a specific activity in her classroom, but in the end it was not offered.

However, the teacher who had been before thought the venue was an improvement:

The university campus impressed the children, they enjoyed going to the laboratories and things like that, dressing up in white coats

They did have some criticisms about the sessions, which focused on three main areas: over-complexity, particularly of language; insufficient hands-on activities; and the absence of spectacular demonstrations.:

I think probably that some of the work that was presented to the children just went a little bit above their heads in the timeframe we're talking about ...

The language that they use and expectations of primary school children – I feel sometimes they don't quite go low enough down to their level and sometimes you find

yourself having to clarify [...] I don't want to interrupt but I need to ...

I was expecting perhaps a little bit more of a hands-on approach

I know when we've been along on previous occasions we've had quite a bit of that whizz bang science which impresses children, when something spectacular happens, and that perhaps, that element was missing, that wow factor. [...] I think we could probably have impressed them a little bit more in terms of chemistry can be fun and exciting and all the other things that we associate with that opportunity.

One felt that in an ideal world, presenters would have observed what went on in a primary school first to get a sense of the correct level to pitch it at. The 'whizz bang' element need not be terribly sophisticated: 'you can add a chemical to something and it suddenly changes colour and those sort of things'. However, they also recognised a danger in valuing form over substance, for instance in reference to one session: I think in the end it lost the point almost, that they enjoyed <the activity, but it> became the focus rather than the chemistry

Despite these issues, both teachers considered it a useful event which they were keen to attend again:

They perhaps needed, to make it very successful, just a little more hands on. But I think the atmosphere, the occasion, the surroundings were all ideal from the point of view of introducing these children to an element of chemistry being fun.

Some of them did come away saying I'd quite like to do that, so I think a seed has perhaps been planted in a couple.

We're very grateful to the RSC for sponsoring and promoting this kind of approach and I think it is important that these people don't forget that at primary age, that's when you increase the interest that children have in an area like science. If you capture them young and motivate them at an early age as I was ... it's at primary level that you will get the greater enthusiasm for as I've said the wow factor of chemistry. And you never know, you just switch on 2 or 3 children as a result and it's served its purpose.

CASE 6: CROSSHAMPTON

Commentary on achievement of these aims from the data collected

This event very clearly met aim 2, and also aim 1. It seemed to meet the aims 4 and 5 to a substantial extent, and to partially succeed with aim 3.

Positive aspects of the event:

A wide range of careers and chemistry applications was on display. Most presenters were interactive within the constraints of the venue, with good use of questioning (sometimes reinforced by prizes), demonstrations and display of samples. The majority of content was at an appropriate level for the audience. An audible signal at the end of the slot approached kept sessions on time.

Issues concerning the event:

The venue was not ideal: because several exhibitors shared the same space it proved difficult to hear presenters and to manage expectations (several pupils were disappointed not to have seen all the sessions, particularly those that 'sounded' exciting). Sometimes the subject matter was too advanced and very occasionally there was an excess of company-related information. A few pupils had expected more practical experiments. At least one iteration of the event did not start on time because of a late-arriving school, and consequently some groups had to leave before they completed the intended number of sessions.

Title of Event: **Chemistry at Work** Other:

Type of event: For one school/**for several schools**

Year Group: 6 7 8 9 **10 11** post-16

Number of sessions each set of pupils attended:
3 4 5 **6** 7 8

Number of pupils per group: <10 c.10 c.15 c.20 **c.25** >25

Length of sessions (hrs): **0.33** 0.5 0.75 1 1.25
1.30 1.45 2

Number of different sessions offered: **11** (plus 'importance of chemistry' by host organisation)

Sessions pupils attended: All those offered
A selection (chosen by organiser)

Nature of sessions observed:
chemical engineering; electroplating; chemistry of Lycra; drug manufacture; drug development; tackling superbugs; gas production and use; analytical

chemistry; synthetic chemistry; food chemistry; green chemistry; importance of chemistry

Nature of presentations

Talk (non-interactive) **11**, Practical demonstration (non-interactive) **4**, Practical demo (interactive) **3**, Pupil expt written activity **0**

Pupils' involvement

	all	most	some	few	comments
listening	7	4	1		
answering questions	2	3	4		3 talks – no Qs
asking questions			1		little opportunity: 10 none
involved in practical	1			3	few had pupil activity, and then only 1/2 usually involved
appear interested		7	5		

Notes: **Students were attentive and well behaved, and showed consistent interest when presenters passed round examples.**

Teacher's involvement

	comments
supervisory	X
interactive 'teaching'	
interactive as pupils	
no clear role	
appear interested	

Notes: **the teacher had attended before and did not seem particularly interested, eg not even sitting in on two sessions (not a supervisory problem as students well behaved).**

Presenter's actions

Presenter	high	med	low	not at all
show know a lot about Chemistry	8	3		
explained things well	6	6		
enthusiastic about job	6	4	1	
show have a valuable job	6	4		
Presentation				
was exciting		3	8	1
showed how Chemistry is used in job	5	4		
helped pupils understand Chemistry	1	4	6	
showed chemicals as dangerous		1		2
showed Chemistry at work different Chemistry in school	1			1
was pitched at the right level	8	4		

Notes: Some aspects of the above were not shown / not applicable.

Although most presentations were talks, several presenters passed round samples and offered freebies, eg prizes for answering questions. All the companies started with an overview of their organisation: perhaps in a couple of cases this took up too much of the slot. The stations were very professionally organised, with posters, pop-up stands etc.

Pupils' views of chemistry and of the event from focus groups / interviews (2 focus groups each with 6 pupils from 2 schools; one group Y10, one Y11):

Some of the pupils had previously held quite a limited view of chemists, either restricted to those working in a pharmacy or the stereotyped image of **'a guy in a lab coat with chemical in the hand'** and **'glasses and frizzy hair'** they had got from cartoons and **'movies like Flubber'**. In these cases, the event had proved eye-opening:

I used to think chemistry was all about medicine and liquids and stuff like that but then you actually learnt it was involved in machinery and stuff, so it changed my

view about that, learning it wasn't just about liquids

I would maybe have thought they just worked in a pharmacy and issued prescriptions to people but know I've found out about all the different careers you can do as a chemist

They were positive about most presenters, finding the talks accessible and involving:

It was very easy to understand what they were talking about

There were quizzes and stuff that I thought was good because everyone got involved together, worked together

They responded well to an enthusiastic manner and being asked questions by the presenters, and were critical of those who were less animated or too complex, or focused too much on their company:

Some of them wanted you to take part in it and they made it really interesting for everyone, but some of them, they just didn't really care ... whereas others said right, we're going to ask you questions and you're going to have to answer them, so you will feel part of it

Most of them were all right but there were a few who were a bit monotone and sort of drifted off, and you didn't have a clue what they were talking about and we were a bit bored by some of them, but the majority you were interested in

I think some of them went on a bit too long about stuff we didn't really know about

- it might have been the person not the thing, if a different person had described it, more enthusiastic

Some were talking more about their company whereas others were just talking about what they do, not really what we would do if we worked there

One presentation proved the most popular for nearly all the students, combining a charismatic presenter with mixed media, interactive questioning and subject matter that threw unexpected light on everyday life:

They showed you how it affected what was in your life, like some stuff we use every day ... how chemistry could help make them

They offered round different [samples to look at/feel] and you felt part of it

The <specific presentation > was good because the guy taking it was enthusiastic and it was good PowerPoint

- It had a video as well so it sort of wakens you up a bit, watching that

One group of pupils felt it was better and more involving than they expected: ***'I thought you'd just have to sit and listen to people talking'***. Yet several in the other group (who were doing single-award GCSE) based their expectations on chemistry as the most practical science in school: ***'I didn't really think that we were going to be just talked to by people. I probably thought it would be more involved, like experiments and stuff'***; 'It was to do with jobs. Chemistry jobs I imagine being more practical but we didn't see much practical work going on, we saw pictures of people doing stuff'. Ironically, the latter group were those with the teacher who had been much more positive about the event. However, they had also attended the plenary careers talk (which the other school missed) that was timetabled halfway through the sessions and was a very passive session where pupils sat in rows in a large hall. This slot was not received positively by those spoken to: ***'I think it was probably a bad idea because it was all the different schools coming together and you couldn't work out what she was saying if you were at the back, and I don't think many people were listening because it got a bit boring cos she was just talking for so long'***.

Unprompted, both groups of pupils raised the issue of struggling to hear the presenters in the hall because of the background noise from other sessions. They were also disappointed not to have had the opportunity to go round all the stations – particularly as one involved an explosion that they heard several times as they sat in other talks: ***'probably the one with the big bang is the one that would have excited us most'***. So they were all keen for the visit to be longer, but most thought the length of the individual slots was about right.

They considered that the event had given them a new perspective on chemistry, broadening their horizons and alerting them to its potential:

In school we don't really learn about how chemistry relates to your life, but in that it was all about what chemistry does to us.

It was just the different branches that made you think, I never knew that was there, maybe I might try that.

It was more about career choices, what you could get from being a chemist, from having a degree in chemistry ... I didn't think it was about learning.

For some, the change was quite radical:

I thought [chemistry] was pretty boring but then a lot of the things I saw made you think, actually I want to learn more .. about materials and things

I used to think that chemistry was just chemistry but after

[CaW] I thought [it's] part of our lives, everything comes from chemistry

Organisers' view of the event – from informal discussion (1):

Heavy traffic meant start delayed because of late arrivals. Most of presentations in one large room divided by screens: groups work their way round in a clockwise direction and no gap needs to be scheduled for changeover. Whistle blown towards/at end of each session to keep presenters to time (not always heard by those in one of the individual rooms). Heavy demand from schools means they have to be initially limited in numbers, then allowed more if overall capacity permits. One presenter had dropped out for unavoidable data protection reasons.

Presenters' views of the event – from interview (1) and brief informal discussion (3)

Presenters saw the event as an opportunity to promote their organisation and attract new potential recruits. They had some experience with audiences around this age, either from previous CaW events or through their own work-related activities, and showed an appreciation of appropriate techniques: ***'we've put interactive exercises here because we know that would keep their interest as opposed to standing up and just talking from the front'***. Another presenter included a video and began with a fairly light-hearted discussion to establish interest and context by the time the chemistry itself was discussed.

Although constrained by the surroundings, the presenters were happy they had conveyed how they used chemistry in their job as well as possible: ***'obviously if at <own base> we could do that a whole lot more and we would do a lot more practical application of <area>, but within this facility it's a much as you can do really'***. There were no obvious barriers in attending, however a slight warning note was sounded in one case: ***'... the question has been asked in the past, what do we get out of this? ... It's something we find very difficult to gauge, but we feel it keeps up contact, keeps our name out there, so we've decided to attend for the time being anyway.'*** In the past, one presenter had been stopped from attending after a takeover, but allowed to return in a bid to raise awareness of the new company name. One set of presenters had been drafted in at very short notice, but said this was not really problematic as they were based at the venue. The one organisation interviewed had no concerns about being part of a broader science event, but this was because they also covered biology-related applications and they wondered if more single-focus presentations would suffer: ***'might get lost a little bit if you're promoting***

chemistry, but it won't affect us as much as some of the other exhibitors'.

The event was generally felt to be well-organised and these presenters did not complain about the large hall. Indeed, the only criticism came from presenters in individual rooms - one felt it was a bit dungeon-like and another had been unable to hear the warning whistle towards the end of the sessions.

Teachers' view of the event – from interviews (2 teachers from 2 schools) and informal discussion (1)

Both teachers interviewed came from schools which had been attending the event for many years, although one individual was herself a first time visitor. Their main motivation was to encourage students to study chemistry further and perhaps pursue it as a job. There was also a desire to show students that school chemistry links to the outside world:

Some insight into the possibilities for studying chemistry at a further level ... I'm very enthusiastic that they find out about the opportunities that are there.

Basically I see it as a careers convention ... to encourage them to do chemistry at A level.

Let the kids say, right, what I'm doing [in school] is actually useful.

The teacher who had not been before had her expectations exceeded: ***'I came back feeling very positive about it and although I'd expected my class to enjoy it ... they came back absolutely raving about it and they thanked me for taking them'.*** She experienced unexpected benefits of seeing pupils behave differently outside the school environment (eg become more extrovert) and discovering what they had learnt and retained from class. The other felt it had improved over the years, by adjusting the level it was pitched at: ***'it used to be very high brow, I think maybe they have lowered the chemistry'.***

One teacher described the presenters as ***'a mixed bag'*** although the knowledge base was consistently high. For her, the difference came down to the individual style and enthusiasm, and this was also reflected in the other teacher's comments:

Some of the ones that I took them into and I thought well, this won't be particularly interesting, the presenter was so captivating, even though the subject material was a little dry, the kids were still right on the edge of their seats and really responding very well, so I think it was a lot to do with personality.

Generally I think the presenters were very good, very personable and they were very good with the pupils. They've obviously been chosen because they can work with children and have good communication skills.

It wasn't what the people were saying as such it was the fact that these are people who actually do this for a living, and then they could see ... this guy is really enthusiastic about it and maybe I could do that and I would be really enthusiastic.

One teacher would have like a bit more chemistry and less process in some of the presentations: ***'I suppose it depends what the RSC want, do they want chemistry content or do they want chemistry at work?'***. The teacher spoken to informally during the event was concerned that the level of self-promotion from some of the companies would be of less interest to the pupils. Another teacher welcomed the perspective it had given on working life: ***'I think maybe a view of what the chemist does - maybe not so much the chemist as industry in <the area> and that there is a working world out there and what's going on in it.'***

Both teachers felt that some parts of some presentations went over the heads of their pupils (one group was higher ability Y10, one was double award Y11), and suggested that the event should be more targeted to a more narrow age range and presenters made more aware of GCSE specifications. Spontaneously, both commented that aspects would have been useful for their sixth formers. They reacted positively to the idea of having CaW as part of a broader science-related event, though one did wonder if it might be so broad it would be difficult to know ***'when to stop'***.

One teacher, who used to be an analytical chemist, had been inspired to once again refer to her own work experience explicitly in class. They were both keen to attend again, although the one who had been before said she would not travel outside the locality for it. The 'first timer' was more enthusiastic: ***'I loved it. I went off from here and everybody was expecting me to come back and say oh that was grim and I came back with a real buzz so that says all there is to say really.'***

The teachers were concerned that holding the event primarily in one large hall had made it very difficult to hear the presenters. One had been forced to miss the last scheduled session as the event had started late and they had to leave on time for the coach (apparently this applied to at least 2 other groups). There was a suggestion that teachers should have a brief feedback form to fill in about each session as they work their way round the event.

Evaluation of the Chemistry at Work events programme

Appendices: Research instruments

Pam Hanley and Mary Ratcliffe
University of Southampton
Fieldwork: 2008

APPENDIX 1: RSC LOCAL SECTION QUESTIONNAIRE

Evaluation of RSC Chemistry at Work Events

RSC has asked us to undertake an evaluation of their Chemistry at Work events for a report to them on whether the events meet their aims.

We would like your honest views which will be treated confidentially and anonymously.

We would be very grateful if you would complete the questionnaire below.

The aims of Chemistry at Work events are:

- 'to present a positive image of chemistry and the chemical sciences to young people at school or in college
- to show the variety of what chemists do and how chemistry can be part of some jobs where it may not have been expected
- to show that chemistry is an important part of the economy of the country
- to show that chemistry is an interesting and exciting way to earn a living
- to show that chemists are real people (and not nerds).'

Each event has a number of short presentations on 'Chemistry at Work' as a circus, with school pupils visiting each presentation during the half day.

The events are not primarily careers events (although if students leave the event favourably disposed towards a career in chemistry this would be a bonus). Neither are they primarily aimed at teaching students chemistry (although if they leave the event with some extra knowledge, this, too, is a bonus).

Name of RSC local section _____

1. What knowledge does the local section have of the Chemistry at Work initiative in general?

- a lot some not much none at all

2. Were there any Chemistry at Work events in your region in 2007?

- Yes No Not sure

3. Have there have been, or will there be, any Chemistry at Work events in your region in 2008?

- Yes No Not sure

4 What knowledge does the local section have of Chemistry at Work events in your region?

- a lot some not much none at all not applicable: none in the region

5. Have any local section committee members been, or will any be, involved in a 2007 or 2008 Chemistry at Work event?

- Yes No

If yes, in what capacity?

6. What do you see as the barriers to an RSC local section getting involved in a Chemistry at Work event?

7. What do you see as the advantages for an RSC local section getting involved in a Chemistry at Work event?

8. Would your local section like to be involved in a Chemistry at Work event in the future?

Yes No

Please give your reasons for your answer:

9. RSC local sections may be achieving the aims of Chemistry at Work events in other ways than running a 'badged' Chemistry at Work event. Are there particular activities in your region that help young people see a positive image of chemistry and a variety of employment?

10. If you are willing to take part in further research about this topic, please provide contact details below:

Name _____

Email _____

Daytime phone number _____

APPENDIX 2: PUPIL QUESTIONNAIRE

Evaluation of RSC Chemistry at Work Events

RSC has asked us to find out what you thought about the Chemistry at Work event you went to recently.

We would like your honest views which will be treated confidentially and anonymously.

We would be very grateful if you would complete the questionnaire below.

Your details _____

Name of my school: _____

I am male female

I am in Year _____

Please show your opinion by ticking one box for each question below:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Chemistry is cool					
2. There are lots of different jobs that use Chemistry					
3. Jobs using Chemistry are boring					
4. Jobs using Chemistry are only for brainy people					
5. I would like a job using Chemistry					
6. Chemistry is easy					
7. Chemistry is for boffins					
8. Chemistry is everywhere					
	All men	Mostly men	Men and women	Mostly women	All women
9. Those working with Chemistry are					

Please tick one box for each question below to indicate your views of the presenters and the activities at the Chemistry at Work event:

	All of them	Many of them	A few of them	None of them
10. The presentations were exciting				
11. The presentations showed how Chemistry is used in people's jobs				
12. The presentations helped me understand Chemistry				
13. The presentations showed chemicals as dangerous				
14. The presentations showed Chemistry at work is different from Chemistry in school				
15. The presenters knew a lot about Chemistry				
16. The presenters explained things well				
17. The presenters were enthusiastic about their job				
18. The presenters have a valuable job				

19. What was the most interesting part of the Chemistry at Work event?

20. What was the least interesting part of the Chemistry at Work event?

21. Why did you attend the Chemistry at Work event? Tick ALL that apply

- | | | |
|--|--|--|
| <input type="checkbox"/> Teacher asked me to go | <input type="checkbox"/> I'd like a job in Chemistry | <input type="checkbox"/> Time off lessons |
| <input type="checkbox"/> I had no choice | <input type="checkbox"/> I like science | <input type="checkbox"/> My friends were going |
| <input type="checkbox"/> I'm in the science club | | |

Other: _____

22. Has your view of Chemistry changed because of the Chemistry at Work event?

- Yes No

If Yes, how?

23. Have you done anything since the Chemistry at Work event to follow up what you saw?

- Yes No

If Yes, what have you done?

24. I would recommend students from my school attend a Chemistry at Work event next year

- Strongly Agree Agree Disagree Strongly Disagree

25. Please write in any other comments you want to make about the Chemistry at Work event:

APPENDIX 3: TEACHER QUESTIONNAIRE

Evaluation of RSC Chemistry at Work Events

RSC has asked us to undertake an evaluation of Chemistry at Work events for a report to them on whether the events meet their aims.

We would like your honest views which will be treated confidentially and anonymously.

We would be very grateful if you would complete the questionnaire below.

Name of school: _____

Location of event _____

Are you male or female? male female

Year group of pupils you took to Chemistry at Work event: _____

You recently attended a Chemistry at Work event and pupils saw some presentations. Please indicate your views of the presenters and the activities by ticking one box for each question:

	All of them	Many of them	A few of them	None of them
1. The presentations were exciting				
2. The presentations showed how Chemistry is used in people's jobs				
3. The presentations helped pupils understand Chemistry				
4. The presentations showed chemicals as dangerous				
5. The presentations showed Chemistry at work is different from Chemistry in school				
6. The presenters knew a lot about Chemistry				
7. The presenters explained things well				
8. The presenters were enthusiastic about their job				
9. The presentations were pitched at the right level				

What views do you think pupils left the Chemistry at Work event with:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
10. Chemistry is cool					
11. There are lots of different jobs that use Chemistry					
12. Jobs using Chemistry are boring					
13. Jobs using Chemistry are only for brainy people					
14. Pupils would like a job using Chemistry					
15. Chemistry is easy					
16. Chemistry is for boffins					
17. Chemistry is everywhere					
	All men	Mostly men	Men and women	Mostly women	All women
18. Those working with Chemistry are:					

19. What was the most interesting part of the Chemistry at Work event?

20. What was the least interesting part of the Chemistry at Work event?

21. Why did you attend the Chemistry at Work event?

22. What are the difficulties, if any, in attending the event?

23. How did you choose which pupils to attend? Tick ALL that apply

- Volunteers Those achieving well in chemistry Those who could achieve better in Chemistry
 All of a class All of a year group Those interested in chemistry
 Science Club members

Other: _____

24. Has your view of Chemistry changed because of the Chemistry at Work event?

- Yes No

If Yes, how?

25. Have you done anything since the Chemistry at Work event to follow up what you saw?

- Yes No

If Yes, what have you done?

The handbooks for the event:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
26. Presented Chemistry as exciting					
27. Gave information about the jobs of the presenters					
28. Presented jobs with Chemistry as accessible to most pupils					

29. I would recommend pupils attend a Chemistry at Work event next year

Strongly Agree Agree Disagree Strongly Disagree

30. Have you taken pupils to Chemistry at Work in previous years?

Yes No

If yes, how many times have you attended? _____

31. Please write in any other comments you would like to make about the event:

APPENDIX 4: PRESENTER QUESTIONNAIRE (ONLINE)

Evaluation of RSC Chemistry at Work Events

RSC has asked us to undertake an evaluation of Chemistry at Work events for a report to them on whether the events meet their aims.

We would like your honest views which will be treated confidentially and anonymously.

We would be very grateful if you would complete the questionnaire below.

Event location _____

Event date _____

Name of organisation you represent: _____

Are you male or female? male female

Please indicate your views of your presentation:

Do you think you were able:	Mostly	Some- what	A little	Not at all
1. To show you know a lot about Chemistry				
2. To explain things well				
3. To be enthusiastic about your job				
4. To show you have a valuable job				
Do you think your presentation:				
5. Was exciting				
6. Showed how Chemistry is used in your job				
7. Helped pupils understand Chemistry				
8. Showed chemicals as dangerous				
9. Showed Chemistry at work is different from Chemistry in school				
10. Was pitched at the right level				

What views did you think pupils left the Chemistry at Work event with:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
11. Chemistry is cool					
12. There are lots of different jobs that use Chemistry					
13. Jobs using Chemistry are boring					
14. Jobs using Chemistry are only for brainy people					
15. Pupils would like a job using Chemistry					
16. Chemistry is easy					
17. Chemistry is for boffins					
18. Chemistry is everywhere					
	All men	Mostly men	Men and women	Mostly Women	All women
19. People who work with Chemistry are:					

20. Were you offered a training event before doing a Chemistry at Work presentation?

Yes No

If Yes, how useful was the training?

very somewhat not very not at all

22. What was the main reason for you participating in the Chemistry at Work event?

23. What did you gain from participating in the Chemistry at Work event?

24. What are the difficulties for you in participating in Chemistry at Work events?

25. How many times have you been presenting at a Chemistry at Work event

- First time 2 3 4 5 more than 5

26. How likely are you to participate in a future Chemistry at Work event?

- Very likely Likely Not very likely Not at all likely

Why do you say that?

27. If you participated again, would you do anything different?

- Yes No

If yes, what would you do differently?

28. Are there any other comments you would like to make about the Chemistry at Work event?

29. We would also like to contact your employer/line manager (if relevant) to find out their general views on the organisation's/business's link to Chemistry at Work. They will not be told anything about your questionnaire responses. Please could you provide their contact details:

Name: _____

Email: _____

Postal address: _____

APPENDIX 5: ORGANISER QUESTIONNAIRE (ONLINE)

Evaluation of RSC Chemistry at Work Events

RSC has asked us to undertake an evaluation of Chemistry at Work events for a report to them on whether the events meet their aims.

We would like your honest views which will be treated confidentially and anonymously.

We would be very grateful if you would complete the questionnaire below.

Event location _____

Event date _____

Name of organisation you represent: _____

1. How many Chemistry at Work events have you organised?

- First one 2 3 4 5 more than 5

2. What was the main reason for you organising the Chemistry at Work event?

3. What did you gain from organising the Chemistry at Work event?

4. What were the difficulties for you in organising the Chemistry at Work event?

5. What type of presenters did you use? Tick ALL that apply

- Industry Academic Voluntary sector Emergency services
- No organisational connection Other: _____

6. What is your view on presenters receiving payment as an incentive to present?

7 How likely are you to organise a future Chemistry at Work event?

- Very likely Likely Not very likely Not at all likely

Why do you say that?

8. If you organised an event again, would you do anything different?

- Yes No

If yes, what would you do differently?

9. Are there any other comments you would like to make about the Chemistry at Work event?

Thank you very much for completing this questionnaire.

APPENDIX 6: HEADTEACHER QUESTIONNAIRE – GATEKEEPER OF ATTENDEES

Evaluation of RSC Chemistry at Work Events

We would like your honest views which will be treated confidentially and anonymously.

We would be very grateful if you would complete the questionnaire below.

The aims of Chemistry at Work events are:

- 'to present a positive image of chemistry and the chemical sciences to young people at school or in college
- to show the variety of what chemists do and how chemistry can be part of some jobs where it may not have been expected
- to show that chemistry is an important part of the economy of the country
- to show that chemistry is an interesting and exciting way to earn a living
- to show that chemists are real people (and not nerds).'

Each event has a number of short presentations on 'Chemistry at Work' as a circus, with school pupils visiting each presentation during the half day.

The events are not primarily careers events (although if students leave the event favourably disposed towards a career in chemistry this would be a bonus). Neither are they primarily aimed at teaching students chemistry (although if they leave the event with some extra knowledge, this, too, is a bonus).

Name of School: _____

1a. Were you aware that some pupils recently participated in a Chemistry at Work event?

- Yes No

1b. If yes, how involved were you personally in this participation?

- Very Fairly Not very Not at all

1c. If no, please answer Q2 then go to Q5.

2. Who makes the decision in the School for pupils to attend such an event?

- Self (headteacher) Deputy/Associate Head Science staff

- Other (please specify) _____

3. What was the main reason for your school participating in the Chemistry at Work event?

4. What do you consider the impact has been on the following from participating in the Chemistry at Work event?

a. Pupils

b. Accompanying teachers

4c. (Impact on) the school

5. Difficulties for the school in pupils attending Chemistry at Work events might include the following. How great a difficulty do you think each of the following presents?

	Great difficulty	Moderate difficulty	Slight difficulty	No difficulty
a. Timing in the year				
b. Disruption to the timetable				
c. Arranging transport to the venue				
d. Financial costs of transport				
e. Organisational load on staff				
f. Selection of pupils to attend				

6. Overall, to what extent do you feel the gains of attending the event outweigh the difficulties?

- Gains far exceed difficulties
- Gains exceed difficulties
- Neutral
- Difficulties exceed gains
- Difficulties far exceed gains
- Don't know

7a. If you have to choose between which external events pupils and teachers can attend, what are your priorities in terms of subjects? Please rank the following by putting 1 against most important, 2 for the next most important etc:

- Drama and Music
- Humanities & Languages
- Sport
- Science, Maths & Technology
- Other: please specify

7b. And what are your priorities in terms of the following? Please rank as before:

0Related to improving performance in national tests / exams

- Liaison with other schools
- Cross-curricular
- Gifted and talented
- Less able
- Other (please specify) _____

8. How likely is the school to participate in a future Chemistry at Work event?

- Very likely Likely Not very likely Not at all likely

Why do you say that?

9. Are there any other comments you would like to make about the Chemistry at Work event?

APPENDIX 7: BUSINESS LINE MANAGER QUESTIONNAIRE – GATEKEEPER OF PRESENTER (ONLINE)

Evaluation of RSC Chemistry at Work Events

We would like your honest views which will be treated confidentially and anonymously.

The aims of Chemistry at Work events are:

- ‘to present a positive image of chemistry and the chemical sciences to young people at school or in college
- to show the variety of what chemists do and how chemistry can be part of some jobs where it may not have been expected
- to show that chemistry is an important part of the economy of the country
- to show that chemistry is an interesting and exciting way to earn a living
- to show that chemists are real people (and not nerds).’

Each event has a number of short presentations on ‘Chemistry at Work’ as a circus, with school pupils visiting each presentation during the half day.

The events are not primarily careers events (although if students leave the event favourably disposed towards a career in chemistry this would be a bonus). Neither are they primarily aimed at teaching students chemistry (although if they leave the event with some extra knowledge, this, too, is a bonus).

1. Name of Organisation: _____

2a. Were you aware that your organisation recently participated in a Chemistry at Work event?

- Yes No

2b. If yes, how involved were you personally in this participation?

- Very Fairly Not very Not at all

2c. If no, please go to Q9a overleaf.

3. Who makes the decision in the organisation for presenters to participate in such an event?

4. What was the main reason for your organisation participating in the Chemistry at Work event?

What do you consider the impact has been on the following from participating in the Chemistry at Work event?:

5. Presenter(s)

6. Organisation

7. What are the difficulties for the organisation in having presenters participate in Chemistry at Work events?

8. Overall, to what extent do you feel the gains of participating in the event outweigh the difficulties, or vice versa?

- Gains far exceed difficulties
- Gains exceed difficulties
- Neutral
- Difficulties exceed gains
- Difficulties far exceed gains

9a. How likely is the organisation to participate in a future Chemistry at Work event?

- Very likely
- Likely
- Not very likely
- Not at all likely

9b. Why do you say that?

10. Are there any other comments you would like to make about the Chemistry at Work event?

Thank you very much for completing this questionnaire.

APPENDIX 8: OBSERVATION SCHEDULE

Venue _____

Date _____

Name of organisation / presenter _____

Content of presentation _____

Nature of presentation

Talk (non-interactive)

Practical demonstration
(non-interactive)

Practical demo
(non-interactive)

Pupil expt

written activity

Pupils' involvement

	all	most	some	few	comments
listening					
answering questions					
asking questions					
involved in practical					
appear interested					

Notes:

Teacher's role

	comments
supervisory	
interactive 'teaching'	
interactive as pupils	
no clear role	
appear interested	

Notes:

Presenter's actions

Presenter	high	med	low	not at all
show know a lot about Chemistry				
explained things well				
enthusiastic about job				
show have a valuable job				
Presentation				
was exciting				
showed how Chemistry is used in job				
helped pupils understand Chemistry				
showed chemicals as dangerous				
showed Chemistry at work different Chemistry in school				
was pitched at the right level				

Notes:

APPENDIX 9: FOCUS GROUP AND INTERVIEW SCHEDULES – PUPILS

Focus group

Someone told me that they think chemists are people who give out medicines in chemists' shops. What do you think of this?

What has influenced your views?

Has attending chemistry at work event changed your view of chemistry?

If so, in what way? (probes about reasons for attending the event; pre-conceptions; career prospects)

If you had to describe the event to your friends tomorrow what would you say?

Interviews (in pairs?)

What did you think of the presenters? (normal / interested in their job)

What did you think of the presentations? (understandable / interesting)

Was it what you expected – from what teacher told you, other info?

How similar / different to what you do in school?

What do you think you have learnt?

What do you think people using chemistry in their jobs really do? (follow up – do they all do the same thing?)

How important do you think their jobs are?

Do they earn a lot?

Would you like a job using chemistry? Why?

Are you likely to do a job using chemistry? Why?

APPENDIX 10: FOCUS GROUP AND INTERVIEW SCHEDULES – TEACHERS

Focus group

Someone told me that they think chemists are people who give out medicines in chemists' shops. What do you think of this?

What has influenced your views?

Has attending chemistry at work event changed your view of chemistry?

If so, in what way? (probes about reasons for attending the event; pre-conceptions; career prospects)

A presenter at one event got really worried beforehand about showing pupils how toothpaste is made – what pupils' would think and understand; whether it really showed chemistry in the workplace; how she'd manage the pupils' questions.

What's been your experience?

Interviews

What did you think of the presenters?

What did you think of the presentations?

Was it what you expected – how were your expectations formed?

How similar / different to what pupils see of chemistry in school?

What do you feel you have learnt from today?

What do you think pupils have learnt?

Will you follow up from today? If so, how?

APPENDIX 11: FOCUS GROUP AND INTERVIEW SCHEDULES – PRESENTERS

Focus group

A presenter at one event got really worried beforehand about showing pupils how toothpaste/shampoo/perfume is made – what pupils' would think and understand; whether it really showed chemistry in the workplace; how she'd manage the pupils' questions.

What's been your experience?

(probes to explore the way they feel they presented their session; impact on pupils;)

Interviews

Why did you attend today?

Have you done one of these events before? How often?

What did you think of the event? (interesting / exhausting / demanding)

Did pupils react in the way you expected them to?

How happy are you that you were able to show chemistry at work as:

- interesting; varied; economically important?

What do you think pupils learnt?

Are there any difficulties for you in attending the event? If so, what?

APPENDIX 12: FOCUS GROUP OUTLINE POTENTIAL ATTENDEES (TEACHERS)

Have you ever heard of CaW events?

If yes, what do you know about them? – aims, organisation, funding

Have any of you ever been involved with such events? In what way?

Introduce concept: aims on large sheet

What are your first reactions – positive, negative, likely interest in attending etc

Card sort – prioritise the potential gains (card sort sheet + blanks)

- discuss these and any they want to add

Card sort – prioritise the potential barriers (card sort sheet + blanks)

- discuss these and any they want to add

Currently CaW events are free to schools. Would you attend if there was a charge?

Should presenters be paid for their input?

The focus of CaW events is on chemistry. What are your views if there was an event which included CaW activities but also had other sciences ?

Prompts: Would you attend? What would be the impact on pupils?

APPENDIX 13: FOCUS GROUP OUTLINE POTENTIAL CONTRIBUTORS (RSC LOCAL SECTION – POTENTIAL ORGANISERS AND PRESENTERS)

What, if anything, do you know about CaW events? – aims, organisation, funding

Have any of you ever been involved with such events? In what way?

Introduce concept: aims on large sheet.

What are your first reactions – positive, negative etc

Card sort – prioritise the potential gains from organising / contributing (card sort sheet + blanks)

- discuss these and any they want to add

Card sort – prioritise the potential barriers to organising / contributing (card sort sheet + blanks)

- discuss these and any they want to add

Should presenters be paid for their input?

The focus of CaW events is on chemistry. What are your views if there was an event which included CaW activities but also had other sciences ?

Currently CaW events are free to schools. Do you think schools should be charged?

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Royal Society of Chemistry

Burlington House
Piccadilly, London
W1J 0BA, UK
Tel: +44 (0)20 7437 8656
Fax: +44 (0)20 7437 8883

Thomas Graham House
Science Park, Milton Road
Cambridge CB4 0WF, UK
Tel: +44 (0)1223 420066
Fax: +44 (0)1223 423623

Email: info@rsc.org
www.rsc.org