AN EVALUATION OF THE ROYAL SOCIETY OF CHEMISTRY CAREERS MATERIALS

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Contents

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Executive Summary

About the project

In the light of a decline in recent years in the popularity of chemistry post-16, and consequently in higher education, the Royal Society of Chemistry (RSC) commissioned the National Foundation for Educational Research (NFER) to undertake a study to determine how pupils make subject and career choices regarding chemistry, and to evaluate the materials[1] it produces to promote the chemical sciences to young people.

Research design

- A literature review was undertaken to determine when young people make choices, who advises them, and what are the influences on choice? It drew on relevant findings from existing reviews in the field (e.g. Jagger, 2004; Lord and Jones, 2006; Payne, 2003), updated with key findings from the most recently published literature.
- In order to gather opinions on the RSC materials, interviews were carried out with 146 young people (aged 11–19) and 52 members of school staff (chemistry teachers, heads of chemistry, and school careers advisors) from 30 schools and colleges in England. The interviewees were also asked more widely about their experiences of school chemistry, careers guidance activity and their future plans.
- Short telephone interviews were also carried out with seven other users of the RSC materials (including university lecturers, Connexions staff, and education liaison officers from the chemical industry).
- The key findings from the literature review were also discussed with a sub-sample of school staff and other stakeholders in order to establish the extent to which they resonated with their experiences.

Key findings from the review of literature

The review of the literature highlighted the following key findings and influences on young people's subject and career choices regarding chemistry:

- the importance of the **primary phase** in science attitude formation
- the deterioration of **science attitude** throughout secondary education
- a need for chemistry teachers' and careers advisors' more **up-to-date knowledge** of chemistry careers

[1] The materials included: RSC posters '*Not all chemists wear white coats*', '*Chemists in their element*' and '*That's Chemistry*'; RSC booklets '*How far have we come with the help of science?*', '*Life Beyond Exams*'; and RSC leaflets 'Chemistry Career Profiles' and '*Choosing a degree*'.

- young people's desire for careers guidance to be impartial, cover the **full range of options**, and come from those ***in the know*** (e.g. in the profession, on the course)
- greater support for developing young people's **decision-making skills**, including more explicit links made between careers guidance activity and the decision-making process
- young people's perceptions and **images of chemists** and chemistry (e.g. 'white coats' and 'labs', 'hard-working' and 'academic')
- pupils' experiences of chemistry in the curriculum (e.g. **difficult**, some lack of relevance/practical application to current lives and jobs)
- pupils' experiences of how chemistry is taught (e.g. requests for greater emphasis on **practical** and collaborative approaches)
- young people's own ambitions (e.g. chemistry tends to be **chosen as means to another end**, such as medicine or veterinary science)
- parental influence (including perceptions of science as a 'solid' subject)
- peer influence (to some extent).

School staff and stakeholders agreed with most key findings from the literature, except the nature and extent of peer influence; and, with regard to images of chemistry, the lack of female role models suggested by the literature. Interviewees identified the following additional influences on pupils' chemistry choice:

- teacher influence (i.e. a perceived impact of **non-specialist teaching** and the quality of chemistry teaching on pupils' engagement in chemistry)
- the pull of financial remuneration (i.e. the **earning potential** related to different careers).

Key findings from the interview survey

About the materials, overall:

- the young people and staff were **positive**, noting their **visual appeal** and promotion of **wide-ranging aspects of chemistry** and chemistry careers
- there was somewhat **limited familiarity** with and usage of the materials by the young people; and amongst the staff and stakeholders, familiarity with the materials was not universal
- the **posters** had an **appeal and relevance to younger pupils** (e.g. those in key stage 3), whilst their helpfulness deteriorated in post-16. In **key stage 4 and beyond**, young people wanted **more detailed information** about careers from chemistry
- the overall impact of the materials varied across the age ranges. At **key stage 3**, the materials seemed **influential on attitudes towards chemistry** and on possibly choosing chemistry. At **key stage 4**, the materials seemed **most useful for decision making**, with some potential for impact on choice. At **post-16**, although the materials were perceived to be useful, for

the majority of pupils it would appear **too late** to have an actual influence on choice

The following recommendations for the materials were made by both young people, and to some extent the staff:

- to be **available at all times**, especially at **key early decision points** (including Year 9 and Year 11); and be more **accessible**, including some **directed use and consideration of the materials** (e.g. by teachers, science and PSE staff), as well as the availability of **personal copies** for use in own time
- to show **even greater relevance to chemistry careers** – relaying 'this is what chemists do'; 'how will I get there?'; 'what will I earn?'; 'where can I work?'; and personal statements relaying 'this is what I do'
- specific actions might include amending the **amount and layout of text** on **poster** material (e.g. using bullet points, annotations and text boxes); and redesigning the **images** on the **booklet material** to convey chemistry careers and further study '**in action**' in the 21st century.

In addition, the staff recommended that the materials: might be **integrated into subject learning**; and might promote an even greater diversity of careers including those that might appeal to middle and lower ability students (e.g. careers that could be accessed via more vocational routes).

Wider findings about chemistry and careers advice included:

- **careers advisors** and **websites** were young people's most common sources of careers advice and information overall; **external people** in the job/profession were particularly '**trusted**' sources of information
- in **key stage 3**, there was a particular preference for careers guidance from people and 'those in the know' over materials. In **key stage 4** the primary careers informants included **careers advisors**, parents, and also **subject teachers**. In **post-16**, students seemed to be undertaking much more **pro-active research** through **websites**, materials and the **careers library**
- in order to attract young people to chemistry study and chemistry careers, young people and staff felt that the **relevance, enjoyment and manageability of the chemistry curriculum** could be improved, in particular via greater **practical application**
- likewise, in promoting chemistry to young people, interviewees recommended more **contact for young people with chemists** (e.g. via talks, demonstrations and work experience), and, noted by staff and stakeholders, **greater partnership working** particularly between school-industry and school-university might be developed.

Findings from the literature review about stimulating interest in chemistry well before times of choice (i.e. before Years 9 and 11) were not as strongly emphasised by staff. The lack of specific nomination by staff of **Years 7 and 8** for targeting careers advice might reflect a possible area of 'lost potential'. Likewise, staff seemed less aware than young people of their preferences for

different sources of careers information across the age ranges (also noted in the literature review).

Some key points for action and reflection

The materials were identified as part of a 'package' of careers guidance and promotional activity received by schools. In order to enhance this part of the 'package', as well as wider aspects of chemistry and careers advice, the following areas might be considered for development.

1) **Accessibility/availability** – e.g. via greater **directed use** of the materials by chemistry teachers and careers staff; the availability of **personal copies** for young people; and targeted use of the materials at key '**early decision points**' (including Year 9, Year 11, and, importantly, earlier).

2) Retaining the range of materials but with clearer '**branding**', given young people's somewhat unfamiliarity with them. The range was appreciated, as the different materials were perceived to have different 'functions' (e.g. the immediate *appeal and promotional function* of the posters; the *careers-decision-making function* of the chemistry career '*Profiles*'; and relaying *understanding about chemistry*, e.g. via '*Chemists in their element*' posters and '*Life Beyond Exams*').

3) Greater **targeting** at **key stage 3** – a time when both *attitudes towards* chemistry and *potentially choosing* chemistry could be positively influenced by the materials. The importance of stimulating younger children's interest around chemistry was posited by the young people themselves and highlighted in the literature. However, in key stage 3 there was a large group of pupils who enjoyed chemistry but were undecided as to future study and career direction. Could it be that **greater attention to careers information** on the key stage 3 materials might also be helpful to young people?

4) Practical resources and support for **teachers'/advisors'**: **supported use of the materials**; **integrating** the RSC materials into subject teaching; and developing their up-to-date knowledge about chemistry-careers.

5) Increased opportunity for young people to explore the **practical application of the discipline** (e.g. events, demonstrations, projects and visits to science museums), as well as opportunities for work experience and taster courses.

6) Even greater tailoring of other careers advice activity to young people's preferences and influences at different ages. For example: enhancing **careers activity from external sources** at **key stage 3**, given their preference for careers guidance from people and 'those in the know'; targeting resources towards supporting **careers advisors** and **subject teachers** in chemistry-careers activity in key stage 4; and exploiting young people's predominant use of **websites** at post-16.

7) Increased opportunities for **partnership working and collaboration** between school and industry, schools and universities, and chemistry teachers and careers staff. Here, the RSC might consider the development of their role in acting as a key conduit in engaging and connecting these various partners.

Finally, we again note that the RSC materials are one part of a package of promotional and advisory materials for schools and young people to consider. The range of the young people's opinions on the materials, careers-advice and their attitudes towards chemistry highlights their individual preferences and needs. It is likely that a mixture of careers-advice and promotional activity works, rather than any one source. However, this study suggests a need for more supported and directed careers activity around these RSC sources.

About the project and this report

Introduction

The Royal Society of Chemistry (RSC) is the largest organisation in Europe for advancing the chemical sciences. Part of its work involves the support of chemistry in schools, colleges and universities, including activities aimed at promoting and widening participation in the chemical sciences. This work includes outreach activities, the provision of teaching and careers resources, and the organisation of careers events.

Encouraging participation in higher education and attracting students to pursue scientific careers has recently come to the fore in both research and national initiatives. A decline in recent years in the popularity of science subjects has been documented, particularly in chemistry and physics, at A-level and consequently in higher education (Stagg *et al*., 2003). Whilst pupils' attitudes towards chemistry reveal a generally positive picture in terms of the perceived benefits of the chemical sciences, there is also a perception that chemistry can be a difficult and abstract subject (Jagger, 2004). Findings on the nature of chemistry careers advice highlight areas for development around support for young people's decision making and the role of careers advisors.

Recognising these findings, initiatives such as the RSC's *Campaign for Chemical Sciences*, and the Government-funded AimHigher project *Chemistry: The Next Generation* signal support for the chemical sciences and their promotion to young people.

Aims and objectives

The RSC commissioned the National Foundation for Educational Research (NFER) to undertake a study to determine how pupils make subject and career choices regarding chemistry, and to evaluate the materials it produces to promote the chemical sciences to young people. The aims of the study were:

- to summarise the findings from recent and current research relating to pupils' subject and career decision making in relation to chemistry, with reference to *when* young people make choices, *who advises* them and what the *influences* are on choice
- to consult with teachers, career advisors and others on these findings
- to collect pupils', teachers', career advisors' and other users' views on a range of materials produced by the RSC that promote the chemical sciences to young people.

Design and methods

The study involved three strands.

Strand one: a literature review summary

A summary from the literature on how young people make subject and career choices was produced, paying particular attention to decision making about science and chemistry. It draws together existing reviews in the field, updated with recently published relevant literature.

Strand two: dissemination of the RSC materials

An audit of the RSC dissemination of promotional materials that have been used over one complete year was undertaken by the RSC. Information from this audit has been incorporated into this report.

Strand three: an interview survey

This strand gathered views on the chemistry career choice materials produced by the RSC. It involved interviews with around 150 young people (aged 11–19) and 60 teachers from 30 schools and colleges. In addition, the views of up to ten other users of the RSC materials (for example, UCAS event organisers, Connexions) were sought.

As well as collecting their views on the materials, the interviews with the young people (five from each of 30 schools/colleges) explored their subject and career preferences, interests and choices, and the influences on those choices.

The report

This report is set out in four parts (A–D).

- Part A focuses on strand one of the research design. It presents a summary of the key findings from the literature on pupils' career choices regarding chemistry. It includes school staff and stakeholders' perceptions on these findings.
- Part B focuses on strand two of the research design. It presents a brief description of each material; and an audit of the RSC dissemination of materials.
- Part C focuses on strand three of the research design. It presents: information about the interviewee sample involved in the research; young people's views on the materials and on chemistry and careers advice more widely; and, likewise, school staff and other stakeholders' views.
- Part D provides a summary and points for action from across the different strands of the study.

Part A

Pupils' career choices regarding chemistry: a summary of the key findings from the literature

1 Pupils' career choices regarding chemistry: a summary of the key findings from the literature

1.1 Introduction

This section of the report presents a summary of the key findings from a review of the literature relating to pupils' career choices regarding chemistry. It presents the following:

- Aims and scope of the review (Section 1.2)
- The key findings (Section 1.3)
- The key findings: Interviewees' perspectives (Section 1.4)
- Summary (Section 1.5)
- References (Section 1.6).

Further details of the review methodology are outlined in Appendix I.

1.2 Aims and scope of the review

The **aims** of the review were to summarise the key findings from the literature relating to pupil career choices regarding chemistry, with particular reference to:

a) when young people make choices
b) who advises them
c) what are the influences on choice.

The review incorporates key findings from existing reviews in the fields of chemistry, young people's views on the curriculum, and making choices (e.g. 'The Right Chemistry' by Jagger (2004); 'Pupils' experiences and perspectives of the National Curriculum and Assessment' by Lord and Jones (2006), which includes findings on pupils' attitudes towards curriculum science; and Payne's (2003) review of research on 'Choice at the end of compulsory schooling'). The **scope** of the review includes updating these findings with those from the most recently published relevant research literature (i.e. published in 2004, 2005 and 2006; up to eight key sources would be included). A bibliography of eight key sources is given in Appendix II. A list of all the references informing the review is given in Section 1.6.

1.3 The key findings

The key findings on: when young people make choices; who advises them; and what are the influences on choice; with particular reference to science and chemistry, are presented here here. A summary sheet of the findings was produced, comprising 11 key findings (see overleaf). Further details on each of these areas then follow (in Sections 1.3.1, 1.3.2 and 1.3.3).

When do young people make choices? Key findings

1. The primary phase is important in terms of science attitude formation. Pupils' experiences of **primary science** tend to set the ground for their attitudes towards secondary science. Career options can be rejected as early as late primary school.

2. Pupils' attitudes towards school chemistry tend to become less positive as they journey through **secondary education**. By **Year 11**, many pupils have switched off the idea of further science study. Pupils **in Years 12 and 13** appear unlikely to change their minds.

Who advises? Key findings

3. A need for advisors' **up-to-date** and relevant **knowledge of chemistry careers**; as well as greater **collaboration between chemistry teachers and careers teachers** on careers advice and guidance.

4. Young people feel that careers advice is often tailored or filtered to 'assumed' need or relevance. However, they request that careers advice should be both specific and broad. It should cover the **full range of options;** and it should include **advice from those *in the know*** (e.g. in the profession, on the course, etc.).

5. Young people might require support in developing their decision-making skills; and more explicit links made between **careers guidance activity** and the **decision-making process**.

What are the influences on choice? Key findings

6. Young people's **perceptions and images of chemistry** and chemists – white coats & 'labs', hard working & academic, environmental & political agendas (e.g. relating to oil, drugs/pharmaceuticals), gendered stereotypes, a possible lack of female role models.

7. Pupils' experiences of **chemistry in the curriculum** (perceived lack of relevance; difficult e.g. factual, content-heavy, abstract; not especially enjoyable). Irrelevance and **difficulty** act as push factors away from chemistry. Whilst **interest** does pull some pupils towards chemistry, there is little evidence that **enjoyment** pulls towards continuing with chemistry.

8. Pupils' experiences of **how chemistry is taught** – they would like even greater practical and collaborative approaches; and lessons to instill a sense of discovery and curiosity.

9. **Young people's own ambitions** (based on abilities and preferences that match job requirements). Chemistry tends to be chosen **as a means to** career plans (e.g. medicine, veterinary science – not necessarily chemical sciences). **Science pupils** feel that **science study will enhance their career** prospects; **non-science pupils** feel that it would **hinder**.

10. **Parental influence** includes their view of science as a good 'solid subject'; young people are most influenced by their same sex parent. Young people who are interested in science tend to be supported in this interest by their parents (e.g. encourage extra participation in science, etc).

11. **Peer influence** (to some extent) – pupils who like science tend to stick together; perceptions and images of chemistry/chemists might be perpetuated by peer-groups.

1.3.1 When do young people make choices?

Two bodies of research contribute to key findings on when young people make choices: i) research on young people's attitudes towards science and when those attitudes are formed; and ii) research on young people's more general decision making and when that takes place. Details of the key findings across these arenas are presented below.

- Pupils' attitudes towards school science (including chemistry) become **increasingly less positive** in terms of **enjoyment and relevance** as they journey from primary and through secondary education (e.g. Lord and Jones, 2006; Reid and Skryabina, 2002; Pell and Jarvis, 2001; Murphy and Beggs, 2001).

- For many pupils, this **decline continues throughout secondary school** (e.g. as found in a study of nearly 3,000 young people's experiences of the whole curriculum in Northern Ireland, Harland *et al*., 2003). Chemistry has been found to be: the least liked science discipline in Year 10, although chemistry topics had been the ones pupils most wanted to do in Year 7 science (Reiss, 2000 and 2001); the least liked subject by a sample of girls in an all-girls' school in Years 10 and 11 (Francis e*t al*., 2004). In a study on attitude formations in science, Cleaves (2005) found that young people who had 'narrowing career ideas over time' showed increasing '*antipathy*' towards school science, finding it especially 'boring' by Year 11.

- Pupils' perceptions and experiences of **primary science** tend to **set the ground for their attitudes towards secondary science**. In a student-led review of the science curriculum Murray and Reiss (2005) found that '*a strong negative or positive primary science experience carries through for the next six or seven years*' (p.91). Young people's retrospective views of primary school science highlight the importance of practical work (so that pupils 'see what is going on in science') and of the teacher and teaching in science (e.g. Murray and Reiss, 2005). Research on science at key stage 2-3 transition shows that children's expectations of continued enthusiasm in secondary school science are not always borne out in practice (e.g. Braund and Driver, 2005).

- Young people's **attitudes towards science are formed by Year 9** (e.g. Dalgety and Croll, 2004; and Jenkins and Nelson, 2005). An international study on pupils' views on their school science education, found that '*many young people have already made up their minds whether or not they wish to pursue a career in science or technology by the time they embark on their GCSE courses at the age of 14 or 15. If this is indeed the case, it implies that good teaching of science to younger pupils is of particular importance*' (Jenkins and Nelson, 2005, p.53).

- **Career options** are rejected as early as late primary school (e.g. Foskett and Hemsley-Brown, 1997, in Jagger, 2004). Although pupils of late primary school age have not made absolute decisions as to what route or career they would like to pursue, there is some evidence that they have limited their options and rejected those that do not fall within their selection. **By Year 11**, many pupils have switched off the idea of further science study (Munro and Elsom, 2000, in Jagger 2004; Bennett and Hogarth, 2006). Pupils in **Years 12 and 13** appear unlikely to change their minds; relatively little change in careers decisions occurs throughout A-level study (e.g. Barker, 2001; in Jagger, 2004).

- There is some indication of **gender differences** in pupils' declining interest in chemistry – related to the strengthening of stereotypical attitudes about gender roles and behaviours, which seem to emerge around age 10 (e.g. Murphy and Beggs, 2001). Primary teachers may be a key change agent in overcoming these stereotypes.

- The **timing** of careers advice is important to pupils. In a review of their views on the curriculum (Lord and Jones, 2006), it was found that pupils would like to receive careers information earlier on in their school careers; i.e. '**Year 11 is too late**' (Maychell *et al*., 1998; Stoney *et al*., 1998; Howieson and Semple, 2001; Foskett *et al*., 2003).

When do young people make choices? Some implications for science

Young people's attitudes towards science form during primary school and the early years of secondary school. Young people are making choices about science (e.g. at age 13/14, and again at age 16) at a time when their attitudes towards science are generally unfavourable. Researchers suggest implications for making changes to the curriculum and teaching, such that science is motivating and stimulating well before times of actual choice.

1.3.2 Who advises?

Several bodies of research contribute to key findings on who advises young people when making choices, including: i) research on sources of advice, information and guidance in general and young people's perceptions of the helpfulness of those sources; ii) research into young people's decision-making skills and awareness of careers guidance; and iii) research on science teachers and careers teachers advising (including their careers-knowledge, impartiality, etc). Details of the key findings across these arenas are presented below.

- In general, pupils receive advice from parents, siblings, subject teachers, careers teachers, and so on, when making decisions about subjects for study and career-paths (e.g. Maychell *et al*., 1998; Stoney *et al*., 1998; Keys *et al*., 1998; Foskett *et al*., 2003). Teachers seem to be essential to the decision-making process (Blenkinsop *et al*., 2006).

- **One-to-one** advice is particularly valued (Maychell *et al*., 1998; Stoney *et al*., 1998; Keys *et al*., 1998) and recommended by young people themselves for greater provision (Foskett *et al*., 2003). Gaining information from **people *in the know*** (for example, people already working in the field, students on the courses or from the institutions they were interested in) is also deemed valuable by young people; as is **direct experience of post-16 destinations**, such as through college visits (Keys *et al*., 1998; Foskett *et al*., 2003).

- Young people's **own approach to decision making** is individual; they require varying levels of, and types of support at different stages in their school careers (e.g. one-to-one, group exercises, and literature on options) (Blenkinsop *et al*., 2006). However, research has shown that greater

support for young people's **decision-making skills**, their self-awareness in terms of strengths and weaknesses and careers research skills may be required (e.g. recent work by Blenkinsop *et al*., 2006; and by Morris *et al*., 1999; Stoney *et al*., 1998).

- Recent research shows young people's **lack of awareness of the links between careers education and guidance and the decisions they are making** (Blenkinsop *et al*., 2006). Other research also reveals young people's lack of coherent awareness of careers education programmes and the purposes of careers guidance (Stoney *et al*., 1998; Howieson and Semple, 2001; Millar and Brotherton, 2001; Payne, 2003). Careers education lessons could be perceived as less important than other areas of the curriculum (Stoney *et al*., 1998; and to some extent found in Harland *et al*., 2003).

- Research into careers guidance in general, shows that whilst **teachers** give impartial advice, their **knowledge of post-16 opportunities** is not always comprehensive enough so as to give fully informed advice (e.g. Blenkinsop *et al*., 2006, found this was particularly the case in 11–16 schools; whilst in 11–18 schools advice was not always impartial, with some encouragement to stay on at the school's own sixth form).

- Within science in particular, young people have noted **disappointment with careers education provision** (e.g. Cleaves, 2005). They have also noted that careers teachers, and to some extent science teachers, seem to **lack up-to-date knowledge of chemistry careers**, resulting in inaccurate images of scientists/science careers going unchallenged (e.g. Medhat, 2003; Cleaves, 2005; and Kidd and Wardman, 1999, in Jagger, 2004). A recent study found that science teachers do not, on the whole, '*regard vocational issues and careers advice as part of their job*' (e.g. Stagg, 2006).

- Research suggests that there is **little collaboration between chemistry teachers and careers teachers** on careers advice and guidance (e.g. Munro and Elsom, 2000, in Jagger, 2004). Likewise, opportunities for work experience in chemistry related careers seem rare (e.g. in key stage 4) (e.g. Stagg, 2006).

- Young people feel that in careers education and guidance generally, **information is filtered in or out** by those giving advice, according to the decisions that young people have already made. In this regard, they feel that careers materials and advice serve a **reinforcing function** (Jagger, 2004; Payne, 2003) on decisions they may have already made.

Who advises? Some implications for science

The quality, timing and frequency of careers advice and guidance might require consideration by schools, and the Information Advice and Guidance Services to schools, FE and HE.

For careers education in general, Blenkinsop *et al*. (2006) suggest that schools might make links between careers education and decision making more explicit. The young people themselves request '*more detailed, clear information on subject options for key stage 4, particularly on subject content (e.g. modules and topics covered), coursework and future post-16 pathways*' (ibid, p.4–5).

For science in particular, opportunities for work experience and taster courses might be increased (e.g. Foskett *et al*., 2003; London Development Agency, 2006); teachers' knowledge of post-16 opportunities might be improved (e.g. Blenkinsop *et al*., 2006); and resource development might be opportune regarding careers advice materials for science in key stages 3 and 4 (found to be '*neither well known nor well used*' in a recent study by Stagg, 2006).

1.3.3 What are the influences on choice?

The research into influences on young people's choice of subjects for study or for a career forms a large body of literature. The most relevant findings in the field of chemistry fall into six main areas.

1) Young people's perceptions and images of chemistry and chemists
2) Young people's experiences of chemistry in the curriculum
3) Young people's experiences of how chemistry is taught
4) Young people's own ambitions and career plans
5) Parental influence
6) Peer influence.

These are outlined further below.

1) Young people's perceptions and images of chemistry and chemists (and of science and scientists)

- Young people have **images of science and chemists** as 'being in white coats', using 'test tubes in labs', chemists as 'hard working', 'nerdy', 'boring', 'perfectionist'; and chemistry being a discipline for high achievers via an 'academic' university route (e.g. Cleaves, 2005; Dalgety and Coll, 2004; and Medhat, 2003). Such images might be perpetuated by the media, and might influence pupils' decision making (e.g. London Development Agency, 2006; Kniveton, 2004). There is evidence that older pupils (e.g. Year 11) in particular are influenced by the media (e.g. Boreham and Authur, 1993, in Jagger, 2004).

- The chemical industry has also been perceived by young people as non-environmentally-friendly, and perceived as caught up in political agendas and issues (e.g. Hilbling and Barke, 2000, in Jagger, 2004). Researchers themselves suggest there is a perceived gulf between the scientific community and the public where a lack of dissemination and communication might fuel **misconceptions** about science (e.g. Dalgety and Coll, 2004).

- Young people have a **narrow knowledge of science occupations** (e.g. Cleaves, 2005); and, in one recent study, they did not strongly show an interest in scientific careers (e.g. Jenkins and Nelson, 2005). Other research shows that whilst pupils value science as an important part of the curriculum and in careers in general, they feel it lacks interest in its own right (e.g. Osborne and Collins, 2000).

2) Young people's experiences of chemistry in the curriculum

- Young people **do not** generally perceive chemistry to have relevance to careers or daily life. Chemistry is perceived as relevant only for those pursuing a science-related university-level career (e.g. Cleaves, 2005; Jenkins, 2005; Murray and Reiss, 2005; Blickenstaff, 2005; Bennett and Hogarth, 2006). For most, perceived lack of relevance would seem to be a key **push factor** away from choosing chemistry. The young people themselves recommend increased relevance through the inclusion of more on controversial and current issues in the chemistry curriculum, and by making links to everyday issues and those of specific interest to the pupils themselves (e.g. Murray and Reiss, 2005; Francis *et al*., 2004).

- Young people generally find chemistry a **difficult subject** (especially in comparison to other subjects). This includes perceptions of the chemistry curriculum as abstract and boring, and content heavy (e.g. '*too many facts*', '*reliance on rote learning*') (e.g. Cleaves, 2005; Murray and Reiss, 2005; Francis *et al*., 2004). Pupils have recommended a slimmer curriculum, to allow for fewer topics to be covered in greater depth (e.g. Murray and Reiss, 2005). However, whilst pupils might find chemistry difficult, it is also noted in the literature that pupils tend to **underestimate their abilities** in science (e.g. Cleaves, 2005; Lupart and Barva, 1998, in Jagger, 2004).

- Chemistry would seem to be one of the **least enjoyed** of the science subjects, particularly by the time pupils reach Year 11 (e.g. Reiss, 2001; QCA, 2004). In primary school, there seems to be a link between perceptions of ease and enjoyment of science (e.g. QCA, 2004). In secondary school, some research shows a link between perceptions of relevance and enjoyment (e.g. Murray and Reiss, 2005), i.e. application to everyday life made topics more enjoyable. There is some evidence that prior to Year 9 enjoyment is a key influence on pupils' attitudes towards chemistry, whereas, post Year 9, ability becomes a more prevalent factor. However, there is little evidence to show that enjoyment alone pulls students towards choosing chemistry. Relevance/irrelevance to their own career ambitions seems more influential in this regard (see point 4 on 'own ambitions' below).

3) Young people's experiences of how chemistry is taught

- Young people cite **teachers and teaching** as important to their enjoyment of school science. Young people value science teachers who are enthusiastic, and feel that 'good' science teachers are important to effective teaching and learning (this includes their teacher's qualifications and specialisms) (e.g. Murray and Reiss, 2005; Francis *et al*., 2004).

- The extent and quality of practical activity in school science is an important factor affecting young people's attitudes towards school science. Numerous studies highlight this aspect of science. Pupils would like **more discussions, more practical work and more collaborative group working** in their science lessons (e.g. Francis *et al*., 2004; Jenkins and Nelson, 2005; Murray and Reiss, 2005). Pupils would also like chemistry lessons to instil a sense of discovery and curiosity that was not currently felt (e.g. Murray and Reiss, 2005).

4) Young people's own ambitions and career plans

- **Young people choose careers based on their own ambitions**, which in turn are influenced by their own conceptions of their **abilities** and **preferences**. Young people choose pathways that match their abilities and preferences with job requirements (e.g. Kniveton, 2004).
- Science students feel that science study will enhance their career prospects; non science students feel that it would hinder (e.g. Harvard, 1996, in Jagger, 2004).

5) Parental influence

- Parental influence regarding science includes **parents' emphasising to their children the 'educational capital' of science subjects**, e.g. as 'fundamental', 'solid subjects' and giving 'grounding' to other disciplines (e.g. Cleaves, 2005).
- There is evidence that young people are most influenced by their same sex parent (e.g. Kniveton, 2004). Girls will actively seek the involvement of their parents, especially their mothers in their decision making (e.g. David *et al*., 2003; Brookes, 2004; and Payne, 2003). Regarding chemistry in particular, one study has found that girls seem more likely than boys to be influenced by parental opinion (e.g. Dalgety and Coll, 2004). However, the influence of home background declines as young people get older (e.g. Dalgety and Coll, 2004).
- Young people who are interested in science tend to have **parents who are supportive of them** and involve them in extra curricular activities relating to science (e.g. Dalgety and Coll, 2004).

6) Peer influence

- Young people who like science tend to gravitate towards other children who like science (e.g. Dalgety and Coll, 2004). This may reinforce 'stereotypical' images of science and other influences on decision making (e.g. Brookes, 2004a and b).

What are the influences on choice? Some implications for science
The influences on young people's decision making in general and with specific regard to chemistry are varied, and probably more than one reason will apply. However, there would seem to be dominant influences at different ages. In the research reviewed here, younger children are more likely to seek advice from their elder siblings; those in key stage 3 and Year 10 seem more likely to be influenced by science teachers and careers teachers than slightly older pupils; and those in Year 11 are influenced by individuals they know in the world of work and the media (e.g. Dalgety and Coll, 2004; Boreham and Authur, 1993, in Jagger, 2004; Kniveton, 2004; Payne, 2003).

The research would seem to suggest a need for helping young people to recognise more accurately their abilities and capabilities in chemistry (often underestimated). This, in turn, might support young people's other experiences of chemistry in the curriculum (e.g. in terms enjoyment and perceived relevance).

1.4 The key findings: interviewees' perspectives

The findings from the literature review were discussed with a sub-sample of the staff and stakeholder interviewees (including chemistry teachers, heads of chemistry, school careers staff, university lecturers, and education officers from the chemical industry).

The summary sheet comprising 11 key findings (presented in Section 1.3) provided the basis of the interviews. Interviewees were asked to what extent they felt the findings resonated with their experiences in chemistry teaching and careers advising, and whether there were any issues or themes they felt were not covered in the reviewed findings. Interviewees' responses to those key findings are outlined below.

When do young people make choices? Interviewees' perspectives
All interviewees agreed with the finding about the importance of the primary phase in science attitude formation: '*If you get them young, you've got them*' (Chemistry teacher). Interviewees felt that experiences of science in the primary school (both positive and negative) tended to set the ground for young people's attitudes towards science in secondary school. Responses included perceptions that:

- **primary science stimulates pupils' future interest** in science; and this positive attitude is sustained into secondary education
- **primary science can potentially de-motivate,** constituting a missed opportunity to nurture young people's natural curiosity and interest in discovering the world around them
- the quality of primary science teaching is a factor in shaping young

people's attitude to science. A perceived **lack of specialist science knowledge** and teaching skills within the primary sector were deemed to be major influences on pupils' enjoyment of science and future attitude.

All respondents agreed with the finding that science attitudes deteriorate throughout secondary education, offering a range of reasons, including:

- **the increased pressure of assessment and a content heavy curriculum** (including perceptions that enjoyment becomes secondary to assessment): '*You can see it happening as they go, they're all enthusiastic in Year 7 and 8, then in Year 9 they're slogging for their SATs and then they get to Year 10 and 11 and all the fun goes out as they're slogging towards their GCSEs*'; and a focus from pupils on '*what do I need to know to pass an exam, and science becomes incidental to that*' (Chemistry teachers)

- **poor transition between primary and secondary science curricula**. Views differed as to the nature of this progression: while some posited that there was too big a difference in teaching and learning style and content (e.g. perceptions that pupils faced a change from the 'concrete' to the 'abstract'), others considered that the key stage 3 chemistry curriculum was too repetitive following key stage 2

- the perception that pupils' attitudes become **fixed by Year 9**, suggesting that trying to change pupils' minds after this point is, by and large, too late. Despite exceptions to this general rule, all interviewees agreed that **by Years 12 and 13 subject preferences are set**.

Who advises? Interviewees' perspectives

The majority of interviewees agreed with the collection of statements about chemistry careers advice, and careers advice more generally. They noted:

- **careers guidance was generally limited, rather than broad**, and that the essence of careers guidance should be about making young people aware of as many different career options as possible

- **their own lack of up-to-date knowledge on chemistry careers** and suggested that the RSC could support them in developing this knowledge, which they could then impart to young people

- the importance of careers advice and information coming from **those in the know**

- there could be improved transfer of materials between chemistry and careers departments. However, their comments implied the **responsibility for conveying *chemistry* careers advice to young people lay with subject specialists**. Peripatetic science advisors were one suggestion.

What are the influences on choice? Interviewees' perspectives
The six key areas of influence identified in the literature were discussed by the interviewees (i.e. images of chemistry and chemists; chemistry in the curriculum; how chemistry is taught; young people's own ambitions; parental influence; and peer influence). These areas are discussed in turn below.

Interviewees agreed with the findings about young people's perceptions and **images of chemistry**. They offered the following further comment:

- several **disagreed that gender stereotypes influence** young people's decision making about chemistry. Frequently, the chemistry teacher interviewed was female themselves and so felt they confounded such traditional perceptions

- some noted a **lack of chemistry role models** (particularly as compared to other science disciplines). For example, one interviewee identified that chemistry teachers are not regarded by pupils as scientists; rather, that doctors are the real scientists

- the **media was the main propagator of pupils' perceptions** and images of chemists and chemistry.

All interviewees concurred with the findings from the literature about pupils' experiences of **chemistry in the curriculum**, noting in particular:

- **pupils' experiencing the chemistry curriculum as difficult, abstract, content heavy and lacking in relevance**, and that this experience was a key factor determining pupils' continuation of chemistry study. '*They* [pupils] *do say* '*how am I ever going to use this, what's the point of it?*' (Chemistry teacher). *The GCSE chemistry currently has a lot of facts, very content heavy and it's difficult to deal with because it's much more abstract than biology or physics. They* [pupils] *find the vast content difficult to cope with and then they think they can't do it*' (Chemistry teacher)

- the **incremental nature of understanding** in chemistry, which was felt to 'confuse' pupils and undermine their confidence in their ability to understand the subject

- **good quality teaching** and a **well balanced curriculum** as a key to overcoming this barrier. They pointed to the need to develop pupils' confidence in their ability, enhance capacity for practical activity and increase the emphasis on skills, as opposed to theory. In this regard, impending developments to the chemistry curriculum were generally welcomed, although some concern was expressed that chemistry did not become diluted.

All interviewees agreed with findings about **how chemistry is taught**. Interviewees felt that:

- pupils were most engaged by **practical activity**, group work, discovery and problem solving

- there were tensions between **having time for practical activity** and

completing syllabuses: '*they'd* [the pupils] *love to do more practical things and they ask every time they come in 'are we doing practical?' But you just can't because you've got so much to cover*' (Chemistry teacher)

- other **barriers to getting practical activity into the curriculum** included class size and manageability, health and safety, teacher knowledge and specialism, and limited repertoires of practical activities and ideas for engaging pupils in cooperative practices. It was felt the RSC could provide valuable additional support to teachers in terms of the latter issues.

There were a range of responses on the extent to which young people's own ambitions influence their subject choice, including:

- pupils **highly motivated and driven by career ambitions** to **pupils' lack of career direction**

- some students' chemistry career decision making is strategic, with many pupils **choosing chemistry** A-level to **meet the requirements** of their chosen career pathways, e.g. medicine, veterinary science, forensic scientist. Interviewees' felt that other 'named' careers within the field of chemistry were less known to students

- pupils select A-levels and subsequent courses that **they feel most assured they will do well in**, perhaps more so than choosing on the basis of enjoyment (again, employing strategic planning). Interviewees witnessed pupils expressing preferences for other subjects, which they felt were 'easier': '*most kids are acute enough to know that there are easier choices, they can choose easier A-levels than chemistry*'

- the **general applicability, relevance and intellectual rigour of chemistry study** as a motivating factor in pupils' decision making. However, other interviewees argued that more could be done to promote these qualities, which they perceived would provide a good grounding for a diverse range of related and non-related careers.

Most interviewees felt there would be parental influence (both positive and negative):

- where parents had science-related jobs or backgrounds and might express preference for science subjects and **value science as important**

- where parents had had negative experiences of science, for example, if they themselves struggled with science during school.

However, interviewees did not identify parents' role in transmitting stereotypical perceptions of chemistry and chemists as highlighted in the literature. It is likely that this forms a more private rather than visible influence.

With regard to peer influence, most interviewees felt:

- there was **little evidence of a strong peer influence** over pupils' chemistry decision making in their experiences; young people's A-level **decision making** was felt to be **a strategic process**, giving little weight

to peer preferences

- it might be a factor where pupils establish friendships with pupils of similar ability to themselves, e.g. small groups of high ability peers taking chemistry (although this would seem to be an incidental, rather than a causal factor)
- peer groups may **emphasise stereotypical** images and perceptions of chemistry and chemists. For example, in the experience of one chemistry teacher, pupils are cautious not to be seen as 'swotty' and too academic; images that are readily associated by pupils' with chemistry.

1.4.1 Interviewees' additional key influences

In addition to their comments on the findings from the literature review, interviewees were asked to comment on whether there were any other factors that they felt influenced young people's chemistry careers decision making. They added the following two issues:

- **teacher influence** – with concerns over the impacts of non-specialist teaching and the quality of chemistry teaching on pupils' engagement in chemistry
- the **earning potential** related to different chemistry careers (e.g. financial remuneration as a key factor in pupils' career decision making).

1.5 Summary and points for action

Interviewees generally agreed with the findings from the literature review. In particular they agreed with the following key influences on pupils' chemistry careers decision making:

- the importance of the primary phase in science attitude formation
- the deterioration of science attitude throughout secondary education
- perceptions and images of chemistry
- pupils' experiences of chemistry in the curriculum
- pupils' experiences of how chemistry is taught
- young people's own ambitions
- parental influence (to some extent).

They also agreed with the finding that careers guidance needs to be more up to date, diverse and based on expertise and knowledge in the field. However, interviewees were less in agreement with:

- the nature and extent of peer influence
- the lack of female role models identified by the literature.

Interviewees identified the following additional influences on pupils' chemistry choice:

- teacher influence (i.e. a perceived impact of non-specialist teaching)
- the pull of financial remuneration.

Both the literature review and the discussion of the literature review findings suggest scope for addressing some of the key influences on pupils' chemistry decision making (and perhaps, in turn, enhancing the uptake of chemistry). These include:

- **practical curriculum materials issued to support both primary and secondary teachers** – for example, providing ideas for simple and manageable experiments and projects; proposals for how to relate the curriculum to everyday life, current affairs and chemistry careers; and guidance on facilitating more collaborative approaches.
- enhancing **chemistry teachers' and careers teachers' up-to-date information and knowledge about chemistry related jobs –** for example through resource development regarding careers advice materials for science in key stage 3 and 4
- more **chemistry careers guidance to come from those 'in the know'** (e.g. providing information, promoting the usefulness of chemistry, increasing relevance and potentially combating stereotypical images) – for example, individuals in chemistry professions coming into schools to provide talks and workshops on the nature of their jobs
- the possibility and value of raising **parents' awareness of chemistry careers** (e.g. through materials and invitations to events)
- greater use of extra curricular activities to explore the process elements and **application of the discipline** (e.g. events, demonstrations, projects and visits to science museums), as well as opportunities for work experience and taster courses
- greater attention to young people's preferred sources of careers advice and influences at different ages – e.g. younger children's reliance on elder siblings and other family members; slightly older pupils' preference for information from subject teachers and careers advisors; and older children's influence by the media (these areas are discussed further in Section 4.7.1)
- making more explicit for young people the **links between careers guidance activities** (such as using materials) **and decision making** – for example via more directed and supported usage of the materials between advisors/teachers and young people
- greater awareness of the impact of early experiences of chemistry learning on later choices – for example ensuring the curriculum is stimulating and motivating well before times of choice.

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Part B

Dissemination of the RSC careers materials

2 Dissemination of the RSC careers materials

2.1 Introduction

This section of the report presents a brief description of each material included in the evaluation; and an audit of the dissemination of the RSC materials to schools and other stakeholders.

2.2 The materials

A brief description of each of the materials included in the evaluation is provided here.

Poster series – '*Not all chemists wear white coats*'

'*Not all chemists wear white coats*' is a series of A1 sized posters aimed at key stage 3, key stage 4 and post-16 students and their equivalent. The posters contain a large image of a **career in action** where the participant has science and chemistry qualifications. The text includes the poster title, '*Not all chemists wear white coats*', and a block of writing regarding the nature of the role. Reference is made to the RSC postal address.

Poster series– '*Chemists in their element*'

'*Chemists in their element*' posters are a series of A1 sized posters aimed at key stage 3, key stage 4 and post-16 students. The posters contain a large annotated image, title and block of text. The nature of these posters exemplifies **the uses and applications of chemistry in everyday life** as the annotated text describes how chemistry is used in the process of researching, designing and making the respective product. The block of text relays a list of chemistry career titles. Reference is made to the RSC website for more information.

Poster series – '*That's Chemistry*'

'*That's Chemistry*' posters are a series of A1 sized posters aimed at key stage 3, key stage 4 and post-16 students. The posters contain a large image with a word (resonated and repeated), a block of text and the phrase '*That's Chemistry*'. This series of posters demonstrate **the link between experiences and feelings and how chemistry can be used to explain such experiences** (e.g. such words as pleasure, adrenaline, fear, etc). The text describes the transferable skills developed by chemistry study. The RSC postal and web addresses are displayed.

Booklet – '*How far have we come with the help of science?*'

This A5 booklet is aimed at key stage 3 and key stage 4 students. The front cover is blue with a cartoon line drawing of stone-age people (similar to 'the flintstones'). The booklet sets out the role of science in life, with a page describing the role of each of the three sciences, followed by a final page on what qualifications are needed at key stage 4 in order to progress to further science study. The back page of the booklet presents a list of organizations, which students might like to investigate, and their contact/web details.

Booklet – '*Life Beyond Exams*'

This A4 booklet is aimed at key stage 4 and post-16 students. The booklet details the various arenas of chemistry careers, e.g. industry, chemistry in community and chemistry in education. In addition, the booklet presents information on the qualifications needed and how to get additional information.

Profiles – Chemistry career '*Profiles*'

This material is an A4 folder aimed at post-16 students which contains individual cards that present the profiles of people who have studied chemistry and their various destinations. The information describes how they got into their job, any factors that have helped them get there, what their day to day job involves, most enjoyable factors, the skills needed, the expected salary and how to get further information.

Leaflets – '*Choosing a degree*'

This material comprises a series of three A5 sized booklets aimed at post-16 students, covering '*Choosing a degree*', 'Which type of chemical science degree?' and 'Where could a qualification in chemical science take you'. The information provides guidance to students on how to compare different degree courses, qualifications and what is involved in chemistry degree study, as well as information regarding the chemistry and non-chemistry careers that further study could lead to and who to contact for work experience. A range of additional contact details are also provided.

2.3 An audit of the dissemination of the RSC materials

Single copies of the RSC materials are sent free to all schools in the UK and Ireland. Further copies can be purchased. This section provides an audit of the additional materials requested by schools and other stakeholders over a one-year period[2] (between February 2005 and February 2006). It presents an audit of:

[2] Note that the materials included in the audit were: posters – '*Not all chemists wear white coats*' and '*Chemists in their element*'; booklets – '*How far have we come with the help of science?*' and '*Life*

- the total number of requests for materials by organisations
- the range of materials requested by organisations
- the range and number of different organisations requesting the materials.

2.3.1 The total number of requests for materials

Over the one-year period, the most requests were for (in rank order):

- '*Choosing a degree*' leaflets
- '*How far have we come with the help of science?*' booklet
- The periodic table
- '*Life Beyond Exams*' booklet
- '*Chemists in their element*' posters
- '*Not all chemists wear white coats*' posters
- Educational activities for schools and colleges
- '*From chemical science to ...*' career '*Profiles*'.

Table 2.1 shows the number of requests for these materials by different organisations.

Table 2.1 The number of requests by different organisations

Material	Organisation					
	Schools	Universities	Careers organisations	Other stakeholders	Unknown	Total
Posters: Not all chemists wear white coats	348	124	202	1107	91	**1,872**
Posters: Chemists in their element	304	129	202	1207	91	**1,933**
How far have we come with the help of science?	2622	544	371	2934	593	**7,064**
Life Beyond Exams	640	216	261	1168	117	**2,402**
Chemistry career profiles	338	129	235	520	113	**1,335**
Choosing a degree	1865	546	231	3826	612	**7,080**
Activities for schools and colleges	395	171	56	743	100	**1,465**
The periodic table	1039	235	87	1717	547	**3,625**
Total	**7,551**	**2,094**	**1,645**	**13,222**	**2,264**	**26,776**

NB: These figures do no include requests from the RSC educational representatives in Scotland and Ireland.
Source: RSC dissemination data for the NFER evaluation of the RSC materials 2006.

beyond exams'; leaflets/profiles – '*From chemical sciences to ...*' and '*Choosing a degree*'; and other teaching/learning material – '*The period table*' and '*Educational activities for schools and colleges*'.

2.3.2 The range of materials requested by organisations

The actual number of materials requested by organisations varied, ranging from individual orders of one copy of some of the materials to more than 200 copies. Table 2.2 shows the range in the number of copies of the materials requested by the various organisations. (The numbers show the total number of requested copies across the materials per order, rather than by specific material. However, a request for one copy of the posters, e.g. '*Not all chemists wear white coats*', would be fulfilled by a single copy of each poster in the series.)

Table 2.2 The number of copies of the materials requested per order

No. of copies	Organisation			
	Schools	Universities	Careers organisations	Other stakeholders
1 – 5	152	21	15	13
6 – 30	42	10	3	15
31 – 60	19	9	0	13
61 – 100	3	0	1	12
101 – 200	4	0	2	8
201+	1	1	1	2

Source: RSC dissemination data for the NFER evaluation of the RSC materials 2006.

As shown in Table 2.2, schools in particular frequently ordered between one and five copies of the materials – i.e. smaller numbers of the materials per order. In contrast other stakeholders (e.g. industry) were more likely to order greater numbers of copies of the materials.

That schools are generally requesting smaller numbers of copies of materials seems to reflect the interview data presented in Part C of this report, where it was found that such materials often form part of a 'chemistry careers resource box' and are chiefly used by individuals. However, it also prompts a question in light of the findings from those interviews:

- **to what extent are school staff aware that they can request multiple copies** of the RSC materials? (in interviews, school staff often suggested the need for multiple copies of materials so that they could use them with the whole class and/or allow students to take their own copy away).

2.3.3 The range of different organisations requesting materials

The organisations requesting the materials over the one-year audit period have been grouped and are presented below:

- schools were the most likely institution to request the materials, with 208 institutions seeking the materials (these include 11–18 schools, 11–16 schools, sixth form colleges, grammar schools)
- 36 universities requested the materials
- 20 careers organisations (including Connexions, and careers advisors outside of school) requested the materials
- 44 other stakeholder institutions requested the materials. These comprised 15 from industry, 11 from RSC and 8 from science centres and events (e.g. science learning centre, science festival and science museums)
- in addition, there were 70 requests for the materials where the customer was unidentifiable/not known (e.g. individuals, no named institution, addresses only).

In both schools and universities there were a small number of cases where, **within the same institution**, individuals in different roles had requested the materials (e.g. a chemistry teacher and a careers teacher in the same school). That the materials are being requested by different individuals/departments within the same organisation highlights the possibility that in some organisations there is an individual approach to requesting materials rather than, say, a coordinated approach. Indeed, the interview data discussed in Part C of this report would seem to suggest this occurs in some cases.

More often though, according to this one-year audit of data, where organisations had made more than one request for materials this was made by the same individual from that institution.

The materials were requested by personnel across the **geographical areas** of the United Kingdom, with a couple of requests from personnel in USA, Europe and Africa. There were no consistent or evident geographical gaps across the UK (i.e. where the materials had not been further requested).

Part C

An Evaluation of the RSC careers materials

3 About the research

3.1 Introduction

Section 3 of this report presents findings from an interview survey of young people's, chemistry teachers', careers advisors' and other stakeholders' perceptions of the RSC chemistry careers materials. The materials evaluated were:

- Posters ('*Not all chemists wear white coats*'; '*Chemists in their element*'; and '*That's Chemistry*')
- *How far have we come with the help of science?*
- *Life Beyond Exams*
- Career '*Profiles*'
- *Choosing a degree*.

3.2 The research

The data collection involved visits to 30 schools in the spring and summer terms of 2006. In each school, up to five young people were interviewed (usually individually), as were two members of staff – usually a chemistry teacher/head of chemistry and a school careers adviser. The interviews collected both qualitative and quantitative data, including responses to the materials on scales of 1–5.

In addition, short telephone interviews were conducted with other users (stakeholders) of the materials.

3.3 The interviewees

This section presents the characteristics of the school sample, young people, teachers and stakeholders involved in the interview survey.

3.3.1 Schools

The data collection involved visits to 30 schools. Table 3.1 shows the breakdown of schools visited.

Table 3.1 Type of school

Type of school	No. of schools
11–18 comprehensive	15
11–16 comprehensive	5
14–18 high school	3
6th form college	3
FE college	1
Independent school	3
Total	**30**

Source: NFER interview survey on RSC materials 2006.

The schools[3] involved in the evaluation also had the following characteristics:

- 28 co-educational schools, one all-girls' school, and one all-boys' school
- specialist status – including **science specialist status** (four schools), technology status (three schools), maths and computing specialist status (three schools), language college status (two schools), sports college status (two schools), and humanities specialist status (one school)
- of the 26[4] schools teaching science at key stage 4, ten teach **double award science** only, nine teach **double award and triple award science**, four teach **single award and double award science**, and three teach courses covering all three types of award. In terms of the curriculum/programmes covered, seven of the schools teach an 'Applied science' course at GCSE, one teaches GNVQ science, and a number of the schools are piloting 21st Century Science programmes
- **key stage 3 science** is usually taught as '**general science**' and by one teacher covering all aspects of the curriculum; although a small number of the schools report separate and/or specialist taught sciences from Year 8 onwards (three schools), from Year 9 onwards (three schools), or throughout key stage 3 (two schools)
- the elements/modules of **key stage 4 science** are reported to generally be taught by **subject specialists**, although five schools indicated that there was some overlap-teaching (e.g. in one case physics and chemistry were taught by one teacher), and four schools indicated that 'specialist-taught' science depended on the ability of the class.

3.3.2 Young people

In each of the schools, up to five interviews were carried out with young people (usually individually). Table 3.2 shows the total number of interviews conducted with young people broken down by key stage. It also details where interviews were conducted with individuals, and where they comprised a small group of pupils. The total number of girls and boys involved in the interviews is also shown.

[3] The schools were located in the north east, north west and the east of England, and the Midlands; and one school in Scotland and one in London also took part in the evaluation.
[4] i.e. four of the schools taught at post-16 only.

Table 3.2 The young people involved in the interviews

Pupil interviewees	No. of interviews	Comprising	No. of interviewees	Girls	Boys
Key stage 3	45	45 individual interviewees	45	20	25
Key stage 4	34	32 individual interviewees plus 2 groups of 4 pupils	40	21	19
Post-16	59	58 individual interviewees plus 1 group of 3 boys	61	33	28
Total	**138**		**146**	**74**	**72**

Source: NFER interview survey on RSC materials 2006.

Table 3.3 shows the chemistry/science courses that the young people involved in the research are currently undertaking.

Table 3.3 Young people's current chemistry/science course

Subject	No. of interviews with pupils in …		
	Key stage 3	Key stage 4	Post-16
KS3 science	45	-	-
Single award science	-	1	-
Double award science	-	24	-
Triple award science	-	5	-
GNVQ science course	-	4	-
AS-level chemistry	-	-	33
A2-level chemistry	-	-	13
Scottish Higher	-	-	3
Not studying chemistry	-	-	10
Totals	45	34	59

Source: NFER interview survey on RSC materials 2006. NB – presented for the sample of 138 interviews.

In the sample, there was an overall spread of low, mid and high-ability pupils (according to their teachers), in the following proportions: 5; 40; and 55 per cent.

The majority of the key stage 3 and 4 pupils interviewed wished to continue their studies at 16 – either in their school sixth form, at sixth form college, or, occasionally, at FE college.

Regarding chemistry itself, the young people interviewed had a range of future plans to study chemistry further, as shown in Table 3.4.

Table 3.4 Young people's plans to study chemistry further

Young people's plans to study chemistry …	N. of interviews with young people
Up to GCSE	46
Up to AS level	8
Up to A2 level	28
For degree level	5
For higher degree	2
Chemistry as a component of/required for a degree course (e.g. biochemistry, medicine, veterinary science, pharmacology, forensic science, modules within natural sciences, etc)	29
Undecided	20

Source: NFER interview survey on RSC materials 2006. NB – presented for the sample of 138 interviews.

It was possible to classify the young people in terms of their attitudes towards chemistry, in the following ways – young people who:

- are chemistry-subject and chemistry-career positive (e.g. enjoy chemistry, find it manageable and relevant and likely to continue with chemistry)
- are science-positive and a continuer into science but not necessarily chemistry
- are chemistry positive and possible continuer/undecided about continuing
- are chemistry-continuers as a means to another end
- do not enjoy chemistry, find it difficult and not especially relevant (e.g. non-chemists, non-continuers).

3.3.3 School staff

Table 3.5 shows the range of school staff who were interviewed.

Table 3.5 The school staff involved in the interviews

Teacher interviewees	No. of interviewees
Head of Chemistry	17
Chemistry teacher	11
Head of Science	5
Head of Careers/Careers coordinator (includes Head of PSHE)	9
Careers teacher/advisor	3
Other (e.g. AimHigher coordinator, vocational curriculum coordinator)	3
Careers coordinator/teacher and chemistry teacher	2
Head of science with some responsibility for careers (e.g. in the 6th form)	2
Total	**52**

Source: NFER interview survey on RSC materials 2006.

3.3.4 Stakeholders

In addition to the interviews with young people and their teachers, ten short telephone interviews were conducted with other users of the materials, including: university lecturers for chemistry with responsibility for admissions and/or schools liaison/outreach; Connexions advisors; education liaison officers in the chemical/pharmaceutical industries; and representatives from the AimHigher programme: *Chemistry the Next Generation*.

4 Young people's perceptions

4.1 Introduction

This section presents the young people's perceptions of the materials. It draws on the responses from the 138 face-to-face interviews conducted with young people from 30 schools. This included 45 interviews with key stage 3 pupils, 34 interviews with key stage 4 pupils and 59 interviews with pupils in post-16 education.

The section sets out:

- the **young people's familiarity with, and initial reactions to, the materials** – i.e. the extent to which the young people interviewed had seen or used the materials and their responses to an open-ended question to gauge initial reactions (Section 4.2)
- the **young people's ratings of the materials: closed responses** – i.e. the young people's ratings for each material on five pre-determined areas using a five-point scale (Section 4.3)
- the **young people's commentary on the materials: open responses** – i.e. the young people's open comments, suggestions and improvements for each individual material (Section 4.4)
- the **young people's perceptions of the impact of the materials overall** – i.e. on decision making, on attitudes towards chemistry, and on continuing with chemistry as a subject and/or for a career (Section 4.5)
- the **young people's suggested improvements and recommendations for the materials overall** – including any overall changes they would make to the materials, and covering issues such as when to use the materials, and the accessibility/availability, relevance and intended audience of the materials (Section 4.6)
- **attracting young people to chemistry** – i.e. the young people's other perceptions and recommendations about chemistry and careers advice (Section 4.7)
- a **summary** of the young people's perceptions (Section 4.8).

4.2 The young people's familiarity with, and initial reactions to, the materials

This section outlines: the extent to which the young people have seen or used each of the materials before; where/when they have seen/used them; and their initial reactions to the materials.

4.2.1 Familiarity with the materials

The young people were asked about whether they had seen or used the materials before. Overall:

- just under **one-third** of the interviewees reported that they **had not seen** or used any of the RSC materials before
- almost **three-fifths** responded that they had only seen the **posters**
- just over **one-tenth** indicated that they had seen the posters and at least one of the literature materials (i.e. '*How far have we come with help of science?*', '*Life Beyond Exams*', Career '*Profiles*' and '*Choosing a degree*').

Table 4.1 shows, for each of the materials, the number of young people who reported to have seen or used the material before.

Table 4.1 Young people's familiarity with the materials

Material	No. of young people who report having seen or used the materials before			
	Key stage 3	Key stage 4	Post-16	Total
Poster: Not all chemists Wear White Coats	18	10	42	69
Poster: Chemists in their element	16	12	32	59
Poster: That's Chemistry	5	1	7	13
How far have we come with the help of science?	0	3	-	3
Life Beyond Exams	-	0	3	3
Chemistry career profiles	-	-	8	8
Choosing a degree	-	-	5	5

Note for the 'That's Chemistry' posters fewer interviewees (31) were asked if they'd used/seen them before as this series came into the evaluation at a later stage.
Note that the young people were asked about materials for their age range. A dash indicates where they were not asked about that material.
Source: NFER interview survey on RSC materials 2006.

Table 4.1 shows that:

- Amongst the sample of young people, the **posters are the most seen and used materials**, whilst the literature materials are the least seen and used.
- Those young people who had used the literature materials came from ten different schools and were 16 individuals – possibly suggesting the pupils accessing the materials were **individuals seeking information**, rather than whole school approaches where all pupils were aware of the materials. Of the 16 individuals, two of these had used more than one of the booklets.
- A small proportion of interviewees felt they had used **older versions** of RSC careers advice materials. This perhaps raises issues as to how often careers information in schools/libraries is being updated.

In addition to the literature material, the young people were asked whether they were familiar with any other materials or events offered by the RSC.

Only a handful of post-16 students and one key stage 4 pupil had come across any other RSC materials or been to any events offered by the RSC. The events included: UCAS fairs, where the RSC were represented; University open days, where RSC materials were available; and Chemistry Week and related competitions which are sponsored by, and feature, the RSC. Such small numbers of responses would seem to highlight the need to overcome barriers that may prevent all pupils having greater access to RSC personnel, events and materials. However, it should be noted that the RSC produces the vast majority of its materials for teachers.

4.2.2 Where and when pupils have seen/used the materials

In terms of where and when the young people had seen the materials before, the most common response referred to the posters (the most seen and used of the materials), most frequently seen by pupils on **science classroom walls** and along **science department corridors**.

From the small number of young people who had seen the literature materials before, there was **an array of responses** as to where they had seen them. These included: at events and open days (e.g. sixth form recruitment evenings, school and university open days); in school libraries and careers libraries; a display in the science department; being given the materials by subject teachers; and use of online versions of the materials.

The interviewees' comments revealed **varying degrees of familiarity and usage** of the materials. Some pupils felt they were familiar with some of the materials but had **not really paid the materials any attention**. A small proportion of pupils felt they had never seen a material before even though it was up on their classroom wall (i.e. in effect highlighting a difference between 'looking' and 'seeing'). A small number of young people also noted that their attention is not necessarily directed to the materials by teachers. There would seem to be a gulf between the materials being available and actually being seen, used and critically considered by the young people. Both **access to** and **usage of** the materials are discussed further in Section 4.6.

4.2.3 Young people's initial reactions to the materials

Young people were asked to give their initial reactions to the materials (including those materials they had and had not seen or used before) in an open ended question. This gave them the opportunity to respond freely about the materials, allowing their unprompted perceptions to be gauged. However, pupils' responses were prompted in relation to the extent to which they found the poster eye-catching and appealing ('*Is there something that hooks you in?*') and whether or not they would notice and/or read them ('*Is it something you would take the time to look at or read?*').

When describing their initial reactions to the materials, young people in the 138 interviews were extremely positive in their responses. Two key themes emerged in their responses – the visual appeal of the materials, and the value of the materials in promoting chemistry.

- **Visual appeal** – '*the materials are **eye-catching***' (reported by the vast majority of pupils). In particular, pupils referred to the **posters** in this respect noting that they were '*really exciting and bold*'. Here, the bright colours and the pictures were identified as two of the main factors which would draw pupils' attention to the posters. In addition, several pupils also felt that the posters were more appealing as they did not contain as much text/detail as the booklets: '*they are short and brief and give you an idea'*. However, some pupils still felt that the posters contained too much detail and that the text was too small (see Sections 4.4 and 4.6 for further details).
- The value of the materials for **promoting the 'other side' of chemistry** – especially with regard to the posters, e.g. putting forward a positive message about chemistry; highlighting the influence of chemistry within society; and raising awareness about the variety of careers from chemistry.

> *I think it's a good thing, it shows that there's more things to chemistry.*
>
> Key stage 3 pupil

> *Some people don't really know what job they want to go into and this really does give you inspiration on what you can be if you take chemistry.*
>
> Key stage 4 pupil

> *I think they're useful, because they show that chemistry comes at you from different angles. And you may want to do it at A-level, and careers in chemistry might seem boring to you, but maybe looking at these posters, they offer something more than you think. They're good in showing the appeal of chemistry in lots of different respects.*
>
> Post-16 student

The young people perceived **different levels of promotion and engagement** with the materials. The posters were felt to draw them in as they were eye-catching; whilst the leaflets and booklets were felt to promote more in-depth information. '*I would start off by looking at the posters, and if that got my imagination going then I would want more information*' (key stage 4 pupil).

When prompted, most pupils reported that they **would take the time to read** the materials. Some pupils felt that they would be more likely to read the posters than the booklets because they contained less text and thus could be read quickly. Likewise, of the booklets, pupils reported that they would be more likely to read the '*How far have we come with the help of science?*' booklet than the '*Life Beyond Exams*' booklet as it looked more interesting and 'fun' and less detailed.

Across the age ranges, generally, pupils' initial reactions to the materials were similar. However, some comparisons could be drawn. Key stage 3 pupils were more likely than their counterparts to suggest that the posters **did not necessarily relay a message about chemistry**. At post-16, the young people were more likely to describe the materials as **informative** than pupils in key stages 3 or 4.

Overview: young people's familiarity with and initial reactions to the materials

- The young people relayed **varying degrees of familiarity and usage** of the materials. Almost three-fifths had only seen the posters before; just under one-third were not familiar with any of the materials.
- There would seem to be a gulf between the materials being available and actually being seen, used and critically considered by the young people.
- **Initial reactions** relayed positive views about the **visual appeal** of the materials (especially the posters), and the messages within the materials which were perceived to **promote relevant** and wide-ranging aspects of chemistry careers and in society.

4.3 Young people's ratings of the materials: closed responses

The young people were asked to rate each individual material in five pre-determined areas, which included:

- the extent to which they liked the **style**, **font** and **layout**
- the extent to which they liked the **images** and **pictures**
- the extent to which they felt they **understood the content**
- the extent to which they felt the material **tells them something about chemistry**
- the extent to which the material would be helpful when **choosing chemistry**.

A five-point scale (where '1' represented not at all, and '5' represented a great deal) was used to rate the materials and pupils were also asked to elaborate with examples and explanation as necessary.

This section sets out: the findings from young people's ratings for the materials according to the above statements; and compares the findings across the materials and by age range.

4.3.1 Young people's ratings

Tables 4.2–4.8 present pupils' overall ratings to these statements for each material. Overall, Tables 4.2 – 4.8 show a high proportion of pupils giving the materials ratings of 4 and 5 out of 5. This reflects their **generally very positive** views about the RSC materials. The key findings from analysis of the young people's ratings of the materials **according to each of the pre-determined areas** are set out below.

- In terms of **style, font and layout** there were positive ratings across the materials, with '*Not all chemists wear white coats*' given the highest proportion of 4 and 5 ratings on the five-point scale.
- For **images and pictures** there was a slightly wider range of ratings given, including lower ratings for two materials where more than half of pupils responding gave ratings of 1, 2 or 3 out of 5 (i.e. '*Life Beyond Exams*' and the '*Profiles*').
- With regard to **understanding the content**, pupils generally rated the materials as very clear to understand – especially '*Life Beyond Exams*' and the '*Profiles*' where the vast majority gave ratings of 4 and 5 out of 5. However, there was some indication that '*That's Chemistry*' posters were slightly less clear to understand (smaller numbers responding might warrant caution here).
- Ratings for **telling you something about chemistry** varied across the materials, and were on the whole lower ratings than those for understanding the content and the appeal of the style and layout for each material. The exceptions to this were for '*Chemists in their element*' and the '*Life Beyond Exams*' booklet which were both given a high proportion of 4 and 5 out of 5 ratings. Again, '*That's Chemistry*' received the lowest proportion of 4s and 5s out of 5 (although still reasonably positive).
- Of all the statements, **helpful for choosing chemistry** received the lowest ratings of all for each material – apart from within '*Life Beyond Exams*' and the '*Profiles*', where the images were rated lower. **Ratings also varied greatly across the materials**, '*Life Beyond Exams*' received very positive ratings in this regard, whilst the posters, especially '*That's Chemistry*' received less enthusiastic ratings.

Tables 4.2 – 4.8

Table 4.2 Posters – '*Not all chemists wear white coats*' (respondents from key stages 3 & 4 and post-16)

Statement	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
To what extent do you like the style, font and layout	117	0	1	22	60	34	94	**80%**
To what extent do you like the images and pictures	115	1	8	16	48	42	90	**78%**
To what extent do you feel you understand the content	116	1	10	20	60	25	85	**73%**
To what extent do you feel this tells you something about chemistry	114	1	11	42	44	16	60	**53%**
To what extent do you feel this would help with choosing chemistry	115	5	11	42	42	15	57	**50%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Source: NFER interview survey on RSC materials 2006.

Table 4.3 Posters – '*Chemists in their element*' (respondents from key stages 3 & 4 and post-16)

Statement	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
To what extent do you like the style, font and layout	115	0	8	27	51	29	80	**70%**
To what extent do you like the images and pictures	115	1	10	31	50	23	73	**63%**
To what extent do you feel you understand the content	113	0	6	22	59	26	85	**75%**
To what extent do you feel this tells you something about chemistry	111	1	6	20	71	13	84	**76%**
To what extent do you feel this would help with choosing chemistry	113	5	20	33	42	13	55	**49%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Source: NFER interview survey on RSC materials 2006.

Table 4.4 Posters – '*That's Chemistry*' (respondents from key stages 3 & 4 and post-16)

Statement	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
To what extent do you like the style, font and layout	31	0	3	6	9	13	22	**71%**
To what extent do you like the images and pictures	31	1	4	4	10	12	22	**71%**
To what extent do you feel you understand the content	30	0	1	11	14	4	18	**60%**
To what extent do you feel this tells you something about chemistry	29	0	1	13	13	2	15	**52%**
To what extent do you feel this would help with choosing chemistry	31	3	8	11	7	2	9	**29%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Source: NFER interview survey on RSC materials 2006.

Table 4.5 Booklet – '*How far have we come with the help of science?*' (**respondents from key stages 3 & 4**)

Statement	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
To what extent do you like the style, font and layout	76	0	4	26	34	12	46	**61%**
To what extent do you like the images and pictures	75	0	4	17	39	15	54	**72%**
To what extent do you feel you understand the content	76	0	2	11	39	24	63	**83%**
To what extent do you feel this tells you something about chemistry	74	1	5	17	29	22	51	**69%**
To what extent do you feel this would help with choosing chemistry	75	4	9	15	38	9	47	**63%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Source: NFER interview survey on RSC materials 2006.

Table 4.6 Booklet – '*Life Beyond Exams*' (respondents from key stage 4 and post-16)

Statement	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
To what extent do you like the style, font and layout	88	1	6	24	44	13	57	**65%**
To what extent do you like the images and pictures	87	2	11	33	29	12	41	**47%**
To what extent do you feel you understand the content	87	1	0	12	47	27	74	**85%**
To what extent do you feel this tells you something about chemistry	82	0	3	9	34	36	70	**85%**
To what extent do you feel this would help with choosing chemistry	86	1	3	9	45	28	73	**85%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Source: NFER interview survey on RSC materials 2006.

Table 4.7 Folder – Chemistry career profiles (respondents **chiefly from post-16)**

Statement	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
To what extent do you like the style, font and layout	56	0	5	12	26	13	39	**70%**
To what extent do you like the images and pictures	55	0	11	21	19	4	23	**42%**
To what extent do you feel you understand the content	54	0	4	4	28	18	46	**85%**
To what extent do you feel this tells you something about chemistry	53	0	4	13	19	17	36	**68%**
To what extent do you feel this would help with choosing chemistry	55	2	5	7	17	24	41	**75%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Source: NFER interview survey on RSC materials 2006.

Table 4.8 Booklets/leaflets – '*Choosing a degree*' **(respondents chiefly from post-16)**

Statement	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
To what extent do you like the style, font and layout	56	0	4	14	26	12	38	**68%**
To what extent do you like the images and pictures	56	0	6	16	17	17	34	**61%**
To what extent do you feel you understand the content	55	0	5	6	29	15	44	**80%**
To what extent do you feel this tells you something about chemistry	52	1	6	16	24	5	29	**56%**
To what extent do you feel this would help with choosing chemistry	54	4	4	16	25	5	30	**56%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Source: NFER interview survey on RSC materials 2006.

4.3.2 Comparing across the materials and by age range

Other key findings presented here focus on comparing across the different types of materials, within the posters, within the booklets/literature, and any differences by age range.

Comparing different types of materials

- In terms of **how much the young people felt the materials would help with choosing whether or not to take chemistry**, the young people gave less positive ratings for all the posters in comparison with all the booklets.

Comparing the posters

- Within the posters, the pupils gave **higher ratings to aesthetic factors** such as images and layout than for the helpfulness of the posters when making choices.
- Pupils **prefer the images and pictures** on the '***Not all chemists wear white coats***' posters, followed by those on '*That's Chemistry*' and then '*Chemists in their element*' posters.
- The '***That's Chemistry*'** posters were rated as the **least easy of the posters to understand**, and **least likely of the posters to help with choosing chemistry** (although smaller numbers responding here warrants caution).
- The '***Chemists in their element*' posters** were rated as **telling pupils considerably more about chemistry** than the '*Not all chemists wear white coats*' and '*That's Chemistry*' posters.

Comparing the booklets/literature

- '*Life Beyond Exams*' and the career '*Profiles*' received some of the **most positive ratings of all** (except with regard to the images and pictures, for which they received the lowest ratings of all the materials). They were felt to be particularly helpful in terms of clarity of content and for choosing whether or not to continue with chemistry.
- In contrast, pupils felt the '*Choosing a degree*' leaflets and '*How far have we come with the help of science?*' booklet to be **less useful** in terms of helping to make decisions (although still very positive in terms of clarity of content).
- Pupils felt the '***Life Beyond Exams***' booklet would **tell them most about chemistry**. However, later comments on the individual materials suggest this material is only likely to be looked at by pupils with some existing interest in chemistry study continuation.

Differences by age range

- Views about the materials are generally **more positive amongst key stage 3** pupils; they give more ratings of 'five out of five' than both key stage 4 and post-16 students.
- **Posters** would seem to have a particular **appeal and relevance to younger pupils**. Young people in key stage 3 felt the posters **told them more about chemistry** than their counterparts in key stage 4 and post-16. In addition, in key stage 3 pupils rate the posters as being **slightly more useful** in helping them to **make a decision** about chemistry compared with their older peers.
- However, throughout all age groups the **posters** are not rated especially strongly in influencing decision making, and, their **helpfulness deteriorates in post-16**.
- Ratings from pupils in key stage 3 showed that they found the '*Chemists in their element*' poster **less easy to understand** than pupils in key stage 4 and post-16.
- Post-16 students and key stage 4 pupils preferred the '*Not all chemists wear white coats*' poster to the other posters in terms of style and images. Contrastingly, key stage 3 pupils preferred the '*That's Chemistry*' poster.
- **Key stage 3 pupils** rated the '*How far have we come with the help of science*' booklet as **more useful** (telling you about chemistry and helping you decide) than key stage 4 pupils. In **key stage 4, pupils seemed to want more detailed information**, as they rated the '*Life Beyond Exams*' booklet more useful (for telling you about chemistry and helping you decide) than the '*How far have we come with the help of science?*' booklet.

Overview: Young people's ratings of the materials (closed responses)

- The young people gave very **positive** ratings for the **style and layout** of all the materials. However, the **images and pictures** in '*Life Beyond Exams*' and in the career '*Profiles*' received relatively low ratings.
- Posters were generally felt to be less helpful for **careers-decisions** than booklets/literature, where '*Life Beyond Exams*' and the career '*Profiles*' received the highest ratings.
- In terms of relaying messages and information **about chemistry**, the young people rated '*Life Beyond Exams*' and the '*Chemists in their element*' posters highly (although the latter were rated less easy to understand by younger pupils).
- **Posters** had an **appeal and relevance to younger pupils** (e.g. those in key stage 3), whilst their helpfulness deteriorated in post-16. In **key stage 4 and beyond**, young people wanted **more detailed information** about careers from chemistry.

4.4 Young people's commentary on the materials: open responses

The young people were asked to provide additional information as to their thinking behind each rating they gave the materials and whether there were any ways they would like to change the material. Such comments are summarised below in Tables 4.9–4.15 providing pictures of pupils' key remarks on each material along with their main suggestions for improving that material.

Table 4.9 Posters – '*Not all chemists wear white coats*'

Perceptions of the material	Clear message	▪ Pupils all liked the title; '*it is very strong and sticks in your mind straight away*' (key stage 3 pupil). ▪ '*It is quite good how it says that not all chemists wear white coats because you think that they are just in labs and things like that, but they are not* really' (key stage 3 pupil); '*I like this one – 'Not all chemists wear white coats' – it's sort of getting rid of a stereotype of a mad scientist*' (post-16 student); '*I like the 'Not all chemists wear white coats' because they show that there is more to chemistry than sitting in a lab bent over a test tube*' (post-16 student).
	Style, font and layout	▪ Pupils liked the large image, the general layout and the light text on a dark background; '*I do think they're really quite attractive*' (key stage 3 pupil). ▪ '*I think the use of a real situation is good, with the environment and everything, relating it* [chemistry] *to other things*' (post-16 student).
	Relevance	▪ '*I think it appeals to kids because they look really active and it's saying 'not all chemists wear white coats', and I think that's really cool, get people interested, because they'll just think it's sitting in an office working, not going outside and doing something, which I think would appeal, because it would make me want to read it*' (key stage 4 pupils).
Improvements	Relevance of image	▪ Pupils opinions, however, were somewhat divided regarding the relevance of the images; *'Maybe the pictures aren't the most appealing pictures they could have chosen. There's more attractive bits of chemistry to be shown – the cutting edge technology in the labs, they discover various drugs or cures – that's maybe more exciting than working on what looks like a building site to me*' (post-16 student). ▪ '*You would see the picture and think 'Well, what is that trying to tell me?*'' (post-16 student); '*It looks like a building site so it should be in the DT room*' (key stage 3 pupil); '*I thought that was physics*' (astronaut poster) (key stage 3 pupil).
	More explicit link to chemistry	▪ Pupils wanted the link between chemistry and the job the person in the image was doing to be clearer and more obvious; '*I think they're pretty cool, but sometimes when I'm looking at them because all the 'Not all chemists wear white coats' is really big and then the explanation is really small, the picture is really big, so you can stick them up where everyone can see them but you don't always really know what the point of them is. It would be nice to have something bigger to say what this chemist's job is, because that just looks like someone trekking through a forest or a river but I don't know what they're doing*' (post-16 student).
	Text size and layout	▪ The text is too small and should be in smaller, more manageable chunks: *'Usually when I'm walking passed stuff I just completely ignore small writing*' (key stage 4 pupil). Pupils felt the layout of this poster led to the writing and information being '*lost*'.

Table 4.10 Posters – '*Chemists in their element*'

Perceptions of the material	Shows diversity of chemistry	▪ '*I think they're really eye catching, and colourful, they're also relating to the student, what they might do in their spare time, like skate boarding. It just relates to them more, if you saw a person in a white coat in a lab you might think of it as a bit boring, but somebody in a skate boarding jumper looks more interesting and exciting*' (post-16 student). ▪ '*I think the posters are good, eye-catching and they make you want to read, they appeal too, with the skate board, I think that's good because you don't link chemistry with something like that, because as soon as you see it you think it will be about sport or something*' (key stage 4 pupil).
	Style, font and layout	▪ Pupils liked the annotated layout of this poster – the text was broken down and manageable – '*I think the boxes are really good because they explain things in a few words, so it doesn't go on and on, so you don't loose interest in it*' (key stage 3 pupil). Pupils also felt the poster was bright and colourful, eye -catching, '*futuristic*' and modern (key stage 4 pupil). Pupils felt the annotated layout helped show how chemistry relates to, and is useful for, everyday life: '*Because you might not be aware of the different types of chemistry and the different things you can do*' (post-16 student); '*it tells you that it's looking at the materials and new paints so it tells you what you can do with a car involved*' (post-16 student); '*It makes you realise how many other things that chemistry is involved in, for example, children and motors* [sic]' (key stage 4 pupil).
	Usefulness in decision making	▪ Some pupils felt this poster may be useful in informing young people's chemistry career decision making: '*They make it attractive, yes, but for someone like me who's not really thinking of it anyway … … But I can see how it would be useful for people who were – it's just ideas that you wouldn't think of, like atmospheric chemists, environmental chemists on this poster. You normally just think in little boxes, but this broadens it out a little*' (post-16 student). '*It would help people who didn't know much about chemistry to think again*' (post-16 student). '*It might help a bit because if you were walking by, thinking 'I'm going to do music' and you see that, you think 'I never knew chemistry was that good, I might do that"* (key stage 3 pupil). All students implied it was the capacity of these posters to show the diverse applicability of chemistry to everyday life that may result in such influencing impacts.
	Appeal to range of interests	▪ Pupils felt the RSC should continue to produce a broad range of posters in this series as they felt the different images appealed to different groups of young people, for example, girls, boys, people who enjoyed sports, etc.
Improvements	Text size	▪ Pupils wanted the posters to have larger text so that they could read the poster easily from a distance.
	Less technical language	▪ Several pupils noted a lack of understanding of the list of chemistry careers at the side of the poster. They requested the use of more everyday language and explanations of what the careers involved. Both key stage 3 and key stage 4 pupils expressed they were put off looking at the poster when they saw what they perceived as '*big*', technical and unfamiliar words.

Table 4.11 Poster – '*That's Chemistry*'

Perceptions of the material	Evoke interest and excitement	▪ This poster evoked the impression that chemistry looked exciting in some pupils: '*This one looks very, very exciting and it looks like there's a lot going on in the whole poster*' (key stage 3 pupil). '*It makes it look quite exciting and interesting*' (key stage 3 pupil); '*I like the style – just the pictures are in your face – like this one is set out in the shape of a wave – it's set out effectively*' (key stage 3 pupil).
	Shows relevance of chemistry	▪ '*They're not actually explaining chemistry; it's explaining what chemistry involves, so it would be like getting more people interested ....*' (key stage 3 pupil).
Improvements	More explicit link to chemistry	▪ However, other pupils were negative about this poster, suggesting the link to chemistry was unclear, there was too much text, too much writing and the writing was difficult. For example, '*I don't actually understand it. The picture doesn't really tell me what it's about straight away. If I was just looking at that by itself I wouldn't know that it was anything to do with chemistry*' (key stage 3 pupil); '*Just judging by the image and the title it doesn't really tell me anything about chemistry*' (key stage 3 pupil). ▪ '*It's quite weird the way it's been all laid out because it doesn't seem to point to chemistry in any way, except for 'That's Chemistry' at the bottom*' (key stage 3 pupil). ▪ Pupils felt these posters needed to make a more explicit link to chemistry. Although, one key stage 4 pupil's thoughtful comment suggests there is a balance to be achieved here: posters that are less obviously about chemistry are more likely to gain the attention of those pupils less interested in chemistry. Conversely, pupils already interested in chemistry are attracted to posters that tell them more about the subject.
	Text size and language	▪ As with all the posters pupils wanted less writing and for the text to be broken down and pitched at a less technical level to aid ease of understanding.

Table 4.12 Leaflet – '*How far have we come with the help of science?*'

Perceptions of the material		
	Relevance and manageability	▪ Pupils generally liked this material, noting its sense of fun, manageability and the relevance of chemistry to everyday life it portrays (particularly conveyed in the images). For these reasons many pupils said they would be more likely to read this material than the '*Life Beyond Exams*' booklet (though some pupils felt the How far… booklet did not give enough information). Pupils suggested the 'How far…' booklet promoted chemistry broadly to a wide audience (was more for 'starters'). Whereas, a material like the '*Life Beyond Exams*' booklet was felt to have a more targeting function as its length deemed it most appropriate to those pupils with an established interest in chemistry. ▪ Relevance and manageability – '*I understand that quite a lot because it's like everyday things, things that you usually do*' (key stage 3 pupil); '*It tells you quite a lot, it's like from the moment you're born you're surrounded by chemistry, it's like telling you it's everywhere*' (key stage 3 pupil). ▪ Appropriateness and manageability – '*Because we don't like to read, I don't think people like to read endless pages of what chemistry is about, for our age group it's good. But then for someone doing A-level chemistry they might want to know a bit more*' (key stage 3 pupil); '*Better than the other because it's more broken up and it's not as long, it's just short bursts of text to tell you what it's about. I would be a bit more likely to read this one* [than '*Life Beyond exams*']' (key stage 4 pupil).
	Questioning title	▪ One pupil liked the questioning title – '*which really involves the reader and makes you think about how far we really have come and if you actually get involved how far will it come*' (key stage 4 pupil).
	Usefulness of chemistry	▪ '*Yes, it gives stuff that it's used for, jobs and that. And it sets it out quite easily. So if you've got past the front cover, it's quite easy to read. It persuades you into thinking well if I do chemistry I'll be helping people. It would persuade me to take chemistry, so I'd give that a 5*' (key stage 3 pupil).
Improvements		
	Front cover	▪ Pupils' main suggestion for improving this material was to make the front cover more enticing. They felt the current front cover was boring and did not give enough information as to what the contents of the booklet would be about: '*I wouldn't specifically pick it up to read. It just looks like any other booklet. It's only got two colours on the front. It needs to be more eye-catching*' (key stage 3 pupil); '*I like posters and leaflets to be understandable, to give you a straight away impression of what you're going to be reading about by just looking at the title and the image*' (key stage 3 pupil).
	More information on jobs	▪ Older, key stage 4, pupils wanted more information than was in this booklet (though liked its accessibility): '*It gives you new ideas about chemistry but it doesn't really push you to take it as a subject. I think it should say if you do this, this is what you can do*' (key stage 4 pupil); '*There's not that much information, nothing about what jobs you can do in chemistry in this booklet*' (key stage 4 pupil).

Table 14.13 Leaflet – '*Life Beyond Exams*'

Perceptions of the material	Manageability	▪ Pupils felt this material was well laid out and manageable to read, noting in particular the chunked text, simple words and clear headings: '*It's quite well laid out, so it's easy to read, in different chunks, it's not just one big page of full text*' (key stage 4 pupil); '*there's enough pictures to separate the text*' (key stage 4 pupil). Pupils also liked the fact there were different mediums for conveying information, for example, the use of flow charts.
	Usefulness in decision making	▪ Pupils felt the material would give them a lot of information and therefore would be the most useful in helping pupils' decision making. For example, '*You tend to imagine chemistry as just a bunch of old people with beards, in a laboratory, wearing white coats and 'pippetting' things. So it's nice to have information about what else you can do, about different roles that chemists play, it opens it up*' (post-16 student); '*It's helpful because it tells you what to actually do with chemistry, because I'm not really sure what you can do with it – it tells you lots of different options*' (key stage 4 pupil). ▪ Pupils thought the material would be potentially useful in some young people's decision making – '*People who didn't know what they wanted to do and were just trying to get ideas and think, 'OK, I might be quite good at chemistry at school, maybe I could do something with that', and it would show them what they could do*' (post-16 student); '*It would be useful for me so I probably should go and find one of these*' (post-16 student).
Improvements	Limited audience	▪ The booklet is large and dense with information, therefore other pupils felt only those pupils who were seriously interested in chemistry already would take the time to read it – '*Unless you are proper into chemistry I wouldn't really pick it up and have a look – it looks a bit heavy*' (post- 16 student).
	Accessibility	▪ Pupils felt the booklet would be more useful if it got handed out to them (rather than the onus being on them to pick it up to read) – '*If somebody said 'read this' then I would find it useful*'.
		▪ Pupils felt although the material provided a lot of information it was not delivered in their preferred medium; they would rather get careers information from a person, than a booklet – '*I'd rather talk to someone*' (post-16 student).
	More on chemistry course content	▪ Some pupils felt the booklet provided information on chemistry careers but not enough about the subject content of future chemistry study.
	More relevant images	▪ Pupils were critical of the images (inside and the front cover), suggesting they needed to be more interesting and related to chemistry: '*It's just people looking like they're thinking about things which seems a bit weird*' (post-16 student); '*They're okay but lots of them are just people, they're not really related to chemistry that much*' (key stage 4 pupil).

Table 4.14 Leaflet – Chemistry career profiles

Perceptions of the material	Personal perspective	▪ Most students loved the personal perspective given in the profiles; '*It's realistic. You can actually see what people have done who would have been like you*'. The profiles tell you about people who've '*been there and done it*'; '*I like it because it tells you about the person and then gives a personal view*'. However, a number of pupils felt the specific nature of the information rendered the material irrelevant to them personally and individually.
	Applicability of chemistry study	▪ Students felt the profiles were very effective in raising their awareness that chemistry study was relevant to a diverse range of careers and opened career pathways, rather than limited them; '*It kind of shows that it's not so limiting as people think, doing a science degree. Because people always think if you want to do a science degree that's you locked in, it's good to show that it's not limiting in that way*' (post-16 student). '*One thing I am quite worried about with university, is what sort of jobs I can get at the end of it. Whether I just go out and get a job just because I've got a degree, or whether it would be something that interests me. These show that with a specific degree you can do quite a lot of things, and that is very helpful*' (post-16 student); '*Yes, they show what you can do after you do chemistry. And as a career you don't have to do a sciencey-lab one*' (post-16 student).
	Style and layout	▪ Students liked the layout of this material and felt it would provide a useful reference to dip into, as opposed to a booklet where they might need to read from front to back.
	Salary information	▪ Students liked the fact the material provided information on expected salaries related to different career routes.
Improvements	Limited audience	▪ Despite young people's positive comments about the material, and the range of careers it covered, some pupils still felt unless they had some prior interest in studying chemistry and what they can do subsequently they would not be likely to even look at the material; '*This is more the sort of thing I would look at if I'd already decided to do chemistry*' (post-16 student); '*I wouldn't read it if it was chemistry because I would get a bit bored. Personally, chemistry is not my thing*' (post-16 student).
	Manageability	▪ Some students felt the profiles contained too much text and technical language (e.g. analytical support), rendering it '*over-whelming*' and '*waffley*'. They suggested the text may be made more manageable with bullet points and more images.
	More relevant images	▪ Students were critical of the images, suggesting they would like to see more images and more images of people doing the profession, to give more idea of what is involved; '*I might like to see them actually in their job*' (post-16 student); '*Not that relevant, just pictures of people*' (post-16 student).
	More information on chemistry jobs	▪ Students wanted more information on chemistry-related jobs and what these entail, '*It needs to say, 'If you get a chemistry degree, you can be like this'*'(post-16 student).

Table 4.15 Leaflet – '*Choosing a degree*'

Perceptions of the material	Manageability	▪ Students liked the manageability and accessibility of these materials, for example, they felt they were a nice length, they liked the use of bullet points and small chunks of text: '*I like the bullet points to break it up, as opposed to just being a chunk of writing. It's all under different titles, which again breaks it up. It makes it easy to digest*' … '*It's not too much, so you don't look at it and think I can't be bothered to read that*' … '*I would read it – it's not a massive big book, just little*' (post-16 students). Students felt the small leaflets acted as a good 'starter', but that if interested they may need additional information.
	Appropriateness	▪ Post-16 students felt the language and content was appropriate to their age group: '*Because I've been looking at courses some of the language is quite familiar, like names and types of degrees you can get, but I suppose if you were younger in the school you wouldn't particularly understand some of them like the masters in chemistry it says here*' (post-16 student).
	Relevance	▪ Some students felt the leaflets showed the relevance of chemistry: '*It's like stuff that people are interested in now, like the environment and bodies and stuff*'; '*It shows that there's more to chemistry than meets the eye, and it can be applied to lots of disciplines*' (post-16 students).
	Attractive and appealing	▪ Some students liked the design and images on the leaflets, for example, noted how they looked '*funky*', '*innovative*' and '*modern*'.
Improvements	Images, front cover and title	▪ Many students felt the images did not relate clearly to chemistry: '*They look a bit random, the fish and cards, I'm not sure …. From the picture I wouldn't know it was about chemistry*' (post-16 student); '*Yes, they look good, but they don't really have loads to do with chemistry from what it looks like*' (post-16 student); '*I'm not quite sure about some of the images - why they are there*' (post-16 student). Some students felt the front covers were too busy and unclear and that the title needed to be clearer and punchier: 'It's *annoying, there's lines of text in between lines of text, so without concentrating I can't read that, so I don't like that. It's a bit everywhere, everything's all over the place*' (post-16 student).
	Salary information	▪ Need more rigorous, persuasive information. For example, '*No, you need to have numbers, pay, 'X graduates earn this much'. You need to have that in bold writing somewhere, otherwise people aren't going to do three years of work if they don't know these things*' (post-16 student); '*I wasn't too impressed with the content. Most people who have gone through choosing their A-level courses have some idea already; a lot of this is not very necessary or very influencing*' (post-16 student).
	More explicit link to chemistry	▪ Make the link to chemistry more explicit, as the information needs to appeal to people who are interested in chemistry (e.g. more obviously chemistry related images on front covers). One student felt the leaflets were trying to appeal to too broad an audience and in so doing were not providing the information those interested in chemistry needed: '*I think they should accept that it's a difficult subject and it's not for everyone*' (post-16 student).

Overview: Young people's commentary on the materials (open responses)

Throughout the discussions with pupils, the **amount and layout of text on poster material** was a recurring and prominent issue. Pupils recommended that:

- posters should be readable from a distance – **less written information**, **larger font** and even more emphasis on visual messages was recommended.
- where text is included, the layout on posters should involve **smaller chunks of text**, for example, using bullet points, annotation and 'text boxes' – the young people particularly liked this method on the '*Chemists in their element*' posters.

Pupils also made a number of recommendations regarding the need to **enhance the relevance of the materials** by making a more obvious link to chemistry. Pupils recommended that:

- the '*Life Beyond Exams*' booklet, chemistry career '*Profile*s' and '*Choosing a degree*' leaflets be accompanied with **images of chemistry careers and further study 'in action'**
- the front cover of the '*How far have we come with the help of science?*' booklet be redesigned to **convey more relevant, modern and engaging images of science**.

4.5 Young people's perceptions of the impact of the materials overall

Having consulted the young people on each of the materials, the young people were asked to consider the materials as a whole 'package' and to rate the extent to which the materials are perceived to:

a) help with decision making with regard to taking chemistry as a subject and/or for a career (see Table 4.16)

b) have an impact on attitudes towards chemistry as a subject and/or for a career (see Table 4.17)

c) make a difference to actual decisions (e.g. more or less likely to take chemistry as a subject and/or for a career) (see Table 4.18).

As shown in Tables 4.16, 4.17 and 4.18:

- Overall, the materials were felt to be **very helpful in decision making** about chemistry (the vast majority gave ratings of 4 or 5 out of 5 on a five-point scale); '*This is exactly the sort of information you need when you're deciding what to do*' (post-16 student). Although this was often qualified with comments on the accessibility of the materials, e.g. 'helpful *if* we saw

them', '*it depends where the materials are available, it depends where they are advertised*' (student,).

- In contrast, the extent to which the young people felt the materials **made a difference to their attitudes towards chemistry was less emphatic** (just over half of the sample gave ratings of 4 or 5 out of 5).

- In terms of overall impact or influence on choice, there is some indication that the young people feel **more likely to choose/continue with chemistry** having seen the materials (almost three fifths of the sample responded in this way) (although it should be noted that many interviewees qualified this with comments such as 'would be more likely to *consider* taking chemistry').

Table 4.16 Young people's perceptions of the extent to which the materials help with decision making with regard to taking chemistry as a subject and/or for a career

The table shows the number of young people responding to each number on the five-point scale to rate the extent of the overall helpfulness of the materials (Scale: 1 = not at all; 5 = a great deal)

Helpfulness regarding decision making	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
Overall usefulness	115	0	5	16	74	20	94	**82%**
Post-16 responses	45	0	2	5	30	8	38	**84%**
Key stage 4 responses	29	0	1	3	20	5	25	**86%**
Key stage 3 responses	41	0	2	8	24	7	31	**76%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Caution is needed when interpreting percentages on less than 100 respondents.
Source: NFER interview survey on RSC materials 2006.

Table 4.17 Young people's perceptions of the extent to which the materials have an impact on their attitudes towards chemistry as a subject and/or for a career

The table shows the number of young people responding to each number on the five-point scale to rate the extent to which the material make a difference to attitudes towards chemistry (Scale: 1 = not at all; 5 = a great deal)

Impact on attitudes towards chemistry	Frequency of responses (N)						Number giving rating of 4 or 5	% giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5		
Overall impact	113	3	13	35	44	18	62	**55%**
Post-16 responses	43	2	5	14	14	8	22	**51%**
Key stage 4 responses	30	1	5	8	13	3	16	**53%**
Key stage 3 responses	40	0	3	13	17	7	24	**60%**

Columns give the number of respondents apart from the final column, which is the % of respondents giving a rating of 4 or 5. % is calculated from the number of respondents.
Caution is needed when interpreting percentages on less than 100 respondents.
Source: NFER interview survey on RSC materials 2006.

Table 4.18 Young people's responses on whether the materials make a difference to their actual decisions regarding chemistry
(i.e. are they more or less likely to choose chemistry as a subject and/or for a career having used/seen the materials)

The table shows the number of young people responding to each of the responses: 'more likely', 'no change', 'less likely' to choose chemistry.

Impact on actual decision	Frequency of responses (N)				% of responses		
	Number of respondents	More likely	No change	Less likely	% more likely	% no change	% less likely
Overall impact	127	72	53	2	**57%**	**42%**	**2%**
Post-16 responses	55	25	30	0	**45%**	**55%**	**0%**
Key stage 4 responses	30	19	9	2	**63%**	**30%**	**7%**
Key stage 3 responses	42	28	14	0	**67%**	**33%**	**0%**

Columns with % are calculated from the number of respondents. Caution is needed when interpreting percentages on less than 100 respondents.
Source: NFER interview survey on RSC materials 2006.

When broken down by age-range:

- The materials were felt to be **even more helpful in overall decision making by the older pupils** (those in key stage 4 and post-16) than the younger pupils (those in key stage 3) in the sample.
- In contrast, the **younger pupils** (i.e. those in key stage 3) were more likely to report **positive changes overall in their attitudes** towards chemistry, than the older pupils. Indeed, one-fifth of the key stage 4 sample and just under one-fifth of the post-16 sample responded with scores of 1 or 2 out of 5 – indicating no change at all, or a little change only in their attitudes towards chemistry.
- In terms of overall influence on choice, two-thirds of the **key stage 4** sample and over two-thirds of the **key stage 3** sample felt that having seen these materials they would be **more likely to take chemistry** further as a subject and/or for a career. However, the most common response at **post-16 was 'no change'** – i.e. by post-16 it would appear too late to change young people's minds/directions.

Interviewees qualified the ratings they gave to the above questions with open comments, suggestions and recommendations. To get the most of the materials in decision making, the young people emphasised the importance of such issues as **the accessibility of the materials**; **how, when and where the materials are used**; and an **appreciation of the full range of materials** – '*the materials would be useful if you use them all together*', '*they're all slightly different so you need all of them*', '*all useful in different ways*', '*each one tells you something different about chemistry*' (young people).

In terms of influencing actual choices, the young people felt the materials would **have most impact on the undecided** and/or for those **already wanting**

to take chemistry further but who were unsure of or did not know about the career progressions this might lead to.

By post-16 however, many young people had made career-route choices, and the potential **impact of the materials** on their decisions seemed **diminished** – '*If you are not interested in chemistry the materials will not persuade you*' (post-16, student). '*To be honest, I don't think many people would read them unless they were specifically researching the subject ... I don't think other people would just pick them up out of general interest ... as soon as I decided that I wanted to do history I've focused on that, I would not look at any of this to be honest ...*' (post-16 student). For some young people, the materials appeared to have limited influence: '*when you're looking at them you think* '*Oh yeah'. But when you go away, you just go back to what you usually think* [about chemistry]' (post-16 student).

In addition, a number of young people felt that there were *other* more **influential sources** than materials, including **chemistry lessons**: '*It is more about the teaching that pupils get, the teaching and the lessons and the amount of experiments that they can do that make pupils enjoy it*' (pupil, key stage 3). These and other themes are explored further in Sections 4.6 and 4.7.

Overview: Young people's perceptions of the impact of the materials overall

- The materials seem **most useful for decision making** in **key stage 4**. They also have some potential for impact on choice at this age: these young people feel somewhat more likely to consider chemistry for a subject and/or for a career.
- Although the materials are perceived to be very useful by post-16 students, for the majority in this phase of education it would appear too late to have an influence on choice.
- The materials are **most influential in terms of attitudes towards chemistry** at **key stage 3** – i.e. the younger pupils. Here, the materials also had a perceived impact on these young people's likelihood of taking chemistry for a subject and/or for a career.
- Taken as a whole, these results suggest that key stage 3 is a point when young people's attitudes *and* choices can be influenced (i.e. young people are receptive to possibilities and opportunities). The question is raised, is it also possible to increase the careers-advice/usefulness/decision-making function of the materials for this age group? (Although as we shall see in Section 4.6, the young people themselves suggested an emphasis on material which has motivational and attitudinal impacts for younger children, rather than a careers-advice function.)
- Likewise, at key stage 4, whilst the materials might have a role in decision making, could the materials have a greater role in attitude forming or changing attitudes towards chemistry (for example, through opening up wider possibilities for young people regarding chemistry?)

4.6 Young people's suggested improvements and recommendations for the materials overall

Having consulted the young people on each of the materials and gained their overall perceptions of the impact or potential impact of the materials, the research also sought the young people's broader perceptions and recommendations regarding the materials overall. Broader questions included whether they *would make any changes to the materials*; and *when* they would like to use/see them.

A notable minority of pupils (24) felt that they would not make any changes to the RSC materials, reflecting pupils' general approval and positive views on the materials. However, the young people made a number of general suggestions for how they would change the materials (in addition to the specific improvements for each material already presented in Section 4.4). Indeed, a number of themes emerged in young people's suggestions for improving the materials (some of these overarching suggestions have already been alluded to in the discussion in previous sections). These themes, discussed more fully here, include:

- when the young people would like to see/use the materials (Section 4.6.1)
- the accessibility/availability of the materials (Section 4.6.2)
- careers information and relevance to jobs (Section 4.6.3)
- relating to chemistry (Section 4.6.4)
- audience (Section 4.6.5).

4.6.1 Young people's recommendations for when they should see/use the RSC materials

The young people were asked when they would like to use/see the RSC materials. Figure 4.1 shows the range of years nominated by the young people (across the whole sample and by age-range) for when they would like to see/use the materials.

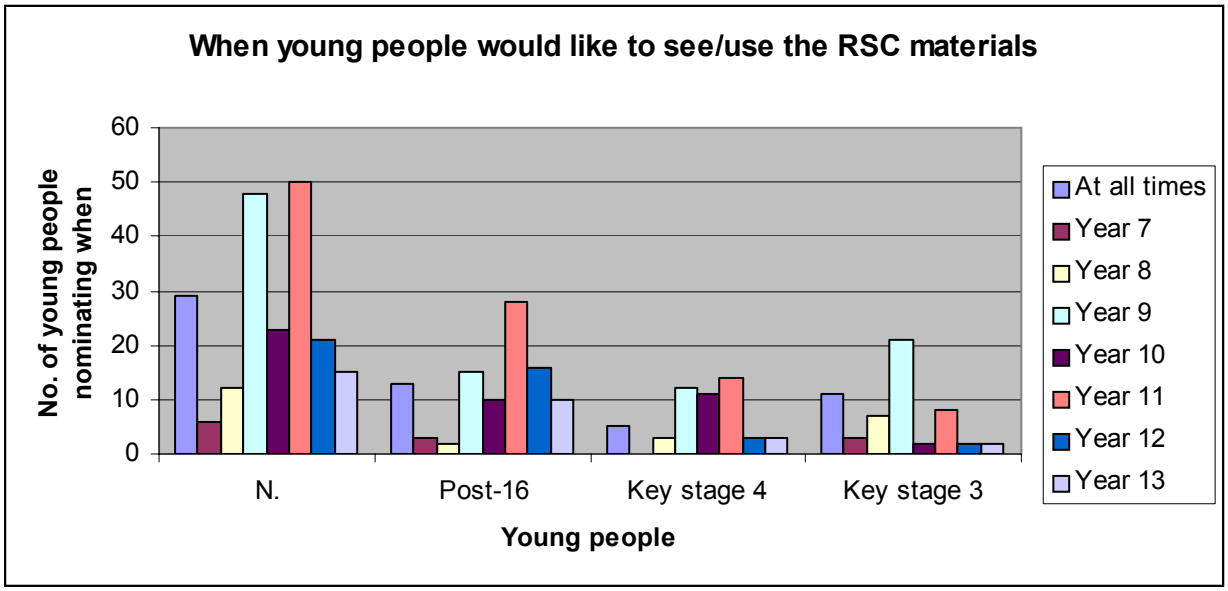
As shown in Figure 4.1:

- young people regarded **Year 9** and **Year 11** as key age groups requiring careers support
- **key stage 3** pupils in particular felt **Year 9** to be a crucial point for when they would like this kind of careers information. With hindsight, **post-16 students** reported that they needed careers support of this kind in **Year 11**
- a significant number of pupils felt the materials should be available to young people **at all times throughout their school career** (including 'as early as possible' from some young people)

- Years 12 and 13 were also key years when young people felt they would need careers guidance in order to support Further and Higher Education decision making.

Figure 4.1 Young people's views on when they would like to see the RSC materials

The table shows the no. of pupils identifying each time period/year group. Interviewees could nominate more than one year group.



Source: NFER interview survey on RSC materials 2006.

Young people appear to need support at two important decision making periods: prior to GCSE and A-level selection. Several pupils noted they had seen these materials too late, having already chosen their A-level subjects or embarked on a chosen career pathway.

Pupils' comments suggested that chemistry information should motivate general interest in the subject lower down the school (rather than have a direct focus on careers information). As shown in Section 4.5, it appears to be at a younger age (e.g. key stage 3) when young people's attitudes *and* choices can be influenced. Materials which have motivational influences may impact on pupils' attitudes towards and enjoyment of chemistry; and *may*, in turn, impact on actual choice.

Indeed, pupils' qualitative comments suggested there was a large group of key stage 3 pupils who enjoyed chemistry but were undecided as to a future study and career direction. The fact that by post-16 this category had virtually disappeared (with students in our sample now being either science continuers – and occasionally chemistry continuers – or non-chemists) reiterates the importance of careers guidance targeted at lower age groups.

4.6.2 The availability/accessibility of the materials

A significant number of pupils raised the **accessibility of the materials** as an area requiring improvement. This included both where the materials were available, and how they could be used and considered. Young people felt that (in order of frequency):

- the posters should be up on walls and the leaflets available in classrooms: '*if there were lots of them around, you would definitely notice them and they would help a lot*' (student, key stage 3)
- **teachers** should have a role in helping pupils to use and consider the materials, at **appropriate times/in appropriate lessons**. As one boy suggested: '*If we were given them at the right time, then yes* [they would be helpful], *not handed out in registration or at the end of the day, because they just get thrown in the bin. How about in PSE days when we're thinking about careers, or in a chemistry lesson about chemistry careers and how chemistry affects the future?*' (post-16 student)
- pupils need to be able to **take the materials home** or even have them sent to their home, in order to look at them at their leisure: '*I'd say that the* [booklets, leaflets, etc] *would be better if they were, like, handed out, if you had your own copy and you could read it in your own time, then I would look at it*' (post-16 student)
- the materials should be available in **libraries** and **sixth form common rooms**.

Pupils also made a number of recommendations regarding further availability of chemistry careers information, including:

- **within school – clearer direction as to where to go for more information**; suggestions included boxes of leaflets in holders below posters and the name and contact details of a person they could speak to
- **from the RSC** – the provision of **more web-based information** and that such web sites should be linked to career profiling and searching programmes. As one student comments, *'there's so much of that kind of information easily accessible on the web – it's just there, so I don't have to go to the library and get it out – it's slightly lazy really but ...*' (post-16 student).

4.6.3 Careers information and relevance to jobs

The young people felt that the careers information in the materials should show even greater relevance to jobs. Their recommendations included:

- the materials to provide **more information about what chemistry careers actually involve**, for example clearer explanation of what the person in the image was doing (i.e. '*this is what chemists do'*)

- **more information about what different chemistry courses involve**, the content of study, as well as **route maps** (visual messages) of where different qualifications can lead to (i.e. '(exactly) *how will I get there?*')

- **more and specific information about salaries** associated with different chemistry jobs (i.e. '*what will I earn?*')

- information to be included on **less high profile chemistry** related professions

- more **local and realistic pictures of chemistry employability.** The pupils themselves felt that some of the images in the RSC materials conveyed unrealistic perceptions of what chemistry jobs would entail, and they expressed scepticism about the demand for such exciting and exotic careers in their locality ('*where can I work?*')

- **more information from a personal perspective** (i.e. '*this is what I do*') Indeed, this was a feature of the careers '*Profiles*' material that was invariably approved by the students. A comment from one post-16 student suggests information from personal experience is more credible and genuine: '*What I want is quotes – if it's quoted then I would look at that to see what they have to say, because I value somebody who has actually been through the degree. I always take notice of that*.'

4.6.4 Relating to chemistry

As well as relevance to jobs and careers, the young people felt that the content of the materials should make clear links to chemistry in everyday life and in the curriculum. Pupils wanted:

- the **images** to be more **strongly and directly associated with chemistry** and for this link to be made obvious

- chemistry careers information integrated with materials providing chemistry subject knowledge (a small number of pupils suggested this). Pupils suggested the RSC should provide **materials that help pupils actually learn chemistry** and relate to the topics they're studying, as well as give them chemistry careers information

- the materials to **promote the usefulness and relevance of chemistry in everyday life**. For example, pupils felt the '*Chemists in their element*' posters did this effectively by showing how chemistry is used in products and materials.

4.6.5 Audience

A theme in young people's responses referred to the 'target' audience of the materials. Some young people felt that the RSC materials should be targeted to the whole pupil population, whilst others (usually those not interested in taking chemistry further) felt that it would be more effective to target materials to the 'undecided' and to those who are already interested in chemistry.

A handful of respondents felt the RSC should **simplify the language** and **avoid technical terms** on the materials where ever possible in order to improve chances of engaging a range of abilities (some pupils felt they would be put off reading the material when they see a word they do not understand). Several pupils noted the effective use of a questioning title in order to hook readers in to discover the answers.

On the whole there were **no significant differences by gender** in these young people's opinions across the full range of areas discussed; careers information and guidance perhaps needs to be reasonably similar for boys and girls. The range of RSC careers guidance materials appeared to appeal to males and females equally.

Overview: Young people's suggested improvements and recommendations for the materials overall

Three key recommendations emerge in pupils' overall suggestions for the materials:

- to be **available at all times** (particularly noted by girls) and especially at **key early decision points** (including Year 9 and Year 11) as by Year 12 it can be too late
- to be more **accessible**, including some **directed use and consideration of the materials** (e.g. by teachers, science and PSE staff), as well as the availability of **personal copies** for use in own time
- to show **even greater relevance to chemistry careers** – relaying 'this is what chemists do'; 'how will I get there?'; 'what will I earn?'; 'where can I work?'; and personal statements relaying 'this is what I do'.

4.7 Attracting young people to chemistry: young people's other perceptions and recommendations about chemistry and careers advice

This final section on the young people's views draws together their broader perceptions and recommendations regarding aspects of chemistry and careers advice. It covers: where they get their careers advice from; how they feel the RSC materials compare with other sources of information and advice; and what else they feel might be done (e.g. by schools, teachers, the RSC and so on) to attract more young people to chemistry study and chemistry careers.

4.7.1 Where pupils get their careers advice from

Table 4.19 shows the range of responses from the young people as to where they get their careers information and advice from. Respondents could mention as many aspects as they wished (in an open question).

Table 4.19 Sources of careers information and advice
N = no. of pupils identifying each source

	Key stage 3	Key stage 4	Post-16
Subject teachers	8	10	15
Careers advisor	9	15	30
Other people	17	7	11
Materials	6	3	22
Websites/internet	9	10	30
Careers library	8	3	15
PHSE lesson	14	4	4
Careers event	6	4	5
Parents	14	14	6
Own experiences	9	4	0
Media	4	6	0
Other	0	1	0

Source: NFER interview survey on RSC materials 2006.

As shown in Table 4.19, the most commonly cited sources of careers information and advice by these young people are:

- **careers advisors** and **websites/the internet**
- in **key stage 3**, **parents**, **PSHE lessons** and other **people**, such as family members doing a course or job they were interested in
- in **key stage 4**, **careers advisors**, parents and also **subject teachers** and the use of the internet
- **in post-16**, students' own **pro-active research** to obtain careers information, e.g. from **materials**, **websites** and the **careers library** as well as careers advisors and subject teachers.

Interviewees across the three age groups were not consistent in their views on where they got most of their careers information from. This suggests a need for careers information to be tailored to the different age groups.

4.7.2 Comparing the RSC materials to other sources

The young people were asked about how they felt the RSC materials compared to other sources of careers information and advice that they had used (e.g. such as the sources mentioned in 4.7.1 above).

Overall, in open responses slightly more pupils commented on less useful aspects of the RSC materials than on more useful aspects (58 interviewees and 35 interviewees respectively). The young people's open responses were categorised as shown in Table 4.20 below.

Table 4.20 shows a striking response from pupils in **key stage 3** that **the materials were less useful than speaking to real people**. For example:

> *Definitely, I prefer to talk to someone else than look at a poster because most people make the best things on a poster but I'd like to know the negative side of it as well because on posters they only say what's good about it.*
>
> Key stage 3 pupil

> *It's better to get information from a person, rather than a poster, because a poster can tell you what they want you to know, but a person can tell you what you want to know.*
>
> Key stage 3 pupil

Responses from the post-16 students suggest a focus on **materials as a compliment to other sources** of information, such as careers advisors and websites (which, in some cases, they prefer). One student commented, '[Materials] *are a useful thing to have alongside because they inform you quite well, but you need to have the discussions as well as the materials*' (post-16 student).

Table 4.20 Young people's perceptions of how the RSC materials compare to other sources of careers information and advice

N. = no. of young people's responses in the category

	Key stage 3	Key stage 4	Post-16
Complementary to other materials	2	-	6
'A good starting place' (as a general source of information)	-	4	3
More in depth information	1	1	5
More accessible	4	-	2
More appealing	-	1	4
More useful than careers lessons	-	1	-
More factual/impartial info	4	1	-
Same – materials on a par with other sources	3	2	2
Less useful than careers advisors	2	1	3
Less useful than media	1	3	1
Less useful than parents	2	2	1
Less useful than websites	-	2	7
Less useful than real people	13	7	3
Less information than other sources	2	-	2
Less attractive than other materials	-	1	-
Less realistic picture of career conveyed	1	-	1
Less relevant unless already interested in chemistry	-	1	1
Less useful than pupil's own experiences	1	1	-
Less useful than seeing the job in action	1	1	-
Less useful than careers lessons	2	-	-

Source: NFER interview survey on RSC materials 2006.

The young people's comments on careers information and guidance in general also suggested a number of features that might contribute to effective careers guidance. These include:

- the **tailoring of careers guidance information** and activities to meet an individual's own needs and enquiries (as discussed in Sections 4.7.1 and 1.5, some tailoring by age group might be appropriate)
- **directed and active support from advisors and teachers** (rather than careers exploration activity as entirely self-directed by the students): '*one it's easier, and two, it's normally a necessity as well, whereas with these* [the RSC materials] *it's more up to you*' (post-16 student). '*In* [careers elements of PHSE] *lessons you have to do lessons but you can choose not to read posters*' (key stage 3 pupil).

- the extent to which young people **trust the source of the information** – in their view, does it present genuine, believable and realistic information? To some extent these young people were cautious about written careers material, being aware of its promotional nature, e.g. '*You don't always believe what you read*' (key stage 3 pupil); '*because I would just look at it and think it was quite good but I wouldn't really read it and think it was that serious*' (post-16 student). Some felt that 'people' themselves provided a more trustworthy source of careers information. However, many of the young people in this evaluation felt that the RSC materials did provide this more impartial and unbiased information; '*I quite like the posters more, because rather than with family, family sort of pressure you into doing things. The posters help make up your mind but they don't pressure you into doing anything*' (key stage 3 pupil).

4.7.3 Young people's perceptions of what else could be done to attract young people to chemistry for a subject or career

Finally, the young people were asked whether they thought there was anything else that could be done to attract young people to chemistry for a subject or a career. The young people's responses referred mainly to the **chemistry curriculum** and to **chemistry careers advice and promotion**. The most frequent suggestions (in order of frequency) for how to attract more young people to chemistry included:

- the chemistry curriculum to be more 'fun' (including 'good' and 'fun' teaching of chemistry)
- more opportunities to do practical chemistry and experimentation
- the chemistry curriculum to be less difficult
- to provide careers talks from those 'in the know'
- to provide events, demonstrations and summer schools (with an emphasis on practical activities and experiments)
- to promote chemistry careers through TV or media advertising (similar to army and teaching adverts)
- to increase promotion of the broad range of jobs available within the field of chemistry, and the applicability of chemistry to a range of careers
- to make more clear the relevance and necessity of chemistry to everyday life – both through promotion and in the curriculum
- to provide more chemistry careers information from chemistry teachers (talks about what different degrees and jobs involve).

There seemed to be some differentiation in pupils' recommendations for making chemistry study and careers more attractive. Students who were chemistry positive were more likely to make recommendations regarding the **type of information** that was needed, the medium of this information and what should be promoted about chemistry. Students who were not chemistry positive were more likely to suggest the need to improve the **chemistry**

curriculum, for example, make it less difficult, more fun, more practical and more relevant and the need to overcome stereotypes – which perhaps they themselves held.

Overview: Attracting young people to chemistry

Whilst overall, **careers advisors** and **websites** are young people's most common sources of careers advice and information, across the age groups different sources are required.

- In **key stage 3**, **parents and family**, and **PSHE lessons** are key sources. Their preference for careers guidance from people and 'those in the know' over materials in general was also striking.
- In **key stage 4** the main careers informants include **careers advisor**s, parents, and also **subject teachers**.
- In **post-16**, students seem to be undertaking much more **pro-active research** through **materials**, **websites** and the **careers library**.

These findings would seem to have particular implications for the means in which careers information is presented at different age groups.

In addition, in order to attract young people to chemistry study and chemistry careers, young people felt that the **relevance, enjoyment and manageability of the chemistry curriculum** could be improved, in particular via **practical application.** Likewise, they felt that careers information should promote the relevance of chemistry.

4.8 Summary and points for action

A number of key themes emerge from the young people's views presented in this section of the report, with possible points for action. These are: the way in which the materials are available to, and used by, young people; the range of 'functions' that the different materials have; the impact of the materials across the age groups; targeting careers advice across the different age groups; and promoting the relevance of chemistry and chemistry careers.

The way in which the materials are available to, and used by, young people

- Given the varying degrees of familiarity with the materials by the young people, and mainly self-directed usage, young people's recommendations for improving the accessibility of the materials might be considered, for example: greater **directed use and consideration of the materials** by teachers, science and PSHE staff, as well as the availability of **personal copies** for use in own time; and targeted use of such materials at key '**early decision points**' (including Year 9 and Year 11, and earlier). By Year 12 it can be too late.

The range of 'functions' that the different materials have

- Given the range of 'functions' that the different materials were perceived to have by the young people (e.g. the immediate *appeal and promotional function* of the posters e.g. showing the wide-ranging aspects of chemistry; the *careers-decision-making function* especially of the chemistry career '*Profiles*'; and relaying sometimes new *understanding about chemistry*, e.g. via '*Chemists in their element*' posters and '*Life Beyond Exams*'), it would seem that **a variety of materials is required**. However, with young people's somewhat unfamiliarity with some of the materials, consideration might be given to '**branding**' across the RSC range.

The impact of the materials across the age groups

- The materials had different impacts across the age-ranges. Key stage 3 appeared to be a time when both *attitudes towards* chemistry and *potentially actually choosing* chemistry could be positively influenced by the materials; at key stage 4, the materials were most useful for *decision making*, with some likelihood of being encouraged to choose chemistry; whilst at post-16 both attitudes and actual choice were least likely to change.

- These findings prompt a 'two-pronged' question: i) is it possible to increase the impact of the materials in other areas? (For example, to raise the careers-advice/decision-making function of the materials at key stage 3); or ii) is it possible to target the materials even more towards the areas where the young people appear to respond? (For example, at key stage 3, where they are responsive to changing *attitudes*, young people might be encouraged to use the materials such as the posters, which had an appeal and relevance to younger pupils).

- The findings from the young people would seem to suggest both prongs might be required here. The young people themselves suggested that chemistry materials should motivate and stimulate interest around chemistry for younger pupils, rather than have a direct focus on careers information. However, in key stage 3 there was a large group of pupils who enjoyed chemistry but were undecided as to a future study and career direction. Could it be that greater attention to chemistry careers information (such as chemistry career-route details) earlier on in secondary education might be helpful to young people?

Targeting careers advice across the age groups

- The range of the young people's opinions on the materials, careers-advice and their attitudes towards chemistry suggests the importance of tailoring careers advice to individuals. It is likely that a mixture of careers-advice and promotional activity works, rather than any one of these sources on its own.

- However, consideration might be given to the way in which careers advice/sources of information are used across the age groups. Whilst overall, careers advisors and websites are young people's most common

sources of careers advice and information, across the age groups different sources are preferred. For example, is it possible to enhance RSC **careers activity from external sources** at **key stage 3**, given their preference for careers guidance from people and 'those in the know'? At **key stage 4,** targeting resources towards supporting **careers advisors** and **subject teachers** in their usage of careers-advice materials and activities might be opportune. And at **post-16**, young people's predominant use of **websites** might be exploited.

- On the whole there were **no significant differences by gender**; careers information and guidance perhaps needs to be reasonably similar for boys and girls. The range of RSC careers guidance materials appeared to appeal to males and females equally.

Promoting the relevance of chemistry and chemistry careers

- A key theme in the young people's responses was for **even greater promotion of the relevance** of chemistry and chemistry careers – both within the curriculum and in the **content** of careers materials such as those produced by the RSC. For example, to include detail covering, 'the work that chemists do', 'how will I get there?'; 'what will I earn?'; 'where can I work?', and personal statements relaying 'this is what I do'.

- Making changes to some elements of design and layout might also enhance 'relevance'. Examples include: greater use of annotation and text boxes on posters (enhancing the textual message whilst not detracting from the visual appeal); showing images of chemists *at work* on the career '*Profiles*'; changing the front cover of '*How far have we come with the help of science?*' to reflect science relevant to the 21st century.

5 School staff and stakeholders' perceptions

5.1 Introduction

This section describes the school staff and stakeholders perceptions of the materials. It draws on the responses from interviews with 36 chemistry staff and 16 careers staff from 30 schools, as well as interviews with 10 other stakeholders.

This section sets out:

- school staff and stakeholders' **perceptions of the materials**, including: the extent to which they have used and/or seen the materials; the extent to which they find the materials appealing and useful; comparing the materials to other sources; their continued use of the materials; and their perceptions of their overall impact on young people (Section 5.2)
- school staff and stakeholders' **suggested improvements and recommendations** for the materials overall (Section 5.3)
- school staff and stakeholders' perceptions for **what else might be done to attract young people to chemistry for a subject or a career** (Section 5.4)
- a summary of staff and stakeholders' views (Section 5.5).

5.2 School staff and other stakeholders' perceptions of the materials

This section details the extent to which school staff and stakeholders have used and/or seen the materials before and the extent to which they find the materials useful and appealing.

5.2.1 The extent to which school staff and stakeholders have used/seen the materials

Chemistry, careers staff and other stakeholders were asked which of the RSC careers advice materials they had seen and/or used before. Overall, there was a range of familiarity with the materials. Table 5.1 below displays the interviewees' familiarity with the materials, broken down according to interviewee type: chemistry staff, careers staff and other stakeholders.

As shown in Table 5.1:

- **most chemistry staff had seen and were using the posters**, in particular the '*white coats*' posters
- just under **half the chemistry staff** were using the '*Profiles*' booklet

- the **other stakeholders** were familiar with **a range of the materials**, in particular with the '*Profiles*'.

Table 5.1 Staff and stakeholders' familiarity with the materials

	Chemistry staff N = 36	Careers staff N = 16	Other Stakeholders N = 10
White coats	31	6	3
Elements	20	4	5
That's Chemistry	6	0	2
How far have we come …	5	3	2
Life Beyond Exams	9	5	3
Chemistry career profiles	15	5	5
Choosing a degree	4	4	2

Note for the 'That's Chemistry' posters, fewer interviewees were asked if they'd used/seen them before as this series came into the evaluation at a later stage.
Source: NFER interview survey on RSC materials 2006.

In addition:

- **one-third** of the chemistry staff reported that they **had not seen** or used any of the materials before
- **just under half** the chemistry staff responded that they had only seen the **posters**
- some of the **careers staff** reported using the **booklet materials** more so than the posters, though they were often familiar with the posters from displays around the school.

Some of the careers staff who were not familiar with the materials felt this was due to the fact they saw a lot of careers material and could not recall this sample specifically, commenting that the RSC materials may well be in use in the careers library. Also some respondents were familiar with other versions of RSC careers materials. Many chemistry teachers when asked about the RSC careers advice materials offered their commendation of the various RSC classroom materials.

Where and how are the materials being used?

The interviewees reported a range of ways that the materials are being used and made available to students.

Chemistry teachers and other stakeholders' usage:

- **As displays in science departments:** Posters and the booklet materials form part of displays in classrooms. For example, posters are on walls and

booklets were displayed on racks or had been laminated as part of wall displays.

- **As displays at events:** The literature materials were often made available to students at open evenings, parents evenings and Year 11 and post-16 options evenings. Here, materials were often available for students to take home and read in their own time and with parents. The other stakeholders were mostly likely to use the materials at such promotional events and talks.
- **Referred to in chemistry lessons:** Posters and materials were referred to during lessons. For example, materials were used in research-careers activities and the posters were used to illustrate chemistry in action outside school life.
- **Used to target specific interested individuals:** Chemistry teachers used the literature materials with individual students who express interest in chemistry careers information.

Careers teacher/advisors' usage:

- **Available in careers libraries:** Careers interviewees' most common use of the booklet materials was to resource the careers library with them.
- **Circulated to relevant departments:** Careers teachers often forwarded the materials to science and sixth form departments.
- **Used in careers interviews and other careers activities:** In careers interviews the booklets were accessed if a student expressed interest in the subject area.

As can be seen from the above list, the most common use of the materials is in displays in classrooms, at events and available in the careers library (with only small numbers of interviewees referencing the other uses). Such uses all place onus on the pupil's motivation to engage with the materials. Examples of more teacher-led and advisor-supported use of the materials were not extensive.

Other RSC materials and events

Chemistry teachers and other stakeholders were asked whether they had come across any other RSC materials or been to any RSC-run events. Of the interviewees asked, the majority had come across other RSC materials and been to events. The range of RSC events accessed included: Demonstrations and lectures, Training and Professional Development courses and Chemistry week. The range of other materials accessed included; RSC teaching resources, the RSC website and RSC competitions (e.g. Young Analyst). A small number of interviewees had been, or were currently, members of the RSC. Where these interviewees had accessed other RSC materials and events they were unanimously positive in their evaluations of them.

5.2.2 The extent to which the materials are useful and appealing (including ratings)

In order to gauge staff and stakeholders' perceptions of the materials, they were asked how appealing and useful they found them.

Appeal of the materials

In terms of their appeal, interviewees:

- felt the materials were **well produced, modern, attractive and interesting**
- noted the **colourfulness and diverse range of images** as being effective in catching pupils' attention: '*They are very well produced, they're up to date, they're modern, they're very cheerful, they take chemistry into the modern age*' (Chemistry teacher).

On the other hand, perceptions of less appealing aspects mirrored those of the pupils, warning against the use of **too much text** and materials that were **too '*serious*' looking**. The use of methods to make the text more manageable, such as bullet points, was approved.

Usefulness of the materials

All interviewees were asked to rate and comment on the usefulness of the materials. Interviewees were asked to give a rating of 1 to 5, with 1 representing 'not at all useful' and 5 representing 'very useful'. This section sets out their ratings (Table 5.2), followed by their qualitative comments about usefulness (Tables 5.3, 5.4 and 5.5), and opinions of where the materials are less useful.

As can be seen from Table 5.2, interviewees rated the materials as useful, giving quite high proportions of 4 and 5 ratings.

Table 5.2 School staff ratings on the usefulness of the materials

	Frequency of responses (N)						Number giving rating of 4 or 5
	Number of respondents	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	
Usefulness (**chemistry teaching staff**)	26	0	3	4	14	5	19
Usefulness (**careers teachers and advisors**)	7	0	0	0	5	2	7

Source: NFER interview survey on RSC materials 2006.

Their responses were qualified with detail of the specific circumstances and types of pupil the materials were useful for, serving three distinctive functions:

- useful for **chemistry teaching** (giving chemistry related information) (see Table 5.3)
- useful for **careers advising** (giving careers related information) (see Table 5.4)
- useful for **pupils** (in particularly noting their usefulness for undecided pupils, interested pupils) (see Table 5.5).

In addition, they made suggestions for ways to make the materials more relevant to wider audiences (these issues are covered further in Section 5.3).

Table 5.3 Useful for Chemistry Teaching Role

Useful for Chemistry Teaching Role
• **Stimulate discussion:** Interviewees felt the materials (particularly the posters and the images) were useful for inspiring pupils' imagination and prompting them to ask questions and discuss with each other; '*The visual impact of the posters gets the students to be more proactive and talk to us, gets them imaginative and starts them thinking*' (Chemistry teacher). • **Provide references:** the posters were noted as being useful for referring to in lessons to contextualise and showing the uses and applications of chemistry in the real world; '[They] *are useful in that it gives you something to talk about, it's a focus, it raises the profile'* (Chemistry teacher). • Decoration and atmosphere: **interviewees felt the posters were useful in making chemistry environments more attractive**, with a possible **knock on effect of making chemistry seem more vibrant, interesting and exciting.**

Table 5.4 Useful for giving careers information

Useful for careers advising role
• **Provide relevant information**: Interviewees felt the materials were useful because they provided them with information relevant and appropriate to pupils' needs, questions and queries. The materials provided the chemistry and careers staff with relevant information so that if asked by students about chemistry study and careers they were better informed and up to date. • **Dispel myths**: Interviewees felt the materials were useful (the posters in particular) for overcoming stereotypical perceptions of chemistry and chemists as only working in laboratories; '*I think it's the images that will attract them to it, I like to have things like babies and girls around in the lab as well as the cars and skateboarders – I think it makes it more accessible to girls*' and '*I do think it's very good for people to see that if you're doing a chemistry degree you don't just go on and sit in a lab all day and pour solutions into test tubes'.* The materials were also felt to be useful for overcoming negative misconceptions about environmental implications of chemistry stemming from public and media perceptions. • **Promote the broadness of chemistry related careers**: Respondents noted the capacity of the materials to raise awareness of the range of jobs chemistry study could lead to – '*because I think kids do have this perception that that's what you do, and they think a chemist is someone who works in a pharmacy. They don't realise the range of opportunities and jobs that you can do. So I do think that's a brilliant poster*'.

- **Information on hand**: Both chemistry and careers interviewees' commented that it was useful to have some literature available that they could refer students to, or use to provide additional information to students on request, that materials were available for students to take home and that such materials were available for use at events; '*The more information you can have the better, so it's useful to have it there*' (Chemistry teacher).
- **Show the usefulness/relevance of chemistry to everyday life**: The materials were felt to effectively link chemistry to aspects of everyday life that are (stereotypically) not usually associated with chemistry. In so doing, the materials raised the profile of chemistry as a useful and relevant subject; '*What I do particularly like about the RSC material is that they frame the circumstances in which chemistry is used and youngsters are not always aware of those circumstances. So it opens their minds' to the practical uses in industry and what types of careers are available to them'* and the materials area useful in expanding pupils thinking and they begin to '*recognise that chemistry is not that funny subject that has absolutely no relevance to their lives what so ever*'.
- **Show the transferable skills developed in chemistry study**: The materials were felt to demonstrate how chemistry study need not mean students are destined and confined to be chemists (for example, the '*Profiles*' in particular) - '*they can inspire kids to think a little bit more widely about what opportunities there are that you could use chemistry to do*'.

Table 5.5 Useful for Pupils' decision making

Useful for pupils
• **Useful for students interested in chemistry continuation or the undecided**: Interviewees felt the materials would be useful for students already interested in further chemistry study and for students who are undecided as to their career direction but who enjoy chemistry – '*I think for those people who are in two minds as to what to read then it will help them maybe choose a career pathway*'.
• **Useful as catalyst/starting place/inspiration**: Interviewees felt the materials were useful for stimulating and sparking interest in chemistry. In particular the posters on the images were felt to have this impact in grabbing students' attention; '*for some it's the catalyst to get them to look at something using chemistry*'.
• **Appeal to different types of pupils**: Interviewees felt the different materials were useful in appealing to a range of pupils, for example, different genders.

Not useful

Some interviewees were less positive about the usefulness of the materials. A small, but notable minority of interviewees reported the materials were not useful. These interviewees felt:

- the materials had only limited usefulness in providing chemistry careers advice to young people as they would only be used and referred to by a minority audience (e.g. high achievers, students already interested in pursuing chemistry etc.)
- that other factors were more salient to chemistry decision making than materials (e.g. students' experiences of the subject and curriculum, perceptions and stereotypes of chemistry and chemists, student ability, students' own ambitions and parental influence)
- the materials were not being used by or looked at by students. (Further details on interviewees' recommendations for improving the relevance and accessibility of the materials are discussed in Section 5.3.).

5.2.3 Comparing the materials to other sources

School staff and stakeholders were asked to compare the RSC careers materials to other sources of careers information and guidance. Two thirds of those asked reported the materials were **more useful than other sources** in the following ways. The materials:

- were felt to be at least **on a par with others** and often considered **more appealing and attractive** than other careers materials of their kind
- were considered by a number of respondents as **complementing other sources** of careers information. In this way, the materials seemed to contribute a piece of the whole package of careers guidance that was felt to be needed
- were believed to be more effective than other sources at **'sparking' interest** in chemistry (with particular reference to the posters and the imaginative images)
- were appreciated by teachers who felt they only usually received limited careers literature and material from elsewhere
- facilitated **self-directed exploration of careers**, as opposed to careers advisor led (mentioned by one interviewee only).

The remaining third of interviewees felt the RSC materials were **less useful than other sources** in the following ways:

- **less useful than speaking to real people** or **seeing chemistry careers in action**
- **less influential than students' own experiences** of the subject (although where students enjoyed chemistry and were already interested in pursuing it for a career, the materials were felt to be useful).

- less influential than other methods (e.g. more practical chemistry, demonstrations, seeing chemistry jobs in action and meeting real chemists would provide a more powerful influence and persuasion).

5.2.4 Extent to which staff and stakeholders are likely to continue to use the materials

Interviewees were asked to what extent they felt they would continue to use the RSC careers materials. Almost all interviewees asked felt they would continue to use the materials, reflecting the importance they gave to them as being a useful aspect of careers guidance. Only one interviewee felt the RSC should cease to produce the materials and, rather, should focus on educating teachers with chemistry careers information. The need to provide more teacher orientated chemistry careers information was a persistent recommendation raised by interviewees, and will be discussed further in section 5.3.

5.2.5 To what extent do the materials make a difference to the take up of chemistry?

Respondents were asked '*to what extent do you feel these materials could make a difference to the take up of chemistry (for a subject and career)?*'. Just over half of the interviewees felt that the materials would make a difference to chemistry participation. Their comments reiterated earlier assertions about the usefulness of the materials. For example, the materials would make a difference because they 'open [students'] eyes' to the range of possible chemistry careers and that they may persuade borderline and undecided young people. By contrast, just under half suggested the RSC materials would not make a difference to the take up of chemistry, citing the salience of other influences and issues relating to the accessibility of the materials as their main reasoning. For example, the materials were informative but were felt not to have the capacity to persuade chemistry continuation: '*Materials can reinforce their views or maybe tip the balance, but I think they've got to have an interest in chemistry in the first place to actually look at them*' (Chemistry teacher).

Overview: School staff and stakeholders' perceptions of the materials

Familiarity with and use of the materials:

- Staff and stakeholders' **familiarity with the materials was not universal**. Interviewees were most likely to be familiar with the range of posters and the '*Profiles*' literature material. Familiarity with the remaining materials was partial.
- The materials were **most likely to be used by staff and stakeholders as display** items in classrooms, libraries and at events.
- **Teacher and advisor-supported use of the materials was not wide-**

spread, perhaps giving weight to pupils' requests for more of this activity.

The usefulness of the materials:

- The materials serve an important and **useful function in providing chemistry careers information and overcoming stereotypes**.
- The RSC materials are useful in that they form **a key element of what should, ideally, be a whole package of careers guidance** and information. (A package may be achieved with the addition of some of the recommendations covered in Section 5.3.)
- **In isolation**, the RSC careers materials are not sufficient **to directly persuade students to take chemistry further**.

The impact of the materials:

- The materials may have **a slight impact on the take up of chemistry** as a subject or career by **providing subtle awareness-raising of the chemistry career opportunities available and the role of chemistry in modern life**.

In sum, interviewees' comments suggest they felt the materials were useful as **part of a whole package of careers guidance**, but that in isolation the materials' influence on decision making was limited: '*They* [materials] *are only part of the answer*' (Careers advisor).

5.3 Staff and stakeholders' suggested improvements and other recommendations for the materials overall

Staff and stakeholders' perceptions of the materials were explored further by asking them whether they *would make any changes to the materials*; and *when* they thought students should see and use them. Interviewees made a range of suggestions for improving the materials. Their comments resonated with those made by the students, and relate to:

- when students should see/use the materials (Section 5.3.1)
- the accessibility/availability of the materials (Section 5.3.2)
- careers information and relevance to jobs (Section 5.3.3)
- relating to chemistry (Section 5.3.4)
- audience (Section 5.3.5).

5.3.1 Staff and stakeholders' recommendations for when young people should see/use the RSC materials

The staff and stakeholders were asked when they felt pupils should see/use the RSC materials. Table 5.6 shows the range of years that interviewees identified for when pupils should see/use the materials.

Table 5.6 Staff and stakeholders' views on when they feel pupils should see/use the RSC materials

When staff and stakeholders feel young people should see/use the RSC materials	No. of interviewees nominating when
At all times	18
Primary	5
Year 7	2
Year 8	2
Year 9	16
Year 10	17
Year 11	23
Year 12	19
Year 13	14

NB: Interviewees could nominate more than one year group.
Source: NFER interview survey on RSC materials 2006.

As Shown in Table 5.6:

- generally, staff and stakeholders' opinions were very similar to pupils' own views, suggesting pupils should see and use the materials from **Year 9 onwards**. Though, staff and stakeholders may place **slightly less emphasis on Year 9**, as the students did, and their responses imply they feel **Year 11 is the more crucial point** for receiving careers guidance
- again, similarly to the pupils' views, a significant proportion of staff and stakeholders felt the pupils should be exposed to the RSC careers guidance materials **at all times throughout their schooling**.

Staff and stakeholders' accompanying qualitative comments suggest post-16 careers guidance serves only an affirming function, rather than persuasive, as many students of this age have already begun to form career preferences and make decisions. Critically, these interviewees suggested **careers advice and guidance needs to come before post-16 study**. Staff and stakeholder interviewees were also more likely to comment that though the materials should be available to a wider spectrum of ages, there should be **greater differentiation of the materials to target distinctive age groups** (in terms of the content of the chemistry/careers information, the level of manageability and the interests of different age groups).

The lack of specific nomination of **Years 7 and 8** for targeting careers advice is worth raising as a possible area of 'lost potential' – especially given the earlier findings from the literature about stimulating interest well before times of choice (see Section 1.3.1) and the opinions of '*as early as possible*' given by some young people.

5.3.2 The availability/accessibility of the materials

A significant number of staff and stakeholders' raised the **accessibility of the materials** as an issue requiring improvement. This included issues regarding the dissemination of the materials as well as a number of suggestions for improving the medium through which pupils are given careers information. Staff and stakeholders' felt that:

- The **careers materials should be directed at chemistry teachers**, **careers advisors and even parents**, so that they could impart the information to the students. Some felt that teacher-directed input was more helpful to students than their own self-directed research: '*You can't rely on teenagers to do their own research*'; and '*I think that resources that are made for teachers in the department to read and use and relay that information to their pupils are probably more useful than creating information straight for the kids themselves*' (Chemistry teacher).

- In this regard, interviewees felt that they themselves would like **help in using the RSC materials** in an accessible and 'user-friendly' way for their students. They suggested that this input might come from the RSC: '*I know that I am not as well up to give careers advice as I could be. That's an area that the RSC could help me by giving me more information*' (Chemistry teacher).

- **More interactive mediums, such as videos, DVDs and websites**, were felt to be a good substitute to students having talks from people, giving insights into the career in action. They also felt that such media were, on the whole, more engaging than literature.

- Interviewees felt that the dissemination of the RSC materials could also be **targeted in the following ways:** a database to directly identify chemistry teachers in schools, more timely dissemination (e.g. prior to times of options and subject choosing), more proactive dissemination, more copies of the materials including notification of new materials and, where applicable, which materials they are replacing.

5.3.3 Careers information and relevance to jobs

Interviewees suggested ways in which they felt the relevance of the careers information in the RSC materials could be improved.

- The materials might present **more information about what chemistry jobs precisely entail** and what life is like as a chemist (including directly linking this to what students might currently be studying as part of their chemistry course)

- **More information on how to get into different jobs**, for instance, the different **routes and pathways** available, was felt to be needed.

- More information on **expected salaries** associated with different chemical science careers. It was suggested chemistry careers could be advertised in comparison to other careers, detailing the benefits of the career over others.

- **More promotion of the transferable skills developed in chemistry study**: '*Science is really hard but if you've got a decent qualification in science, wow, that says something about you*' (Chemistry teacher).

- **Greater references and links to industries** and companies that offer student **work experience**. It was suggested the RSC could collate a list of the organisations that offer work experience and present this on their materials so that students had some way of exploring sparked interests.

- **Greater diversity of jobs and levels of jobs** advertised in the materials. The careers currently being presented in the current RSC materials were felt be relevant only for the 'high fliers'. Promoting other careers, such as lab technician, and careers with apprenticeship entry would enable appeal to a wider audience and ability of student.

- **Improving the relevance of the careers information to the age groups** it was trying to attract. Recommendations were made regarding the need to reflect current fashion and issues; and 'hooks' such as a headline 'Do *you want to save lives? Don't be a doctor, be a chemist*' (stakeholder).

5.3.4 Relating to chemistry

Like students, staff felt the materials could be improved to be more clearly linked to and integrated with chemistry, in the following ways.

- **Greater and more obvious links to chemistry**. In particular, it was suggested images, titles and front covers needed to provide a clear message that the content of the posters was about chemistry.

- **The materials to be more integrated into the curriculum**, including chemistry teachers' express need for receiving guidance on how and when to use the materials in relation to specific curriculum topics, as well as resources to enhance the careers-relevance of chemistry. Overall, these interviewees felt **careers guidance should be more integrated with subject learning**, a view shared by students.

- Provide even **greater relevance to everyday life and the role of chemistry**, in particular, relating to current affairs; '*I think that would be useful to see how scientists are solving problems that we've got in the environment*' (Chemistry teacher).

5.3.5 Audience

Staff and stakeholder interviewees made a number of comments relating to the need to improve the manageability of the materials in order to appeal and be

accessible to a wider audience. Overall, chemistry teachers and careers teachers seemed more likely to mention such improvements than the pupils themselves.

- A considerable number of interviewees argued the materials were **pitched at too high a level** (including perceptions of academic and technical language). For example, interviewees suggested the use of the double meaning of *elements* in the '*Chemists in their element*' posters would not be understood by younger and/or lower ability students. Attracting lower and mid-ability students via the promotion of more vocational routes was suggested: '*In some cases we do need not all very wordy materials, so that they would actually attract students into industry at a more apprenticeship level*' (Careers advisor).

- Like students, the staff also suggested the materials could be improved by having **less writing**, and placing more emphasis on visual messages (e.g. images, diagrams, pathways). Many of the materials were felt to be too 'large' in design; the A5 format were deemed more manageable and accessible for a student audience.

Overview: staff and stakeholders' suggested improvements and recommendations overall for the materials

Three key recommendations emerge in staff and stakeholders' overall suggestions for the materials:

- To be **available at all times** and especially from **Year 9 onwards**. By **post-16 careers guidance may be too late**, as the role of careers materials by this stage seems to be confirming, rather than persuasive and influential.

- To be even more **related to chemistry** and the curriculum and **more integrated with subject learning**. Chemistry teachers requested support in this regard.

- To promote an even **greater diversity of careers**, including those that might **appeal to middle and lower ability students** (e.g. careers that could be accessed via more vocational routes), thus widening the audience and participation.

5.4 Attracting young people to chemistry: school staff and stakeholders' other perceptions and recommendations about chemistry and careers advice

This final section draws on staff and stakeholders' views on wider aspects of chemistry and careers advice (i.e. beyond the RSC materials). When asked what else might be done to attract young people to chemistry for a subject or a

career, three key themes emerge in staff and stakeholders' responses. These are:

- more contact with chemists (Section 5.4.1)
- greater partnership working (Section 5.4.2)
- enhancements to the chemistry curriculum (Section 5.4.3).

5.4.1 Contact with chemists

One of staff and stakeholders' most common suggestions for improving chemistry careers guidance was for students to have more contact with real chemists and see chemistry careers in action. Here it was suggested the RSC could provide a crucial role in collating and disseminating lists of speakers, events, and industries willing to take work experience students. Staff and stakeholders felt careers information from a personal perspective was particularly powerful. They raised the need for:

- more **speakers and talks** from chemists to share the nature of their jobs with students. It was emphasised that such representatives would have personal attributes such as 'charisma', 'youth' and 'ability to engage with young people'. The need for more **positive chemistry role models** was argued and was felt to be important to overcoming negative stereotypes of chemists and chemistry: '*The best thing of all to get kids to think about careers is personal contact with somebody who does that job. People are the important things in attracting people in*' (careers advisor).
- increased participation in **demonstrations and workshops**
- more opportunities to see chemistry careers in action, for example, in **work experience placements** or shadowing activities.

5.4.2 Partnership working

A number of the interviewees raised various issues relating to the need to work in closer partnership with other key partners in order to enhance chemistry careers information (and ultimately the uptake of chemistry). These included the need for:

- greater **links between schools and industry**
- greater **links between schools and universities**
- more **collaboration between chemistry staff and careers staff**.

It was felt that increased partnership working would improve chemistry teachers' awareness of current chemistry careers and degrees, support the practices of non-specialists, provide opportunities for students to visit HE and industry settings and improve the transfer of chemistry students to further study or employment. It was suggested that the RSC could act as a conduit in helping different organisations network and make links.

5.4.3 Chemistry curriculum

Pointing to a number of themes already highlighted in this section, interviewees noted areas of the chemistry curriculum that could be developed, including:

- enhanced relevance and practical activity – though they noted that changes to the new curriculum should help this (e.g. 21st Century Science courses)
- consideration of the A-level curriculum so that pupils' experience of transfer from GCSE to A level is improved
- the development of chemistry degrees, which might include more vocational elements and packaging, e.g. via links with specific careers and professions.

Overview: staff and stakeholders' suggestions for what else might be done to attract young people to chemistry as a subject or for a career

Three key themes emerge in staff and stakeholders' responses. These are:

- more contact with chemists (via talks, demonstrations and work experience)
- greater partnership working (e.g. school-industry; school-university; and chemistry teachers-careers advisors)
- enhancements to the chemistry curriculum (in school, at post-16 and at degree-level).

5.5 Summary and points for action

A number of key themes emerge across the staff and stakeholders' views presented in this section of the report, with possible points for action. These focus around: the role of the RSC materials as part of a whole package; what might be done to enhance the RSC materials within that 'whole package'; and what might be done to enhance other parts of the package elsewhere.

Throughout, interviewees felt that the materials were useful in fulfilling an important role that was **part of a whole package of careers guidance**, but that, in isolation, the materials' influence on decision making was limited.

In order to enhance this 'RSC' element of 'the package', consideration might be given as to how to encourage greater teacher and advisor-supported use of the materials, including **resources and support to help integrate such materials into subject teaching**. The development of materials to appeal to middle and lower ability students might also be considered.

In order to enhance the 'package' elsewhere, responses might come from a number of arenas including **schools**, **universities**, **industry/business, careers information/guidance services, and the RSC**. Each or all of these might consider school staff and stakeholders' requests for: more contact for their young people with chemists; greater partnership working (especially between schools and industry and schools and university); and enhancements to the chemistry curriculum. Here, the RSC might consider the development of their role in acting as a key conduit in **engaging and connecting these various partners**.

Part D

A summary of key findings and points for action

6 A summary of key findings and points for action

6.1 Introduction

This section draws together a summary of the key findings from each of the strands of the research (Section 6.2). It highlights the similarities and differences in the findings from across the sources of data (i.e. the literature review, young people's perspectives, staff and other stakeholders' perspectives) (Section 6.3). It also draws together some of the key points for action that have been discussed throughout the report (Section 6.4).

6.2 A summary of the key findings

6.2.1 Key findings from the literature including interviewees' perspectives

The review of the literature highlighted the key findings on when young people make choices, who advises them and the influences on choice with regard to chemistry (as well as science and careers education more widely). The key findings and influences on young people's subject and career choices regarding chemistry include:

- the importance of the **primary phase** in science attitude formation
- the deterioration of **attitudes to science** throughout secondary education
- a need for chemistry teachers' and careers advisors' more **up-to-date knowledge** of chemistry careers
- young people's desire for careers guidance to be impartial, cover the **full range of options**, and come from those ***in the know*** (e.g. in the profession, on the course)
- greater support for developing young people's **decision-making skills**, including more explicit links made between careers guidance activity and the decision-making process
- young people's perceptions and **images of chemists** and chemistry (e.g. 'white coats' and 'labs', 'hard-working' and 'academic')
- pupils' experiences of chemistry in the curriculum (e.g. **difficult**, some lack of relevance/practical application to current lives and jobs)
- pupils' experiences of how chemistry is taught (e.g. requests for greater emphasis on **practical** and collaborative approaches)
- young people's own ambitions (e.g. chemistry tends to be **chosen as means to another end**, such as medicine or veterinary science)
- parental influence (including perceptions of science as a 'solid' subject)
- peer influence (to some extent).

School staff and stakeholders agreed with most key findings from the literature, except the nature and extent of peer influence; and, around images of chemistry, the lack of female role models suggested by the literature. Interviewees identified the following additional influences on pupils' chemistry choice:

- teacher influence (i.e. a perceived impact of **non-specialist teaching** and the quality of chemistry teaching on pupils' engagement with chemistry)
- the pull of financial remuneration (i.e. the **earning potential** related to different careers).

6.2.2 Key findings from young people's perspectives on the RSC materials and wider aspects of chemistry and careers advice

Overall

- The young people's reactions to the materials were **overall positive**, noting their **visual appeal** (they were very positive in their ratings for the style and layout of all the materials) and promotion of **wide-ranging aspects of chemistry** and chemistry careers.

- There was, however, somewhat **limited familiarity** with and usage of the materials by the young people in the sample. Almost three-fifths had only seen the posters before; just under one-third were not familiar with any of the materials.

- In this regard, the young people recommended that the materials: be **available at all times**, especially at **key early decision points** (including Year 9 and Year 11); and be more **accessible**, including some **directed use and consideration of the materials** (e.g. by teachers, science and PSE staff), as well as the availability of **personal copies** for use in own time.

- **Posters** had an **appeal and relevance to younger pupils** (e.g. those in key stage 3), whilst their helpfulness deteriorated in post-16. In **key stage 4 and beyond**, young people wanted **more detailed information** about careers from chemistry.

- The overall impact of the materials varied across the age ranges. At **key stage 3**, the materials seemed **influential on attitudes towards chemistry** and possibly on choosing chemistry. At **key stage 4**, the materials seemed **most useful for decision making**, with some potential for impact on choice at this age. At **post-16**, although the materials were perceived to be useful, for the majority of pupils it would appear **too late** to have an actual influence on choice (and some noted that they would have liked to have seen such material earlier).

- Pupils felt that the materials could show **even greater relevance to chemistry careers** – relaying 'this is what chemists do'; 'how will I get there?'; 'what will I earn?'; 'where can I work?'; and personal statements relaying 'this is what I do'.

Recommendations for specific materials

- The young people made specific recommendations about the **amount and layout of text on poster material**. They suggested less written information, larger font and even more emphasis on visual messages. Where text is included, they recommended the use of bullet points, annotation and 'text boxes' (as on '*Chemists in their element*') so as to provide more manageable information.

- For the **booklet** materials, they requested more **obvious links to chemistry in the images** used. They suggested that the '*Life Beyond Exams*' booklet, the chemistry career '*Profile*s' and '*Choosing a degree*' leaflets be accompanied with images of chemistry careers and further study 'in action'. They also recommended that the front cover of the '*How far have we come with the help of science?*' booklet be redesigned to convey more relevant, modern and engaging images of science.

Wider findings on chemistry and careers advice

- **Careers advisors** and **websites** were young people's most common sources of careers advice and information overall. **External people** in the job/profession were particularly '**trusted**' sources of information.

- In **key stage 3**, there was a particular preference for careers guidance from people and 'those in the know' over materials. In **key stage 4** the primary careers informants included **careers advisors**, parents, and also **subject teachers**. In **post-16**, students seemed to be undertaking much more **pro-active research** through **websites**, materials and the **careers library**.

- In order to attract young people to chemistry study and chemistry careers, young people felt that the **relevance, enjoyment and manageability of the chemistry curriculum** could be improved, in particular via greater **practical application.** Likewise, they felt that careers information should promote the relevance of chemistry.

6.2.3 Key findings from staff and stakeholders' perspectives on the RSC materials and wider aspects around chemistry and careers advice

Overall

- Staff and stakeholders' **familiarity with the materials was not universal**. Interviewees overall were most familiar with the range of posters and the chemistry career '*Profiles*' material.
- The materials were most likely to be used by staff and stakeholders as **display items in classrooms, libraries and at events**. Teacher and advisor-supported use of the materials was not widespread.
- The interviewees felt that the RSC materials were useful in fulfilling an important role that was **part of a whole package of careers guidance**, but that, in isolation, the materials' influence on decision making was limited.

Recommendations for the materials

In order to have a greater impact on young people, staff and stakeholders recommended that the RSC materials:

- be **available at all times** and especially from **Year 9 onwards**; they noted that by post-16, careers guidance may be too late
- be **even more related to chemistry** and the **curriculum** and **more integrated with subject learning**; chemistry teachers requested support in this regard
- promote an even **greater diversity of careers**, including those that might **appeal to middle and lower ability students** (e.g. careers that could be accessed via more vocational routes), thus widening the audience and participation.

Wider recommendations about chemistry and careers advice

In promoting chemistry to young people and enhancing engagement and take-up of chemistry, staff and stakeholders recommended:

- more contact for their young people with **chemists** (e.g. via talks, demonstrations and work experience)
- greater **partnership working** (e.g. school-industry; school-university; and chemistry teachers-careers advisors)
- enhancements to the **chemistry curriculum** (in school, at post-16 and at degree-level).

6.3 A summary of similarities and differences across the research

Across the different sources of data (i.e. the literature review, young people's perspectives, and staff and other stakeholders' perspectives), the following similar key findings emerge.

- Young people's, teachers' and careers advisors' opinions on the RSC materials were very similar – especially in terms of appeal and overall usefulness.
- Young people and teachers also raised similar issues in terms of improving the materials, including around their availability, showing even more relevance to jobs, more direct linkage with the chemistry curriculum, and relevance to both specific and wider audiences.
- Findings from the literature review and the young people interviews concurred over the potential need for different sources of careers information at different times in young people's school careers (i.e. targeting to age range).

- Staff and stakeholders generally agreed with the main findings from the literature review (as described above in 6.2.1).

On occasion, the findings from the different sources of data differed.

- Chemistry staff and careers advisors were more likely than pupils to highlight that they felt the materials lacked appeal, relevance and manageability for middle and lower ability students.
- The young people were overall slightly more positive about the potential impact of the materials on choice, than staff and stakeholders (who emphasised that the materials were one part of a 'package' of careers activity and unlikely to have an impact in isolation).
- Whilst findings from both the literature review and the young people interviews highlighted preferences for different sources of careers information across the age ranges, staff seemed less aware of this issue (they did not raise it in their interviews).
- Findings from the literature about stimulating interest in chemistry well before times of choice (i.e. before Years 9 and 11 – which were the most commonly nominated years by teachers and young people as important for using materials such as these) were not as strongly emphasised by staff. The lack of specific nomination by staff of **Years 7 and 8** for targeting careers advice might reflect a possible area of 'lost potential'.

6.4 A summary of points for action

Finally, this section draws together some selected key points for action that have been discussed throughout the report. Nine key recommendations emerge, covering two arenas: i) the RSC materials in particular (1–5); and ii) wider aspects of chemistry and careers advice (6–9).

The RSC materials

The materials are part of a package of careers guidance and promotional activity received by schools. However, there were varying degrees of familiarity with the materials across staff and students, and usage by young people was mainly self-directed. In order to enhance this part of the package, the following arenas might be considered for development.

1) The **accessibility/availability of the materials**, e.g. via greater **directed use** and consideration of the materials by teachers, science and PSHE staff; the availability of **personal copies** for young people to use in own their time; and targeted use of such materials at key '**early decision points**' (including Year 9, Year 11, and earlier). By Year 12 it can be too late.

2) The '**branding**' of the range of RSC materials. The different materials were perceived to have a range of 'functions' (e.g. the immediate *appeal and promotional function* of the posters; the *careers decision making*

function especially of the chemistry career '*Profiles*'; and relaying *understanding about chemistry*, e.g. via '*Chemists in their element*' posters and '*Life Beyond Exams*'). Thus, it would seem that **a variety of materials is required**. However, with young people's somewhat unfamiliarity with the materials, consideration might be given to '**branding**' across the RSC range.

3) Greater **targeting** of the materials at **key stage 3**. This appeared to be a time when both *attitudes towards* chemistry and *potentially choosing* chemistry could be positively influenced by the materials. Given the findings from the literature about the importance of 'early' experiences of science, targeting key stage 3 might be considered. The young people themselves suggested that chemistry materials should **motivate and stimulate interest around chemistry for younger pupils**, rather than have a direct focus on careers information. However, in key stage 3 there was a large group of pupils who enjoyed chemistry but were undecided as to a future study and career direction. Could it be that **greater attention also to careers information** (such as careers-route details) on the key stage 3 materials might be helpful to young people?

4) Alongside the above recommendations for the availability of the materials to young people, staff themselves requested support for **greater teacher and advisor-supported use of the materials**. Chemistry teachers in particular requested **practical resources and support to help integrate** the RSC materials into subject teaching. Likewise, staff requested support in developing their own up-to-date knowledge and information about chemistry related jobs.

5) The materials to show even greater promotion of the **relevance of chemistry** and chemistry careers. For example, covering detail on 'the work that chemists do', 'how will I get there?', 'what will I earn?', 'where can I work?', and personal statements relaying 'this is what I do'. Specific actions might include amending the **amount and layout of text** on **poster** material (e.g. using bullet points, annotations and text boxes); and redesigning the **images** on the **booklet material** to convey chemistry careers and further study '**in action**' in the 21st century.

Wider aspects of chemistry and careers advice

With regards to wider aspects of chemistry and careers advice, response might come from a number of arenas including schools, universities, careers advice services, industry/business and the RSC. Each or all of these might consider the following areas.

6) The importance of **chemistry careers guidance from those 'in the know'**, (e.g. individuals in chemistry professions coming into schools to provide talks and workshops on the nature of their jobs).

7) Increased opportunity for young people to explore the **practical application of the discipline** (e.g. events, demonstrations, projects and visits to science museums), as well as opportunities for work experience and taster courses. Teachers' requests for **practical curriculum materials** to support both secondary and primary teachers might also be considered – for example, providing ideas for simple and manageable experiments and projects; proposals for how to relate the curriculum to everyday life, current affairs and chemistry careers; and guidance on facilitating more collaborative approaches.

8) Even greater tailoring of other careers advice activity to young people's preferences and influences at different age ranges might be considered. For example, is it possible to enhance RSC **careers activity from external sources** at **key stage 3**, given their preference for careers guidance from people and 'those in the know'? In this regard, the possibility and value of raising **parents' awareness of chemistry careers** (e.g. through materials and invitations to events) might also be explored, as parents were among key sources of careers information for young people in key stage 3. At **key stage 4,** targeting resources towards supporting **careers advisors** and **subject teachers** in their usage of careers-advice materials and activities might be opportune (as in point 4 above). And at **post-16**, young people's predominant use of **websites** might be exploited.

9) Increased opportunities for **partnership working and collaboration** between school and industry, schools and universities, and chemistry teachers and careers staff. Here, the RSC might consider the development of their role in acting as a key conduit in engaging and connecting these various partners.

Finally, we again note that the RSC materials are just one part of a package of promotional and advisory materials for schools and young people to consider. The range of the young people's opinions on the materials, careers-advice and their attitudes towards chemistry highlights their individual preferences and needs. It is likely that a mixture of careers-advice and promotional activity works, rather than any one source. However, this study suggests a need for **more supported and directed careers activity around these RSC sources**; and within careers activity more widely, making more explicit for young people the links between careers guidance activities and decision making.

Appendices

Appendix I

The methodology for the review

Identifying the sources

Literature database searches were undertaken to identify recent literature in this field. These were undertaken from 2003 onwards, so as to capture publications that might have not yet been available for the report by Jagger, in 2004.

The searches were undertaken to identify literature which satisfied the two key areas under consideration: *chemistry-related terms* AND *choice-related terms*. A full set of key words and search terms were employed so as to cover all possible combinations. These search terms were matched to the databases under consideration, and words not recognised by the databases could still be searched for by using a facility known as a free-text search. In addition to the database searches, other available literature known to the research team or sponsors was also considered.

Criteria for inclusion and recording the findings

A three-step selection process was applied to the identified literature, in order to help identify the most relevant sources and findings.

- The first step was applied to the references and abstracts from the search results – these were scrutinised for their pertinence to the review. In order to be considered for inclusion, abstracts should highlight young people, chemistry or science and an aspect of choice/attitudes/influences. Full sources of the references and abstracts which appeared pertinent were then obtained.

- Once obtained, the second step involved considering these sources for their relevance to the review. The findings from these publications were briefly summarised onto an Excel sheet against the three main questions – When do young people make choices? Who advises them? And what are the influences on choice? An additional category for other comments/findings was also completed.

- The third step then involved identifying the most pertinent sources – with the chief criteria that the research considered: chemistry (then science), young people making choices and decisions regarding science, young people's attitudes towards learning science, young people's perceptions of science subjects and careers in science. In addition, it was felt that empirical and UK-based research would be the most pertinent to this review (rather than discussion pieces, or work outside the UK). Sources identified in this third step were summarised more fully (bibliographies of these works are presented in Appendix II).

Appendix II

Bibliographies of the key sources included in the review

The scope of the research review allowed for up to eight relevant sources from the most recently published literature to be included in the review, adding to the summarised findings from Jagger (2004). These key sources, in alphabetical order by author, are:

Blenkinsop, S., McCrone, T., Wade, P. and Morris, M. (2006). *How Do Young People Make Choices at 14 and 16?* (DfES Research Brief 773). London: DfES.

Cleaves, A. (2005). 'The formation of science choices in secondary school', *International Journal of Science Education*, **27**, 4, 471–486.

Dalgety, J. and Coll, R.K. (2004). 'The influence of normative beliefs on students' enrolment choices', *Research in Science and Technological Education*, **22**, 1, 59–80.

Francis, B., Hutchings, M. and Read, B. (2004). *Science in Girls' Schools: Factors that Contribute to Girls' Engagement and Attainment* [online]. Available: http://www.gsa.uk.com/datafiles/hostFiles/host-116/Amgs%20Final%20Report%20on%20Science.pdf [20 November 2006].

Jenkins, E.W. and Nelson, N.W. (2005). 'Important but not for me: students' attitudes towards secondary school science in England', *Research in Science and Technological Education*, **23**, 1, 41–57.

London Development Agency (2006). *Science, Technology, Engineering, Mathematics (STEM): Achieving World Class Skills for London* [online]. Available: http://www.lda.gov.uk/server/show/ConWebDoc.1575 [23 November, 2006].

Murray, I. and Reiss, M. (2005). 'The student review of the science curriculum', *School Science Review*, **87**, 318, 83–92.

Qualifications and Curriculum Authority (2004). *Pupils' Perspectives on Science 2003/4* [online]. Available: http://www.qca.org.uk/downloads/12363_sc_pupil_perspectives_report_03_04.pdf [23 November, 2006].

A summary of each key source follows, with details on a standard template about the study, the sample, the research design, the key findings, and how the research contributes to the aims of this review: When do young people make choices? Who advises them? What are the influences on choice?

Blenkinsop, S., McCrone, T., Wade, P. and Morris, M. (2006). *How Do Young People Make Choices at 14 and 16?* (DfES Research Brief 773). London: DfES.	
The study	
About the study	This study explores how young people make educational choices at 14 and 16, including how personal attributes and school/other structural contexts might influence choice.
Sample	165 young people from 14 schools (85 in Year 9 who had just made decisions about option subjects; 80 in Year 11 who were just thinking about applying for courses, training and jobs in the following year).
Research design	Interviews with 165 young people in spring 2005; with 127 followed up in autumn 2005 (i.e. the next 'school' year). Questions with the young people covered 'circles of influence' (which might include people, lessons, TV programmes), and their attitudes towards maths, English and science.
Key findings	**Key factors relating to how young people make decisions** Factors relating to **context**, e.g.: • school context including school leadership and student support – the young people attending schools that appeared to be effective in curriculum management, student support, staff expectations and school leadership, were the ones who seemed to be making the most 'thought-through decisions', with positive mindsets, and remained happy with their choices two terms later • school support in decision making – where young people perceive their school to be supportive in decision making, they were more influenced by school-related factors (e.g. teachers, careers education and guidance) than by external factors (e.g. friends and family) • sufficient time to make choices (including the opportunity to individually discuss options with teachers) – valued by young people; some schools in this study offered limited time to careers education and guidance. Factors relating to **individuals**, e.g.: • young people's decision-making skills - including some inability to cope with unanticipated changes in 'plans', there might be a need for greater emphasis in supporting young people's decision-making skills and the process of decision making • young people's approach to making decisions – individuals need varying levels and type of support at different stages in their school careers (e.g. one-to-one, group exercises, literature on options, and a mixture of such approaches) • lack of links made by young people (aged 14) between careers education and guidance activities and their decisions about courses and pathways. Schools might make the links more explicit. The young people themselves request '*more detailed, clear information on subject options for key stage 4, particularly on subject content (e.g. modules and topics covered), coursework and future post-16 pathways*' (p.4–5). Factors relating to **careers education, guidance and advice**, e.g.: • most effective when it was 'comprehensive', impartial and delivered by trained staff as a dedicated part of the curriculum – here young people were less reliant on external sources such as family and friends; elsewhere young people had more varied approaches to decision making and were more likely to change their minds over time • in 11–16 schools, whilst teachers were impartial in their advice-giving, their knowledge of post-16 opportunities '*did not always seem to be comprehensive enough to give fully informed advice*' (p.5) • in contrast, in 11–18 schools, whilst teachers had the knowledge they '*did not always seem impartial in giving it, tending to encourage students to say at their own school sixth form*' (p.5) • some young people preferred careers advice from external experts (e.g. Connexions Personal Advisors).

Findings and themes for this research review	
When do young people make choices?	
Who advises them?	In Year 9 and Year 11, Careers staff, teachers and external experts (e.g. Connexions Personal Advisors)
What are the influences on choice?	Influences include: • School factors – including effective in leadership, curriculum offer and student support • Teacher factors – including their knowledge of post-16 offer(s) and their impartiality when advising • Young people factors – including their decision-making skills, and individual approaches and needs around decision making • 'Coherence' – or linkages between careers education and guidance and decision making – with young people requiring more explicit help and direction in this regard • External factors – including parents, family and friends, relied on more by young people from schools where internal support and offer appeared less effective. Although the study does not rank order the influences that it found on young people's decision making, it states that teachers were essential to the decision-making process (including that 'young people were influenced by discussions with teachers, particularly in schools which had support systems which appeared effective overall', p.5); but questions whether teachers had the necessary knowledge to provide careers information and guidance that the young people needed.

Cleaves, A. (2005). 'The formation of science choices in secondary school', *International Journal of Science Education*, **27**, 4, 471–486.	
The study	
About the study	This study is set in the context of: • the decline in uptake of post-16 science courses (e.g. Stagg *et al*., 2003) • the decline in positive attitudes towards science throughout secondary school (e.g. Woolnough, 1996; Osborne and Collins, 2000) • the stereotypical/narrowness of pupils' views about science work (e.g. Stables, 1996). This study examines: • the formation of Year 9, Year 10 and Year 11 science choices for post-16 • the changes in their views over time
Sample	72 higher achieving pupils from 6 mixed comprehensive schools were tracked from Year 9–Year 11.
Research design	A three-year longitudinal study using semi-structured interviews; analysis via grounded theory approach. Each pupil was interviewed four times (at the start of Y9, end of Y9, end of Y10, end of Y11), covering aspects such as subject interests, influences on choice, future plans.
Key findings	Five choice trajectories were identified amongst the pupils who were followed throughout: • '*Directed trajectory*' – '*early and specific career commitment*' • '*Partially resolved trajectory*' – '*less focused ideas about a career direction*' • '*Funnelling identifier*' – '*narrowing of ideas over time*' • '*Multiple projection*' – '*the student with constantly changing ideas*'. • '*Precipitating trajectory*' – '*broadly based ideas and vocationally uncommitted*' (p.473). The 21 young people who chose science subjects for post-16 were mainly from 'directed', 'partially resolved' and 'precipitating' trajectories.
Findings and themes for this research review	
When do young people make choices?	The study highlights findings on when young people's science attitudes are formed: • Those from a funnelling choice trajectory eliminated science from their choices by Year 11. Over time, these pupils showed an increasing '*antipathy*' towards school science, perceiving less and less practical work and more theoretical work (which they found 'boring') as they approached Year 11 and GCSEs. • For pupils who chose science for post-16 study, and for many of those with a 'precipitating' trajectory, there was an increasing and deeper appreciation of science careers, although this understanding might not have been '*acquired in the classroom*' (p.483).
Who advises them?	The study highlights young people's: • disappointment with careers education provision • lack of awareness of the full variety of science careers Stronger links between science and careers departments might be required (e.g. Munro and Elsom, 2000).
What are the influences on choice?	As well as the characteristics of the trajectory types, influences on the young people's choices include 4 key areas: • **occupational images** of science and scientists and **a lack knowledge about science occupations** and science work, especially amongst those who decide against science past 16. E.g. whilst perceptions include that scientists discover things and improve the world, they also reveal limited images of science related careers – e.g. food science and speech therapy perceived as not related to

	science. • **disappointment with school science** – difficult; heavy workloads; overloaded content**;** challenging; criticisms of the quality of practical activities in science (e.g. should reflect scientific enquiry and the activities of working scientists more). (Note that in this sample there were also pupils who found school science enjoyable, 'makes me think a lot', 'an intellectual challenge but not particularly inspirational'). • **perceived lack of relevance of science to current life or working life** (or relevance only to university-level careers), even amongst those who have chose science at post-16 and particularly by those from the 'partially resolved' and 'funnelling' trajectories. • **underestimating abilities in science** • **parental** (and other significant adults') **influence**, e.g. emphasising the 'educational capital' of science subjects, as 'fundamental', 'solid subjects', either in their own right or in relation to other subjects. E.g. parents' perceptions that physics would give a good grounding to music technology; and biology would be a 'solid' science subject alongside geography and geology.

Dalgety, J. and Coll, R.K. (2004). 'The influence of normative beliefs on students' enrolment choices', *Research in Science and Technological Education*, **22**, 1, 59–80.	
The study	
About the study	The study investigates the perceptions that chemistry students hold about chemistry and chemists; and the influences on those attitudes (e.g. peers, family, mentors, the media).
Sample	37 tertiary chemistry students in New Zealand (aged 17–30 years).
Research design	Interviews with students about their associates' attitudes towards chemistry, covering: knowledge on what chemistry occupations entail; values and the effect of chemistry on humanity; and 'chemists' and their personality traits.
Key findings discussed in this paper (including findings from other research)	**Peer influence** • Children with a background in science (enjoy science/engage in science related extra curricular activities) are likely to form peer relationships with students who also have a science background. • As students' relationships with their peers develop and strengthen, the student's attitude towards science becomes similar to that of their peer group. • Females tend to be influenced more by friends than males, with girls responding to the perceptions of older students. • The influence of peer social pressure increases in the early secondary school years, climaxing at about Year 9 (equivalent). • Students believe their peers subscribe to the stereotypical images of science and scientists (white coats, test tubes, labs etc.) – this is the normative group. • Students feel their peers would think that a certain level of intelligence was necessary to be a chemist, that chemists are hard working, nerdy, unsociable and boring, eccentric, perfectionist and problem solvers. **Parental influence** • Home background can influence attitude to science, although this influence declines as young people get older. • Girls are more likely than males to be influenced by parental opinion. • Students who are interested in science subjects typically have parents who are supportive of them and involve them in extra curricula science related activities. These students also gravitate towards peer groups that have similar interests and are therefore supportive of their science choices. • Students also perceived that their parents may subscribe to the stereotypical images of science and scientists although less negative. **Teachers** • Female students appear to respond better to female science teachers. • There is contradictory evidence as to how influential teachers are – some evidence suggesting teachers are more influential than parents and others suggesting teachers have little influence over course choices. **Public images of science** • The public rely heavily on media for science information about science issues (e.g. science articles and findings rarely reach the public unless they are presented in the media – something of a gulf between these two which fuels misconceptions and stereotypes of science). • There would appear to be a lack of science role models in the general everyday public arena.

	Links between the scientific community/industry and schools • Although the students in this study were exposed to negative normative beliefs about chemistry, they were also exposed to positive associates (these students had chosen chemistry). This encouraged them to question others' views or reinforced their own attitudes • One potential means of addressing the lack of interest in chemistry is for members of the chemistry community to develop relationships with students at secondary school level. The research reported here suggests that the negative attitudes towards chemistry that are prevalent in western society can be overcome, but this requires the science community to have greater participation in key societal structures such as schools.
Findings and themes for this research review	
When do young people make choices?	This paper suggests that young people's attitudes are influenced during the primary and early secondary years, and are formed by Year 9.
Who advises them?	
What are the influences on choice?	Influences include: • Home background (although this influence declines with age) • Parents (girls influenced by parents more than boys) • Teachers • Peers • Public images of science and scientists.

NB – although this study took place in New Zealand, it fitted the criteria for inclusion in the review due to its strong focus on chemistry and 'influences'.

Francis, B., Hutchings, M. and Read, B. (2004). *Science in Girls' Schools: Factors that Contribute to Girls' Engagement and Attainment* [online]. Available: http://www.gsa.uk.com/datafiles/hostFiles/host-116/Amgs%20Final%20Report%20on%20Science.pdf [20 November 2006]. and a previous study: Francis, B., Hutchings, M. and Archer, L. (2002). *The Learning Preferences and Perceptions of Education Among Pupils at Girls' Schools*. London: Institute for Policy Studies in Education. Available online at: http://www.gsa.uk.com/datafiles/hostFiles/host-116/Amgs%20Final%20Report%20on%20Science.pdf	
The study	
About the study	The study follows a previous study which found that girls in all-girls' schools tended to rate science as their least favourite subject (Francis *et al*., 2002). The study explores: • achievement levels in science in relation to other subjects • factors which encourage girls' enjoyment of and engagement with science • factors which encourage their achievement in science.
Sample	Key stage 4; girls in all girls' schools. The pupil element of the project focused in 3 schools identified from the staff questionnaire responses.
Research design	Pupil focus groups; classroom observations; questionnaire to headteachers, heads of science departments and science teachers. The themes covered with the pupils included enjoyment, teaching, topics, activities, learning, manageability, relevance. Questions included what do you think makes an enjoyable science lesson; what kind of things in the science lessons particularly help you to learn?
Key findings	In the previous study, Francis *et al*. (2002), it was found that one-third of the 203 surveyed girls (Y10 and Y11) noted science as their least favourite subject. Chemistry was the least popular (12% as least favourite); biology was the most (2%). When compared with similar research in coeducational schools, the findings suggested that science was less popular with girls in single-sex schools than their counterparts in coeducational schools. What this study (Francis *et al*., 2004) found. Factors affecting girls' **engagement with science** included: • relevance to everyday life – these girls felt that it was important to see the relevance of science to their everyday lives (e.g. preference where relevance was clear, frustration where the topic etc seemed 'pointless') • topics such as the human body, genetics and other biology-topics in particular (although less so for 'plants') • group work and collaboration in science – aided confidence in science and metacognitive skills (peer-teaching and peer-marking was a feature in the more successful schools here, as well as visual aids and teaching effective for a range of abilities) • practical experiments. Many girls found science 'hard' and 'boring' – '*even in schools successful at science*'. They **disliked**: • copying – from the board or textbooks • elements that were 'abstract', technical or mathematical • '*topics not clearly relevant to their own lives*' (p.iii) – on this though, it should be noted that even where teachers tried to make science relevant, this was not always recognised by pupils.

	Other findings: • girls picked up on messages of 'relevance to exams' but did not always see other relevancies • perceived lack of relevance particularly in chemistry and physics • some intimation of science as 'pointless unless you want to become a scientist' • teachers' enthusiasm for the subject-matter transmitted enthusiasm to the pupils and prompted their engagement.
Findings and themes for this research review	
When do young people make choices?	The studies highlight that science is amongst one-third of these girls' least favourite subjects in Year 10 and Year 11. Chemistry is nominated as least popular, far more than biology, for example. Chemistry seems to be less popular with girls in all-girls' schools than it is with their counterparts in coeducational schools.
Who advises them?	
What are the influences on choice?	The study includes a range of themes, which might have a positive influences on engagement in science, including: • relevance – where science was *'brought alive'* (p.43) by teachers, e.g. specifically targeting towards girls (e.g. investigating cosmetics) this seemed more successful in engaging girls in science (NB – lack of relevance to everyday life, and relevance only for exams was a predominant message reported in this research, as putting girls off science) • well structured lessons (mainly from the teacher comments) • groupwork (this aided girls' confidence in science, allowed for peer-teaching and peer-assessing, and catered for a range of ability, and improved girls' metacognition and understanding through reinforcement, teaching someone else, etc.).

Jenkins, E.W. and Nelson, N.W. (2005). 'Important but not for me: students' attitudes towards secondary school science in England', *Research in Science and Technological Education*, **23**, 1, 41–57.	
The study	
About the study	An international comparison study on the Relevance of Science Education Project (ROSE). This part of the study explores results from England on: • pupils' views on their school science education • choice of careers • what they would most like to learn about in science lessons.
Sample	1,266 pupils from 34 schools (1,180 14/15 year olds, i.e. Y10; 86 16 year olds).
Research design	Questionnaires using Likert-type scales (disagree, low disagree, low agree, agree), using closed items (e.g. topics on 'what I would like to learn in science' were nominated from made from 108 closed items; and a section on 'My science classes' involved 16 statements about difficulty, interest, future plans, etc.
Key findings	**'My science classes':** • not too difficult • generally interesting • on the whole, not pupils' preferred subject • pupils did not on the whole aspire to become scientists • careers in science or technology did not appeal to these pupils • encourages curiosity, but does not on the whole increase appreciation of nature, foster the desire for enquiry, or make these young people more critical or sceptical • has not 'opened our eyes to new jobs' • science is not specifically important to the way we live • would be useful as a career asset in general. **What I would like to learn in science** **Other findings** Whilst these pupils strongly agreed that 'everyone should learn science', they also strongly disagreed that 'we should have as much science as possible at school'. Girls were more likely to disagree with the statements '*school science is easy*', '*school science is better than other subjects*', and '*I would like a job in technology*' – than boys.

Findings and key themes for this research review	
When do young people make choices?	The findings seem to suggest that '*many young people have already made up their minds whether or not they wish to pursue a career in science or technology by the time they embark on their GCSE courses at the age of 14 or 15. If this is indeed the case, it implies that good teaching of science to younger pupils is of particular importance*' (p.53).
Who advises them?	A message is also raised here for science careers advisors and the science profession – how to engender enthusiasm for scientific enquiry, critical and sceptical skills, opening a world of exciting jobs. Linked to other research, (e.g. Munro and Elsom, 2000) there might also be implications for when such advice is effective – many students make choices when their motivation in science subjects has decreased, and they have limited awareness of potential science careers.
What are the influences on choice?	Key influential factors include: • **the science curriculum** – including in the way in which it is taught (the study suggests a disparity between the intended science curriculum as specified, and the curriculum as taught and experienced by pupils • **gender** – the authors ask whether it is possible to construct a science curriculum that reflects pupil interests? Would there be a tension between provision for gender equity, and providing for these different interests? • **lack of interest in scientific careers** – one of the strongest responses in this survey. (Other research, e.g. Osborne and Collins (2000), also shows that whilst pupils value science as an important part of the curriculum and possible career benefits, it lacks intrinsic interest in its own right) • **other influences** – outside the school system, which might refer to wider issues in the 21st century around the nature of science, religion and other **socio-political/philosophical** issues.

London Development Agency (2006). *Science, Technology, Engineering, Mathematics (STEM): Achieving World Class Skills for London* [online]. Available: http://www.lda.gov.uk/server/show/ConWebDoc.1575 [23 November, 2006].	
The study	
About the study	A report which draws together the evidence on STEM skills, STEM skills gaps in the UK, and the action needed to embed STEM skills in London. Although of relevance particularly to London, the findings will have resonances elsewhere.
Sample	
Research design	Desk-based research and consultancy, as well as case study interviews and questionnaires with employers.
Key findings discussed in this paper (including findings from other research)	The report highlights: • Young people's impressions of STEM subjects – e.g. at school, more difficult, less well taught and more boring than other subjects • Young people's perceptions that the STEM sector is less well paid, less exciting and less stimulating than others (with similar perceptions being reported from teachers and careers advisors) • Young people's images of STEM with 'old economy' rather than innovation • A lack of positive media coverage of STEM • Age 13–14 being the key time when careers guidance and stimulating teaching can motivate young people towards STEM pathways • A lack of vocational content and general employability skills of STEM degrees • Issues of recruitment and retention regarding STEM teaching staff in schools, FE colleges and universities in London • Issues around widening participation among under-represented groups. Amongst the recommendations is the need to: • improve the support available to those offering careers education, 'so that they can provide informed advice on the opportunities of STEM' (p6), including raising both the quality and frequency of Information Advice and Guidance services and careers support in schools, FE and HE • increase the number of young people studying STEM subjects at school, FE and HE and to raise careers awareness in these subjects • extend the use of role models, ambassador schemes and technology competitions to promote STEM to young people and to promote closer education-business links • provide STEM taster courses for students and potential returning students.
Findings and themes for this research review	
When do young people make choices?	Age 13–14 is suggested as a key time when choices are made, and hence when STEM teaching should be stimulating and motivating, so that students are making decisions at a time when they are positive towards STEM.
Who advises them?	Teachers, careers adviser and other support from the Information Advice and Guidance Services – although this report suggests this sources of support to young people needs to be both better quality and more frequent.
What are the influences on choice?	Some influences include: • Young people's perceptions of STEM subjects (e.g. difficult, boring, less well taught than other subjects) • Young people's images of STEM careers • Lack of vocational content of STEM courses at degree-level • Lack of positive media coverage.

Murray, I. and Reiss, M. (2005). 'The student review of the science curriculum', *School Science Review*, **87**, 318, 83–92.	
The study	
About the study	A student-led review of the science curriculum, to examine issues such as: • the content of the curriculum (topics, amount, likes/dislikes, values, ethics, relevance) • teaching pedagogy and effective ways of learning • modes of assessment • attitudes to science (including relevance, interest) • manageability (including workload).
Focus / Description	An on-line survey of 55 questions on the science curriculum. Most questions referred to science at key stages 3 and 4; however, a number of questions asked the young people to reflect back to primary science.
Sample	Responses were received from 1,493 young people in six weeks.
Research design	An online survey, designed by 16–19 year olds, for 14–16 year olds, and 16–19 year olds, to complete.
Key findings	**What the young people felt about the science curriculum** **Content –** the curriculum should include: • more on controversial issues • more on philosophy, ethics and moral issues • the encouragement of curiosity (to some extent, although more than half of those taking double-award science did not think so) • choice regarding dissection • more on learning how to apply what they were learning. **Attitudes towards school science** • is 'interesting', 'useful', 'relevant' and 'thought-provoking' as well as 'boring' and 'difficult' • biology-related topics the most interesting in GCSE science (because they related to 'everyday life'), followed by physics and then chemistry • physics-related topics the most irrelevant, followed by chemistry then biology (this pattern was portrayed strongly by the girls; there was little within-science variation for the boys). **Manageability and facts** • workload in science was felt to be similar or more than in other subjects • 'too many facts', 'too much emphasis on rote-learning', reliance on memory rather than understanding • the young people would like fewer topics in more depth. **Views on primary science:** • should be more practical – to '*see what is going on in science*' (but pupils do not necessarily want science to be more IT-based) • had put them off science (11%); had encouraged them to do more science (34%); had no impact on their enthusiasm for science (the remainder); ' … *the data suggests that a strong negative or positive primary science experience carries through for the next six or seven years*' (p.91). • Those who did not understand GCSE science often reported being put off science at primary school.

	What the young people felt about ways of learning science **Enjoyable and effective ways of learning:** • class discussion and practical activity were rated as both enjoyable and effective • most enjoy: science trips; watching videos; doing experiments; class discussion/debate • most useful to learning: discussions/debates; taking notes from the teacher; doing experiments • least useful to learning: researching science on the internet (i.e. nominated least often from a given list). **Practical activity** • helped pupils understand theory; but science theory/learning was not that often backed up with practical work • single award scientists reported the least amount of practical work. **Modes of assessment** • generally happy with their current assessment arrangements – mainly module exams and tests • little call for more practical-assessments – pupils worried about pressure to get it right, or felt that their teacher could get 'better' results when they carried out experiments. **Science teachers** • science to be taught by an enthusiastic teacher • good science teachers were crucial – science teachers should be qualified to teach science and should have appropriate subject specialisms.
	The young people's recommendations The students themselves compiled **ten recommendations** for the science curriculum and science teaching. The science curriculum should: 1. include more ethical and controversial issues 2. cover fewer topics, be slimmer (i.e. allow for in-depth and detailed treatment) 3. include a coherent treatment of the maths needed for science 4. enhance the real-life relevance of chemistry and physics, as pupils perceive the case to be for biology (pupils feel this would raise the popularity of chemistry and physics) 5. afford primary science equal status/importance as English and maths, integrate science with other subjects, and provide better equipment in primary science. Science teaching should: 6. be carried out by qualified science teachers with a subject specialism in science 7. allow individual students the choice as to whether to not they do dissection 8. include relevant (to the syllabus) and supervised practicals, with up-to-date equipment 9. include class discussions – which provide the opportunity to learn from others (other than the teacher), and to disagree and develop their own ideas 10. be engaging for students (teachers should be able to engage students) and use visually stimulating material.

Findings and themes for this research review	
When do young people make choices?	The study highlights findings on when young people's science attitudes are formed, including that primary science had: • put some off science (11%); encouraged some to do more science (34%); no impact on their enthusiasm for science (the remainder); '*the data suggests that a strong negative or positive primary science experience carries through for the next six or seven years*' (p.91).
Who advises them?	
What are the influences on choice?	The findings highlight a range of themes, which might have an influence on 'choice' including: • curriculum content (relevance, management, enjoyment) • extent and quality of practical activity in science lessons • the importance of science teachers and science teaching.

Qualifications and Curriculum Authority (2004). *Pupils' Perspectives on Science 2003/4* [online]. Available: http://www.qca.org.uk/downloads/12363_sc_pupil_perspectives_report_03_04.pdf [23 November, 2006].	
The study	
About the study	This study was part of QCA's monitoring of science curriculum, including its assessment arrangements, support materials, schemes of work for key stages 1 to 3, and science at post-16. The study examines pupils' views on school science and assessment issues.
Sample	Interviews with 77 young people (43 in primary school; 23 in secondary; 11 at post-16) from 11 schools/colleges. Questionnaires to 367 young people (71 at KS1&2; 176 at KS3&4; 120 at post-16).
Research design	Interviews and questionnaires covering key stages 1–4, and post-16. Questions explored favourite subjects, likes/dislikes about science lessons, what is easy/difficult in science, things pupils would like to learn more about in science, whether science helps them understand issues on TV/news etc, views on assessment in science, extent of choice at key stage 4, and reasons for choice at post-16.
Key findings	**Primary science** (perspectives from key stage 1 and key stage 2) • Science was ranked as primary pupils' second favourite subject (just behind art) • Pupils liked the practical, hands-on nature of science, including doing experiments, and some who liked outdoor science work, researching, and using ICT in science • '*There was a close correlation between what key stage 1 and key stage 2 children like best in their science lessons with 'what they find easy*' (p.4) • Areas of difficulty included writing up, recording, interpreting graphs, and explaining things; and topics such as changing states, forces, electricity, parts of a flower, planning a fair test etc; skills and topics noted by teachers as difficult for children • Recommendations for changes to science lessons included: more 'fun', more practical, less writing. Other areas suggested by fewer pupils were to be trusted for doing experiments, using proper equipment, more trips. 15% would not change anything about their science lessons. By far the most common other area they would like to learn about, but had not yet covered, was chemistry and chemical reactions (26% would like this) • Pupils felt that their school science helped them most of the time or sometimes to understand scientific issues in the news/on TV etc • Most felt the key stage 2 statutory tests were important – they helped them to know how they were progressing. A number found them stressful. **Secondary science** (perspectives from key stage 3 and key stage 4) • There were similar likes/dislikes of activities at key stage 3 as at primary; and similar areas of difficulty/ease; although there was a more diverse range of 'favourite subjects'. Although only noted by four of these pupils, a key to what else they would like to learn in science was 'relevance to their everyday lives' – e.g. how mobile phones work, sex education, space, GM crops. • In terms of manageability, most pupils were finding their key stage 4 science courses (double award, three sciences, 21st century applied science) 'OK'; and 15% rated their course 'difficult'. Areas of difficulty included: the amount to remember, time to learn it in, facts, depth, precision. Certain topics caused difficulty, e.g.: electricity, equations, chemistry-related, physics-related. • Again, it was areas relevant to their own lives that pupils would like to learn more about, or to be added to their science courses – particularly those taking Double Award. E.g. science related to drugs, how things work, illnesses, practical science. Those taking three separate sciences tended to request more on space and the universe.

- Their school science seemed relevant to their understanding of scientific issues in the world/news about them, although 14% (mainly from double award pupils) felt it did not help them in this way at all.

Science at post-16

Reasons for choosing science at post-16 included:
- interest (for the subject and studying it in more depth) – by far the most popular reason
- important for chosen university course and/or career (including some who felt science subjects kept options open) (39%)
- enjoyment of subject (31%)
- good at subject (including had good GCSE grades in it) (9%)
- relevant to everyday life and the world (7%).

In terms of progression/transition **from key stage 4 to post-16 science**, 45% found it 'OK', while 44% found it 'difficult', and 10% 'really difficult'. Difficulties with this transition included:
- amount to learn, process and remember, especially in time for the AS January exams
- greater details and depth of knowledge required
- perceived big jump or gap in demand between GCSE and AS
- workload
- mathematical demand, particularly in chemistry and physics.

Regarding **manageability of post-16 science:**
- 27% felt they coped with this well through their own organisation and planning; 9% felt they did not cope well, and pointed to the demands of conflicting coursework deadliness. 69% noted strategies such as doing work in study periods, mornings, evenings & weekends, doing homework immediately, spreading the load across subjects, making clear notes and clarifying points with the teacher, revising along the way and at least a month before exams.
- Whilst the majority felt that the assessments were 'OK', difficulties included: the timetabling of coursework deadlines; compressed and pressurised timetable for exam papers; perceptions that some exam papers were poorly worded, and thus misinterpreted.
- Recommendations for additional topics or changes to the curriculum came from A/AS students, and included to learn about: modern science and scientific breakthroughs; medicine; and overlapping topics for those taking biology, chemistry and physics.

The future
- 54% of these students hoped to go on to scientific degrees and careers including: medicine, midwifery, physiotherapy, sports science, forensic science, chemical engineering, etc.
- 27% wished to study further, but were not sure or did not specific a subject area.
- 7% not sure; 8% did not respond; 11% indicated a degree/career in a non-scientific area.

Findings and themes for this research review	
When do young people make choices?	The research highlights how young children link enjoyment with ability, i.e. '*a close correlation between what key stage 1 and key stage 2 children like best in their science lessons with 'what they find easy*" (p.4)
Who advises them?	
What are the influences on choice?	Young people who do choose science at post-16 cite the following reasons: • interest • enjoyment • importance for own career • keep options open • ability. Factors that might put young people off science include: • workload, amount to learn • extent of practical activity • finding the subject hard.

Appendix III

Alternative presentation of data

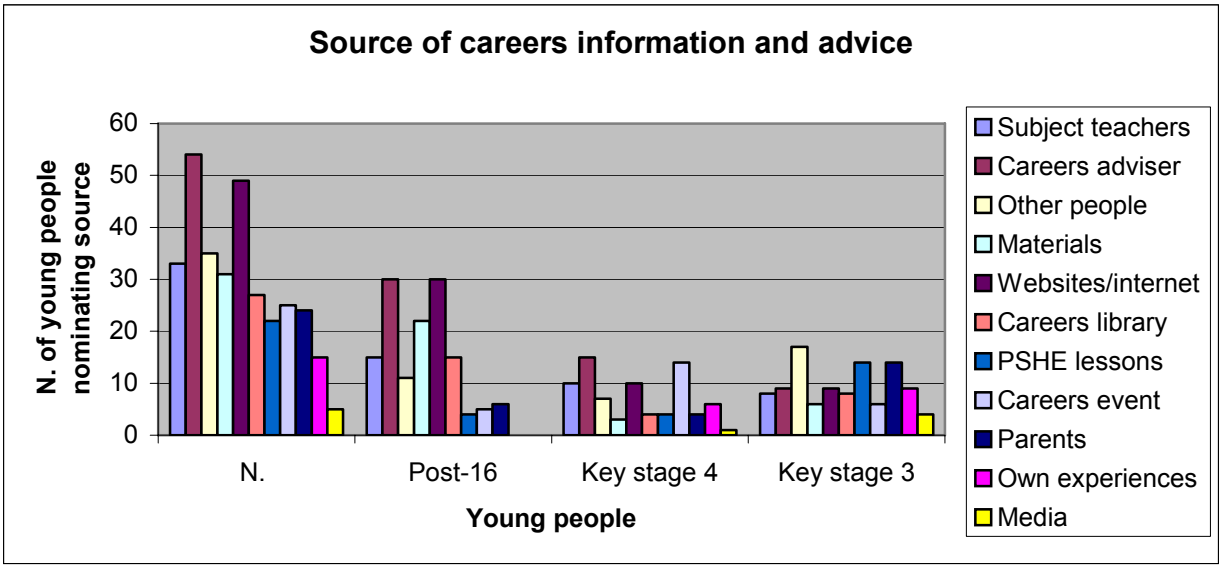
Figure 4.1 alternative Young people's views on when they would like to see the RSC materials

The table shows the no. of pupils identifying each time period/year group. Interviewees could nominate more than one year group.

	Post-16	Key stage 4	Key stage 3
At all times	13	5	11
Primary school	-	1	-
Year 7	3	-	3
Year 8	2	3	7
Year 9	15	12	21
Year 10	10	11	2
Year 11	28	14	8
Year 12	16	3	2
Year 13	10	3	2

Source: NFER interview survey on RSC materials 2006.

Table 4.19 alternative Sources of careers information and advice



Source: NFER interview survey on RSC materials 2006.