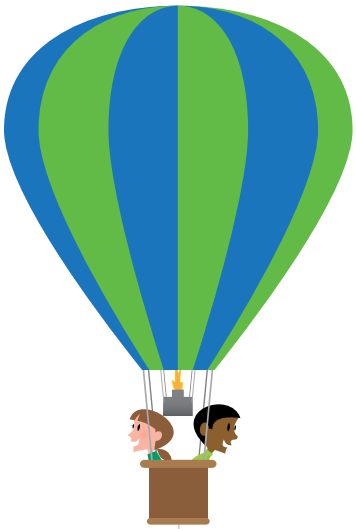

The National Strategies
Secondary

Progression to post-16 science: the report

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department for
children, schools and families

Progression to post-16 science: the report

First published in 2009
Ref: 00461-2009PDF-EN-04

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Progression to post-16 science: Executive summary

- This research project gathered evidence from 86 schools that were particularly successful at encouraging students to study science post-16. Students, teachers and other stakeholders were interviewed and the results analysed to indicate successful strategies. Some factors are beyond the control, and sometimes beyond the influence, of schools, many others are not. Good schools with diverse curriculum structures and good teachers are making a difference.
- In these schools, teaching in science is good or very good. Subject knowledge and understanding, and pedagogical skill are significant factors. Lessons are orderly, but the dialogue is lively and the possibility of asking questions is ever present. There is lots of practical work. The teaching challenges, asks questions, is relevant, meaningful and purposeful. Work has to be finished on time and be of an appropriate standard. However, the challenge is tempered by high-quality student–teacher relationships.
- The science departments are well led and managed. Collegiality is high and subject specialists are used effectively and support colleagues. The curriculum is enriched by visits, visitors and projects that bring the world of science into the classroom and introduce students to the science world outside. Resourcing is not necessarily generous but is used effectively and targeted at identified priorities. While an improved learning environment alone may not cause an increase in post-16 take-up, a poor one discourages it.
- Other features of the curriculum include well-informed, timely careers education, including work experience specifically related to careers in science; support for students' learning; knowing the students academically and personally; making good use of tracking systems; and hence being able to provide appropriate support and engagement.
- Where uptake was high the science team had deliberately set out to recruit students into post-16 sciences, even in 11–16 schools, by such strategies as challenging students to try some sixth-form work in their lessons and using sixth-formers to mentor students and act as demonstrators.
- Some factors, which apply to all students, are of particular significance for students who achieved B grades in GCSE science. Schools successful at encouraging these students to continue with science offer a diverse, differentiated curriculum, track them carefully and identify potential sixth form science students early, giving them formal and informal tasters. They understand that girls' reasons for pursuing science post-16 may be different from those of boys and modify teaching accordingly. The research suggests that these students have come to science as a result of more recent experiences; many decided on science in Key Stage 4. They may be easier to influence and have benefited from policies of inclusion. However, their commitment may not always be as secure and approaches to nurturing them must look to the long as well as the short term. Links with parents, universities, the world of work and other partners are vital. It is important for schools to keep these students engaged and connected to other stakeholders. Relationships with and support from teachers, team work in the department, enrichment, relevance, interest and enjoyment in the curriculum all seem to have a higher profile.

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The report

Background

There have been three reports to the Department for Children, Schools and Families (DCSF) about the factors which support progression to post-16 science:

- February 2006: Report presented to DfES school science board
  - This report identified characteristics of schools and science departments in which organisational factors were associated with higher-than-average uptake of science subjects post-16. The report was based on 12 school visits drawn from a group of 30 high-attaining schools nationally.
- March 2007: Progression to post-16 science: interim report (Ref: 00372-2007DWO-EN-01)
  - This reported the research into progression to post-16 sciences in a small initial sample of schools (ten) where uptake by students with two A*–A grades in science GCSEs was greater than the average deviation from the mean. The findings of this report were used to focus the research undertaken in a wider range of schools in the following 12 months.
- April 2008: Progression to post-16 science – an enquiry into the factors which are influential in achieving high levels of take-up of science subjects post-16. (Ref: 00130-2008DWO-EN-01)
  - This report summarised the findings from an enquiry into 55 schools which showed good progression by students attaining two A*–B grades in science at GCSE to post-16 science courses. The findings were based on visits to over 40 secondary schools, involving both student and teacher interviews as well as an exploration of data and questionnaire responses.

This new report widens the evidence base to a total of 86 schools, a further 23 of which have been visited, and includes the findings from schools in which uptake by students with two B grades in GCSE science is above average.

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Findings from the 2007 report

- This report, based on a limited sample of schools, found that the schools with high take-up of science post-16 were generally good, or outstanding, schools which added value at both key stages and whose students generally possessed high levels of functional literacy and numeracy. In these schools, the science department enjoys a reputation of being important and successful, and knowledgeable specialists in biology, physics and chemistry teach their subjects enthusiastically and well. Teamwork and professional development are significant features of the departments. Teachers are highly collaborative and share a determination that their students should enjoy science and do well. They know the students well, both academically and personally, and tailor their efforts to meet individual needs. Students not only enjoy learning science but also the challenge of studying what they perceive as a difficult area. Parents show an interest in science and there are often, though not always, strong vocational influences on students' choices.
- The report made recommendations for the further development of the project as follows:
  - widen the student base from A*–A to A*–B and use this data to identify further schools to be visited
  - improve the enquiry tools; for instance, including Year 11 and younger students in the interviews
  - examine the links between take-up and effectiveness post-16, looking at rates of attrition, attainment and contextual value added (CVA) in science subjects post-16
  - examine the extent to which science-based work opportunities in the locality influence uptake
  - explore students' pre-16 experience to investigate the influence of curriculum models (time allocation, subject allocation, teacher allocation) on take-up in science
  - seek more corroborative evidence for the interim findings to date
  - seek further examples of effective practice to illuminate the practicalities of increasing uptake of, and enhancing progression in, science from Key Stage 4 to Key Stage 5 and inform guidance to be published in 2008.
- These recommendations provided the basis for the research leading to the existing 2008 report and this new 2009 report.

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Aims of the 2008 and 2009 reports

The aims of the enquiry were to:

- identify the factors that are significant in influencing young people to pursue science studies post-16
- provide evidence of the ways in which these factors interrelate to improve progression to post-16 science
- describe the strategies used by schools to improve and enhance progression in science post-16, and explain how and why these have an impact in the context of the schools involved to assist transferability to other organisations
- make recommendations about what to do to improve uptake of science subjects post-16.

The findings in this report are based on two pieces of research: the first (reported on in 2008) focused on forces, policies and processes relating to good practice in supporting students who were awarded (two or more) grades A*–B in science at GCSE and the second (in 2009) on those who were awarded (two or more) grade Bs. Unsurprisingly, a significant number of the elements identified in the first piece of research (and therefore featured in the 2008 report) were also found to be significant in the 2009 research. They have therefore been retained in this report without further comment as aspects of significance. However, there are other findings which are of particular importance in relation to students with two grade Bs in science at GCSE and attention is drawn to these. The identified schools are tabulated in the sections Background contextual data and information, with respect to region, age range, gender, admissions and specialism. The tables show the make-up of the survey groups from the two years and of the combined group.

Structure of the main findings of the 2008 and 2009 combined report:

- Rationale
- What are the distinctive differences between the schools visited in 2008 and 2009?
- Background contextual data and information
- Common features of schools that correlate to high take-up of post-16 science
- Distinctive differences between students with a grade B in science at GCSE and those with A* or A grades, in terms of what is needed to support and encourage them to study science post-16
  - The nurturing influences
  - The messages emerging from student interviews in relation to gender
- Factors that contribute to high take-up of post-16 science
- Forces that contribute to high take-up of post-16 science
- Processes that contribute to high take-up of post-16 science
- Policies that contribute to high take-up of post-16 science

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Main findings from the enquiry

Rationale

1. According to the report presented to the DfES school science board in February 2006, certain characteristics of schools and certain organisational factors within science departments were associated with higher-than-average take-up of science subjects post-16. For instance, take-up was seen to be higher in selective schools, in schools where socio-economic factors are favourable and where attainment on entry is high. Setting by prior attainment, provision of separate science and specialist teaching also featured in schools where progression to post-16 science was higher than usual. There are also well-established patterns of take-up associated with gender, and with achievements in and enthusiasm for specific science subjects.
2. In that initial report, considerable emphasis was placed on the fact that the factors identified could not be regarded as causal. Neither could they be considered separately from each other.
3. The methodology behind the second phase of this post-16 project, leading to the interim report in March 2007, built on these early findings by continuing to examine schools as case studies. Using a broader range of perspectives, in particular those of the students, and a more comprehensive database, the project added depth to those early findings and unearthed additional features common to schools with high take-up post-16. It began to reveal the subtlety of the factors that interact to advance post-16 science and highlighted the forces (e.g. parental support, student enthusiasm), factors (e.g. prior attainment), policies (e.g. separate science at GCSE, specialist status) and processes (e.g. bridging courses, links with HE, teacher continuing professional development (CPD)) that contribute to its success.
4. The third phase of the enquiry leading to this report was designed to corroborate initial findings by widening the database further still and to identify, with greater reliability, the policies, arrangements and practices associated with success in recruiting students to study science in the sixth form.
5. Key questions then became:
   - Why do students choose to study science A Levels?
   - Why don't students select science A Levels?
   - What can schools do to improve their uptake of science subjects post-16?

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What are the distinctive differences between the schools visited in 2008 and 2009?

The full report (published June 2008) has been supplemented by additional research and analysis to identify distinctive differences between students who were awarded two grade Bs in science at GCSE – and what is needed to support them through to post-16 – and A*–A grade students and what they need. In many cases the findings are similar but where the new research has identified additional factors or a different weighting this is identified by the insertion of italicised text.

The research included extensive interviews with teachers and students. As well as basing the findings on a synoptic view of the challenges and solutions, quotes from individual schools are included. They have been selected on the basis of offering a particular insight into the perspective held by a school that has been successful at recruiting students to study science post-16, rather than necessarily being typical of all such schools. Such quotes have been placed in boxes for reasons of clarity.

Background contextual data and information

1. There are significant regional differences in take-up of the three sciences. Tables illustrating the national and regional variation can be downloaded at www.standards.dcsf.gov.uk/nationalstrategies (Appendix 1).
2. The picture nationally demonstrates what is already widely known. Biology is the most popular of the sciences at A Level, though not significantly so with the highest attaining (A*–A) students. Physics is the least popular, with 15%–20% of the highest-attaining students opting to take it in each of the three years examined, compared with 30%–35% opting for biology and 25%–35% for chemistry. When a wider range of prior attainment is taken into account the patterns are similar but the overall uptake is proportionately smaller. More detailed accounts than these are available through the learned associations and the office of the Government Chief Scientific Adviser.
3. There are, however, regional variations and patterns which seem to prevail year on year, at least for the periods studied. These variations and patterns appear to be subject specific.
4. The pattern of take-up in physics is similar year on year for both the A*–A and A*–B cohorts. Inner London and the North West seem to have consistently lower take-up than other regions. The South West, East Midlands, West Midlands and the South East have a higher take-up than is the case nationally in each of the three years examined.
5. In chemistry, the pattern of take-up is also similar year on year irrespective of prior attainment, though different from physics. In Inner and Outer London and the West Midlands (and to some extent the East Midlands) take-up tends to be higher, while in the South West and South East and to a lesser extent in the Eastern Region, take-up is lower.
6. Biology presents a slightly different picture but it remains the case that there appear to be regional variations and patterns associated with the take-up of biological sciences at A Level that are consistent over time and with the prior attainment of the cohort. In London, the East Midlands and the North East take-up is higher, consistently, whereas in the South West, South East and Eastern Regions it is relatively low.

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7. The regional distribution of the 54 identified schools in the 2008 survey and the 32 in the 2009 survey considered in the study is described below.

Region	% of schools in the sample 2008 survey	% of schools in the sample 2009 survey	% of total sample
West Midlands	24	15	21
Greater London	20	13	17
North West	20	9	16
East of England	9	15	10
South East	7	13	9
East Midlands	7	9	8
Yorkshire and Humberside	7	13	9
North East	5	7	6
South West	0	7	2

This table indicates that extending the research, to include schools with good uptake by students with two B grades at GCSE, has not only increased the number of schools but shows a more even balance across the regions; however some regions, particularly the South West, remain under-represented.

8. The following tables illustrate the characteristics of the sample of schools selected using the criteria of high student uptake of science post-16.

Age range	Selected schools % 2008	Comment	Selected schools % 2009	Comment	Selected schools combined	Comment
11–16	7%	4 schools	25%	8 schools	14%	12 schools
11–18	84%	46 schools	63%	20 schools	77%	66 schools
11–19			6%	2 schools	2%	2 schools
13–18	7%	4 schools	6%	2 schools	7%	6 schools

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Gender						
	2008 sample		2009 sample		Combined sample	
Boys	27%	15 schools of which 11 selective	9%	3 schools, of which 2 selective, 1 comprehensive	21%	18 schools, of which 13 selective, 5 comprehensive
Girls	4%	2 schools, 1 selective	3%	1 school, selective	3%	3 schools, of which 2 selective, 1 comprehensive
Mixed	69%	37 schools	84%	28, all comprehensive (inc. 2 secondary modern)	75%	64, all comprehensive (inc. 2 secondary modern)

Admissions			
	2008 sample	2009 sample	Combined sample
Selective	27%	9%	21%
Comprehensive	71%	84%	76%
Modern	2%	6%	3%

Main specialism						
	2008 sample		2009 sample		Combined sample	
Science	16%	9 schools	9%	3 schools	14%	12 schools
Sport	16%	9 schools	22%	7 schools	19%	16 schools
Technology	15%	8 schools	22%	7 schools	17%	15 schools
Mathematics & Computing	15%	8 schools	16%	5 schools	15%	13 schools
Art	15%	8 schools	9%	3 schools	13%	11 schools
Humanities	7%	4 schools	3%	1 school	6%	5 schools
Business & Enterprise	4%	2 schools	0%	0 schools	2%	2 schools
Languages	4%	2 school	9%	3 schools	6%	5 schools
Engineering			3%	1 school	1%	1 school
None (academies)			6%	2 schools	2%	2 schools

Note: The total percentages may not add up to 100% due to rounding of figures.

These tables indicate that a large proportion of the schools in both samples are mixed, comprehensive 11–18 schools; the addition of the more recent sample tends to suggest that there is not a significant correlation between subject specialism and success in encouraging students to study sciences post-16.

9. School specialisms appear not to have an impact since a sports specialism or a technology specialism or a mathematics and computing specialism appear as frequently as the specialism in science. Nevertheless, in a number of the sports specialist colleges the link between sports science and biology was identified as a key part of the successful uptake of biology. Furthermore sport was also described as being influential because it made science 'less geeky' (see Appendix 5 Case Study Cameo i which is available from www.standards.dcsf.gov.uk/nationalstrategies) particularly where science teachers contributed to coaching in sport and as a result built good relationships with the students, which spilled over into lessons (see Appendix 5 Case Study Cameo v which is also available from www.standards.dcsf.gov.uk/nationalstrategies).

10. Relationships between subjects and the influence of the specialism on science and students' attitudes to science are worthy of further enquiry since it is notable that arts, humanities, languages and business and enterprise specialisms barely figure.

11. The data in the charts has been used to raise questions, such as whether the age range of the schools or the gender base make a difference.

12. These headings have been retained for this report to help practitioners to understand the recommendations. Where appropriate the content has been developed and, if the broader evidence base provides sufficient justification, key points have been either added or deleted.

13. In September 2007 the National Strategies provided, for most LAs and schools, the first student-matched data on progression to A Level sciences they had analysed. Relatively few schools (13) had data from other sources (either Advanced Level Information System (ALIS) or A Level Performance Systems (ALPS), that enabled them to evaluate the effectiveness of provision. Some had comprehensive data sets, tabulated and going back year on year, and used the data rigorously to steer science department development.

14. In most schools there is inconsistent year-on-year take-up of A Level sciences. Often the variability in take-up is related to inconsistent practice within the science department. Students' perception of the quality of teaching and their learning experience throughout Key Stage 3 and Key Stage 4 can affect their choice.

15. The significance of students with B grades is worth drawing attention to: admissions policies of schools in relation to A Level courses vary significantly with regard to these students. They are proportionately less likely to choose to study A Level science and they are a larger group. In other words this is a key group to be looking at if increased recruitment is to be achieved.[1]

Common features of schools that correlate to high take-up of post-16 science

The science departments are seen to be a key part of the whole school. Most of the schools in the sample of schools visited are judged by Ofsted to be good schools with outstanding features or outstanding schools. Even where a school was judged to be satisfactory overall, certain features stood out as good. The features that stood out in all the schools (even if attainment and achievement were not particularly marked) were:

- the promotion of the personal development and well-being of the learners by the school
- the curriculum, and the other activities provided by the school to meet the range of needs and interests of learners, as part of a process of personalising provision

1. Institute of Physics, Royal Society of Chemistry, Institute of Biology and Sir David King Kt FRS FRSC FinstP Government's Chief Scientific Adviser

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- the care, guidance and support given to ensure that learners are enabled to realise their potential.

In addition, the following common features were identified from the school statistics and responses:

- student mobility is low
- value-added statistics are good in both Key Stages 3 and 4
- half of the students at the end of Key Stage 4 have level 2 functional literacy and numeracy; most schools have far higher levels than this.

Differences that emerged from the cohort of schools in the 2009 research compared to those in the 2008 cohort

A number of characteristics emerged and these are summarised below.

- As a result of interviewing separate gender groups there seemed to be 'clearer gender voices', suggesting that the reasons for girls pursuing science post-16 may be different from those for boys.
- There was a higher proportion of 11–16 schools.
- There was a lower proportion of selective and single-sex schools.
- There was less distinctive regional variation.
- There was a more diverse, differentiated curriculum on offer, with a range of pathways to suit individuals, including triple science, some of which were responding to the 2008 requirement while others had been established much longer.
- There was more careful tracking of students (in line with a wider school agenda), identifying potential sixth-form science students early and giving them formal and informal tasters.
- Accommodation was generally poor or adequate, though resourcing was satisfactory and sufficient for practical work to take place. There was good technical support, the lessons were orderly and ICT was used for research, though not necessarily extensively.

These characteristics are explored in more detail in the following text.

Distinctive differences between students with a grade B in science at GCSE and those with A* or A grades, in terms of what is needed to support and encourage them to study science post-16

- The research supported the view that students with a grade B in science at GCSE have come to science as a result of their life experience. They seem easier to influence and are more open-minded about the nature of science education. First/second generation immigrants and girls may have benefited from policies of inclusion and emancipation but the situation may not be secure and approaches to nurturing such students must look to long-term as well as short-term measures.
- Developments must be sustainable. Schools have to be adaptive and respond to needs and changing circumstances. Hence the importance of responding to student voice, nurturing relationships and developing good pastoral care systems. Links with parents, universities, the world of work and other partners are crucially important. It is important for schools to maintain dialogue with these students and keep them connected to other stakeholders.

- For these students, their interest in science seems to be one that developed – many decided on science in Key Stage 4. In other schools they may have been lost to science: it shows that schools can have an impact and teachers can make a difference. The A and A* grade students tended to be committed to pursue science from an earlier stage, were often exceptionally good at it and found it easy.

(Student) views about sixth-form science were that it was a lot harder than GCSE and that you studied in more depth, were expected to work a lot more out of class and hence needed 'lots of commitment'. It was still fun and interesting and built on GCSE. Most students would still choose the same subjects but would do more work from the beginning. They suggested, like most sixth-formers, that you should only do science 'if you really want to do it' because it is 'definitely not a "doss" subject!' Their view was that people who don't choose science have a perception that science is very hard.

The nurturing influences

Compared with the schools visited for the 2008 report, the curriculum, relationships, support, teamwork in the department, enrichment, relevance, interest and enjoyment all seem to have a higher profile. It seemed to be more important to see the student as a 'client', to hear their voice and respond to their needs if they were to be recruited. For some schools this is a hard message because of the challenging behaviour of some of the students. It was noticeable in all the schools visited that behaviour and attitudes were exemplary.

All the students talked to achieved grade B at GCSE and were quite clear that although they didn't get the best grades, the fact that they had enjoyed their science and been taught in an interesting way was a main reason for choosing it post-16. Because of this they were motivated and prepared to work hard at it, and didn't feel they were disadvantaged in any way.

The messages emerging from student interviews in relation to gender

Most of the reasons cited by boys and girls were similar. However, boys in single-sex schools seemed to suggest that being educated separately was a factor, indicating that while boys may think that girls who study science are fairly 'cool', the reverse was not the case and boys who studied science were concerned about being seen as rather 'geeky' to girls. They were fearful of their image: 'geekiness' as well as the subjects being too hard and lots of work were cited as the main reasons why other students didn't pursue science.

More widespread, since there were fewer boys' schools (proportionately) this time round, was the tendency for boys to do science because they enjoyed it, or wanted to find out about the world – the reasons were more intrinsic. Girls generally had extrinsic reasons, such as careers or helping others.

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Asked 'What influenced your choice of subjects?' the boys explained that they chose science for the following reasons:

- family influences
- they know that science is going to be important in the future
- they like and enjoy the subject
- their chosen careers require science;
- they are good at science subjects.

They felt that students who didn't choose sciences did so because it required too much commitment and science subjects were considered too hard.

Girls highlighted the careers that interested them. They wanted to help people and felt that science-related careers do this. They felt that science offered reasonably good career prospects. They too were interested in science and enjoyed the subjects they studied. Like the boys, they felt they were good at science.

Key factors that are influential in achieving high levels of take-up of science subjects post-16 in the school:

- Boys cited science as enjoyable, with few other influences on their choice. Some mentioned careers (pharmacy), one mentioned the 'influence of mum' but otherwise it was the experience of science in school that had urged them towards science post-16.
- Science is 'respected' by employers.
- Girls tended to have other reasons: 'curiosity', parental pressure, caring, they 'wanted to influence the lives of others'.

Factors that contribute to high take-up of post-16 science

Factors describe strategies that can be implemented relatively easily that might make a difference but are likely to be limited in impact unless proper attention is paid to policy and process. The following factors were all identified (from student and teacher interviews) as having an impact on the decision to study post-16 science courses.

Pedagogy

- Teaching in science is good or very good. Subject knowledge and understanding, and the pedagogical skill of the teachers are very significant factors indeed, almost universally so, and the tendency for separate sciences at GCSE to feature in about half (52%) of schools that participated through visits and questionnaires must be seen in this context (see Appendix 5, Case Study Cameo ii which is available from www.standards.dcsf.gov.uk/nationalstrategies).
- Orderly lessons, keeping the intellectual thread going, enabling meaningful practical work, lively dialogue and debate and the possibility of asking questions if things are not clear.
- Lively, experiential, colourful teaching of science in Key Stage 3 and (less so) in Key Stage 4 with lots of practical work.
- Teaching that challenges, asks questions, is relevant, meaningful and purposeful.
- Expectations of the students are high and the subjects are taught with the level of rigour that would be expected at university – teachers are 'on our tail', they 'take no prisoners'. Work has to be finished on time and be of an appropriate standard. The universally-given advice from sixth-formers studying science to those who might be considering it was unequivocal – 'Work hard', 'Keep up', 'Ask when you don't understand, don't get left behind' and 'Only do it if you really want to; it is tough'. In a number of schools, students' notes are checked after a few weeks to check that they are up to speed (see Appendix 5, Case Study Cameo ii which is available from www.standards.dcsf.gov.uk/nationalstrategies). However, the challenge is tempered by supportive student–teacher relationships and patient determination.

Curriculum

- In the schools providing 11–18 provision, A Levels are taught by subject specialists.
- At GCSE, in double science subject specialists are usually deployed to the relevant subject modules wherever possible and, where this is not the case, collegiality is high and subject specialists are on hand to support colleagues working beyond their graduate science qualification.
- Students studying separate sciences are taught by subject specialists and often study all three sciences, sometimes within curriculum time, sometimes supplemented by extra lessons outside school time.
- Usually students are selected for separate science on the basis of prior attainment, so that the groups are usually described as 'rigidly set'. However in one school the curriculum model enables students to choose from the three sciences those that they like and that they feel they are good at and this has a significant influence on uptake of the sciences chosen as students are not 'turned off' by having to study, for example, physics when they find mathematics very difficult, (see Appendix 5, Case Study Cameo i which is available from www.standards.dcsf.gov.uk/nationalstrategies).
- A curriculum enriched by visits, visitors and projects that bring the world of science into the classroom and students to the science world outside, (see Appendix 5, Case Study Cameo vi which is available from www.standards.dcsf.gov.uk/nationalstrategies).

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- Good resourcing, effectively used and targeted at identified priorities. While improving the learning environment alone may not cause an increase in post-16 take-up, a poor learning environment detracts from the efforts made by effective teachers to motivate students to follow science courses; students talked of the use of ICT to make lessons more visual and memorable, to illustrate difficult concepts, to scaffold their note-taking and to make the key points clear.
- Well-informed, timely careers education, including work experience, specifically related to careers in science. In several schools the science teachers took a hand in providing information about careers in science and organised work experience and visits for sixth-formers to explore careers in science that they would not otherwise have considered, for example, radiography, (see Appendix 5, Case Study Cameo v which is available from www.standards.dcsf.gov.uk/nationalstrategies)

Forces that contribute to high take-up of post-16 science

Forces are those circumstances which are influential but relatively difficult for a school to control or manage. They form the capacity of the school, department or community to change and develop. The following forces were all identified (from student and teacher interviews) as having an impact on the decision to study post-16 science courses.

Leadership

- Reputation and market forces, both internally and externally. Departments with effective progression to post-16 courses take a proactive role in 'marketing' their subjects with students, and take a long-term view of developing students' interest in and enjoyment of science throughout their secondary science experience.

Pedagogy

- Student enthusiasm and pleasure in studying, and being good at, subjects that they perceive as being regarded as difficult and which as a result have credibility.
- Students' attitudes, aspirations and ambitions: an aptitude for and enjoyment of science, a desire to find out how things work and apply their knowledge to help others and to pursue science professionally. A small but significant proportion had firm vocational reasons for choosing science subjects post-16, while others chose them in order to keep their options open. Some did three sciences because they wanted a lot of GCSEs, to look good on their CV.
- Teacher commitment, enthusiasm and 'professionalism': being quality-minded and 'client-centred'.
- 'Success breeds success' was a phrase used independently in three out of four schools visited to describe the influence of the achievements of other post-16 students on students selecting the courses they wish to study.
- Relationships with teachers, often identified as a 'significant other'. These can be relationships that build up through activities such as coaching in sport and field trips, because the science teachers are also sixth-form tutors or because they provide careers advice that relates specifically to science, or simply because the students know they will 'go the extra mile for me'. Students particularly emphasised the importance of not being left behind and the patience of teachers in this respect which enabled them to keep going even if it meant staying after lessons.

Other

- Parental interest in, and support and enthusiasm for, science as well as, in some cases, a personal background in science.
- For students with a grade B in science at GCSE there seem to be a number of reasons why parental influence may be exercised:
  - respect for education as a social (and economic) lever, though this is as likely to be realised through business, economics, accountancy or law as science
  - high credibility of science because it is perceived as difficult – 'my son/daughter the chemist.'
  - career prospects in general and perception of marketability
  - members of the extended family having a science background
  - vocational aspirations, associated with Asian and African families (might explain regional differences), especially for careers in medicine and related fields
  - media interest, which may include science-specific programmes and articles, science-oriented celebrities who have credibility and science-oriented TV programmes such as *CSI, Gray's Anatomy* and *Scrubs*.

Science A Level subjects have enjoyed a lasting reputation among parents and students for several years that, one could argue, would take a prolonged period of failure to erode. This reputation was built on, and sustained by, good-quality specialist science teaching from a supportive and collegiate science faculty. Many factors combine to perpetuate the success of the department: a wide range of enrichment activities, support from parents, confident and engaging teaching, availability of specialist teachers, courses appropriate for the needs of learners, extremely competent and well-qualified support staff, energetic and forward-looking teaching staff, good-quality accomodation/ resources and good management and leadership of the department.

Peer group pressure also influenced the decision, as did the fact that science was seen as interesting, linked to life, explained how things work and enjoyable, though sometimes difficult.

Processes that contribute to high take-up of post-16 science

Processes are necessary to acquire long-term professional habits and disciplines that ensure that change is sustained.

Leadership

- Science departments that are well led, well organised and well managed, (see Appendix 5, Case Study Cameo i which is available from www.standards.dcsf.gov.uk/nationalstrategies)
- CPD, integral to the daily workings of the departments and supporting the identified departmental priorities, rather than a series of professional development events which only enable development of a few individual teachers. Levels of collegiality within the science departments visited were very high indeed. Teachers both challenged and helped each other to provide the best they could.
- Effective leadership of teaching and learning, including such factors as:
  - a clear determination to 'put science on the map' – possibly due to competitive pressure
  - effective staff recruitment
  - clearly-established professional expectations of team members
  - clear sense of purpose, enhanced by evidence from self-evaluation including student voice
  - good technical support and an orderly environment for the team
  - effective team work, with a balance between longer-serving members and enthusiastic more recent arrivals.

'It's a small department that works well together as a team. We feel that this has a positive impact on post-16 uptake. Students always know where they are in science, they have continuity and are able to talk to staff. The team shares a lot, especially informally at the end of each day. The agenda of departmental meetings always has a "bring and brag" session. Peer lesson observation is well established and the 'Learner walk' initiative supports us in visiting lessons systematically to explore what is happening.'

In discussion, teachers, when asked 'To what do you attribute your good uptake of post-16 science?' attributed their success to:

- staff training in the department; sharing expertise and resources
- shared departmental materials are on the school's Virtual Learning Environment
- small teams meet to plan and deliver modules
- good team work and high levels of commitment
- every Monday staff meet to discuss GCSE Applied Science through portfolio scrutiny – optional but all attend.

Pedagogy

- Support for students' learning; knowing the students academically and personally, keeping good records and tracking systems and hence being able to provide appropriate support and stimuli to engage, motivate and develop students; using observations and challenging tasks to keep them at the frontiers of what they know, understand and can do, (see Appendix 5, Case Study Cameo ii which is available from www.standards.dcsf.gov.uk/nationalstrategies)
- Teachers having a range of qualities, including:
  - being passionate both about the subject and how it is learned
  - having a good subject understanding and a willingness to find out more and keep up to date
  - developing a positive 'can do' attitude with students
  - encouraging learners to be inquisitive and active
  - being energetic, hard-working, trusted and reliable
  - being persistent: not giving up on students but being both challenging and supportive, and sometimes taking the role of the 'significant adult'
  - having a good sense of humour.

Asked 'What influenced your choice of subjects?' students explained that they chose science because 'teachers were alright', they're 'humorous' and 'interact with you informally'. They will 'push you to achieve your potential' even 'if you don't believe in yourself'. Some students were quite heavily influenced by their parents' view that 'science opens up opportunities'. 'They convinced me,' one said.

- Teaching, according to students, is 'engaging', 'interesting', 'bubbly', 'exciting', 'fascinating', 'consistently good', 'capturing', 'interactive', 'practical', 'hands on' (games, etc.). You 'learn a lot' and 'are not just copying'.
- Teachers are 'nice', 'dedicated', 'hard-working'; they 'don't let you fall behind', 'push', 'enjoy teaching you' so 'you want to do it too'.
- 'The school has high standards and the teachers help you to reach them'.

- Teachers are passionate about their subject, eccentric and have their own way of doing things. They are specialists who sometimes go off-subject ,'we need more risk', and are lively, dynamic, colourful and imaginative. Not much book work took place, lessons were challenging, with an emphasis on enquiry.

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From conversations with teachers and students:

- Teaching is lively, exciting, enquiry-based, and driven by the new secondary curriculum.
- 'Big', unpredictable science, with little use of books or worksheets.
- Dedicated teachers who 'make you dedicated'.
- Trust: students know what to expect from teachers, such as the syllabus being covered and coursework planned well ahead.
- Teachers being reliable, 'not away', knowing their subjects, making students work hard – 'you can't just dawdle away'.
- Strong pastoral support from all science teachers – 'you can go to any science teacher'. The staff having high aspirations, high expectations, strong belief in students' ability to learn and conveying this successfully to students.

Curriculum

- The evidence from school information on curriculum pathways indicates that the curriculum model provided for 14–16-year-olds is important to the uptake of post-16 science courses.
- Curriculum continuity and planning to ensure that students make progress in their learning each year.
- Ensuring students have a positive experience of science lessons and seeing that lessons are:
  - imaginative, interesting and enjoyable
  - relevant, interactive and practical
  - challenging, and satisfying when the challenge is met
  - providing high credibility
  - supporting the enjoyment of the success experienced
  - supported by reliable structures and systems
  - leading to good results
  - not making excessive use of worksheets and books, but using engaging questions and presenting problems to solve, so that lessons are an opportunity to think
  - well structured, with the teacher finding different approaches for different students.

Teachers described students' experience of science by remarking that they were 'less keen on' PowerPoint, textbook work and board work. They further explained that at Key Stage 3 students would usually have a three-part lesson with experiments, active engagement with learning (including ICT), enthusiastic teachers, lots of resources, interactive whiteboard use, games, individual, group and whole-class work. Assessment for Learning teacher and peer assessment would be usual and used to differentiate within sets.

In discussion, teachers, when asked 'To what do you attribute your good uptake of post-16 science?' cited the overall school environment as a 'place where students are happy to be'. The enthusiasm generated and good relationships teachers have with high-ability students inspires students to study science post-16.

Another response was: 'Teaching relationships would be the primary reason. Obtaining good grades in science and now building on our reputation as a successful department'.

- The curriculum structure and organisation being appropriate and effective, including such features as:
  - options being kept open and offered with guidance
  - a variety of courses being provided, each leading to qualifications in science but suitable for different learning styles, interests and future careers
  - visits and visitors to support enrichment, especially involvement of HE institutions
  - extra-curricular support, including revision clubs, science clubs and science, technology, engineering and mathematics (STEM) activities.
- Careful tracking of students (in line with wider school agenda), identifying potential sixth-form science students early and giving them formal and informal tasters of post-16 courses.
- Good pastoral care, with teachers knowing the students and offering subject-specific pastoral guidance.
- Good careers education provision, integrated into lessons by knowledgeable teachers and enhanced by events such as science career fairs.

Strategies influential in promoting post-16 science:

- Open evening, with post-16 students talking to Year 11 students
- Speed 'dating' (Year 11 and Year 12/13 students)
- Visiting speakers including ex-students
- University taster days for Year 10 students
- Visits to universities
- Gifted and Talented events.

Policies that contribute to high take-up of post-16 science

Policies are deliberate decisions that can be made by a school that will, on the evidence of this enquiry and if implemented faithfully over a period of years, contribute to sustainable increases in the uptake of the science post-16.

Leadership

- In many, though not all schools, success was attributed to participation in whole-school policies such as Assessment for Learning, progress tracking and intervention.
- There is no causal link between gaining specialist science status and effective progression to post-16 science, though often the links between science and other popular subjects (e.g. sports specialist colleges) was important in relation to emerging career prospects and keeping options open, (see Appendix 5, Case Study Cameo i which is available from www.standards.dcsf.gov.uk/nationalstrategies).
- Where results are sustained, teacher mobility is low and A Level is taught by a stable team of teachers who are exceptionally committed to A Level teaching, who teach well, are constantly improving what they do and who keep up to date with the subject and the examination requirements.
- In the schools visited, uptake of science was high not because of an accident of fate or serendipity. The head of science and the science teachers deliberately set out to recruit students into post-16 sciences, even in 11–16 schools. They are often described as 'passionate' about their subject and this passion manifests itself most markedly in the fact that as much attention is paid to the needs of the sixth-form as to Key Stage 3 and Key Stage 4. The departments saw it as a strategic goal to establish a healthy sixth-form science and this ethos permeated everything that they did. Challenging Key Stage 4 (and even Key Stage 3) students to try some sixth-form work in their lessons, having sixth-formers to mentor younger students and act as demonstrators in lessons are just a few examples of how teachers establish the expectation that students will specialise in science early, and at every opportunity.

Audience: LA strategy managers, science line managers, consultants, subject leaders and teachers.
Date of issue: 06-2009
Ref: **00461-2009PDF-EN-04**

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Published by the Department for Children, Schools and Families

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