

Guidance for students studying science

Inspectors visited 45 secondary schools in February 2010 to find out how students at the end of Key Stage 3 and Key Stage 4 were guided to science courses. The schools were directing most students appropriately to suitable courses at the end of Key Stage 3 and very few students felt that they had been misdirected. Sixth form students chose science partly because of their particular career intentions, but mainly because of their interest in and enjoyment of the subject. They often cited good teaching as a factor that attracted them to science.

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Executive summary

Inspectors visited 45 secondary schools in February 2010 to look at their science curriculum provision at Key Stage 4 and to find out how students at the end of Key Stage 3 and Key Stage 4 were guided towards specific science examination courses. A total of 1,623 Key Stage 4 students returned questionnaires which were recorded electronically and analysed in detail for this survey.

One of the key findings in Ofsted's triennial report on science in June 2008 was that the secondary schools visited were beginning to develop programmes of study for 14–19-year-olds; these programmes gave access to vocational and academic pathways in science that were suited to their needs and interests.¹ However, progress in delivering those programmes was too slow. Two of the recommendations from that report were that secondary schools should:

- provide a range of courses matched to pupils' needs and relevant to a life of continuing education in a technological age
- ensure that the science curriculum is engaging, relevant to pupils' needs and not constrained by an undue focus on meeting examination requirements.

The curriculum provision had improved from June 2008. The schools visited had responded to the 2008 report and to the changes introduced by the former Department for Children, Schools and Families (DCSF).² Twenty-seven of the schools had introduced applied science and vocational courses to meet the needs of a wider range of students. Thirty-four of the schools were providing GCSE courses in the three separate sciences of biology, chemistry and physics (triple science). This is consistent with findings from Ofsted's science inspections from 2008 to 2010 that the proportion of schools offering three separate sciences continues to increase.

During the survey, school leaders said unanimously that the rescinding of the requirement for students to take statutory Key Stage 3 tests in science gave them increased curricular freedom. They said that this allowed them to design science courses that put a greater emphasis on developing science skills in Key Stage 3. As a result, students were now following different courses that were more suitable, engaging and interesting for them. The removal of the tests had also facilitated 33 schools in delivering an early start during Year 9 to Key Stage 4 science examination courses.

The majority of the students spoken to in Key Stage 4 were content with the science courses that they were following. Only 5% of the students who completed an electronic questionnaire for this survey were unhappy with their science courses. Inspectors judged that the schools were directing the vast majority of students

¹ *Success in science* (070195), Ofsted, 2008; www.ofsted.gov.uk/publications/070195.

² The new Department for Education was formed on 12 May 2010.

appropriately to suitable courses at the end of Key Stage 3. Very few students felt misdirected. The match of students to courses was commonly based upon analysis of performance data, teachers' views of students' likely success with test-based or coursework-based examinations, and students' track record in terms of effort and commitment to learning. Where students were allocated to vocational pathways, it was most often because the qualification was awarded through coursework only; the teachers believed that the students would achieve higher grades as a result of this method of assessment. Although the staff were aware of the career implications if students followed particular courses, this awareness did not necessarily find its way into the advice offered.

The sixth form (Year 12) students interviewed were better informed and their choices for post-16 courses were managed more rigorously, and with better support, than those for students at the end of Key Stage 3 who were choosing 14–16 options. The sixth form students chose science mainly because of their interest in and enjoyment of it; they often cited good teaching as a factor that attracted them to it. For the majority of these students a science qualification was also a necessary component for their particular career intentions. Wanting a science career came from enjoying its study at Key Stage 4. Most of the students spoken to in Key Stage 4 and in the sixth form said that practical investigative work was the aspect of science they enjoyed most. They also described a healthy mix of academic challenge, independent research, group work and discussion of difficult and topical scientific concepts as promoting their interest and enjoyment. Students spoken to in the sixth form who had chosen not to follow science courses at AS and A level had done so because they found other subject areas more personally interesting, and occasionally because they had not enjoyed the style of teaching they had experienced in science at Key Stage 4.

Key findings

- Inspectors found that the vast majority of current Year 10 students were following science courses well matched to their talents, and sufficiently broad enough to permit successful progression to further science study in Year 12. However, the opportunities for students following a vocational Key Stage 4 course to continue with a level 3 science-based qualification were limited, and this information was not always made clear to students.
- All but one of the schools visited had changed the curriculum offered to their current Key Stage 4 students compared to the curriculum they had offered in 2007. Of the 45 schools visited, 34 were offering a pathway of triple science. All but one of the remaining schools were planning to do so for September 2010. Some schools had not been fully aware of the statutory requirements for science that 'all maintained schools must offer any pupil who so wishes the opportunity to study *either* GCSEs in Science and Additional Science or Triple Science'.
- In 33 of the schools visited, Year 9 students had already begun GCSE or vocational science courses. Schools said that this had been made easier by the ending of the Key Stage 3 statutory tests.

- The schools were using the increased flexibility of Key Stage 3 to emphasise the development of practical science skills, with a focus on making science engaging and enjoyable for students.
- The schools that were embarking on a three-year Key Stage 4 science programme were keen for the early release of the proposed new GCSE specifications, since they already (in spring 2010) had students studying on the courses designed for completion in summer 2012.
- All but two of the schools firmly directed Key Stage 3 students to one of their available science pathways at Key Stage 4. The vast majority of the 422 students with whom discussions were held, and of those who made written comments in the questionnaire, felt they had little choice about the science course they were studying. Despite this, only 5% who completed the questionnaire were unhappy with their science programme.
- The 25 schools currently offering a vocational pathway were very selective about which students they enrolled. Schools based the decision on their perception of a student's aptitude for course assessment using solely coursework, with no written test component. For such students, schools believed that these courses would lead to better grades than a more traditional examination-based qualification.
- All the schools visited provided information to students and their parents and carers about science courses. Half of the schools had considered the readability of the information and made suitable adjustments, but others had used verbatim text from examination board information; for example in relation to examination formats and different kinds of assessment strategies. In the questionnaire, 6% of Key Stage 4 students used careers adviser staff as a source of information on science courses.
- Most of the Key Stage 4 students interviewed did not know enough about course content and assessment methodology to allow them to take some responsibility for their progress through the science course they were on. From the questionnaire, 22% of the students had been given information about careers they could do with science qualifications. Staff were aware of the limitations of following particular courses but this awareness was not automatically translated into the basis for advice. Essentially, the information and advice were of little use since most of the students had no practical way of expressing a preference between courses, nor did they want one.
- Information, advice and guidance about science were more robust and much better understood by sixth form students. A large majority of the 195 sixth form students spoken to in the schools visited had a good understanding about science courses and the connection to further careers. The sixth form survey suggested that almost every student was content with her or his choice of science studies.
- In the schools visited that had sixth forms, the uptake of post-16 separate science level 3 courses was not directly related to whether the students had studied double award GCSE or triple science, once a minimum threshold grade for entry to the post-16 course had been reached. Students cited their enjoyment of

the subject and, particularly, the quality of practical investigative work as important factors in choosing science at A level.

- Students who had followed a vocational course at Key Stage 4 had limited opportunities for studying vocational science at either level 2 or level 3 at post-16 level, and were ill-prepared to switch back to separate sciences at AS and A level. Students who had studied applied science at GCSE could continue to applied science A level, but were not easily able to pick up a separate A-level science. This limitation was not the case for students who studied double award or triple science at Key Stage 4: they could choose vocational or applied level 3 science courses as well as the separate science AS/A levels.

Recommendations

- Schools must be cognisant of the statutory requirements surrounding the science Key Stage 4 curriculum.
- Schools must ensure that all students have a clear understanding of how future career pathways are made possible or denied by the science course that they follow.
- The Department for Education, the Qualifications and Curriculum Development Agency and Ofqual should ensure that rigour and equivalence are preserved across the many different science qualifications, taking into consideration the wide variation in the proportion of coursework required.

The science curriculum and choice

1. The science curriculum at Key Stage 3 and 4 is undergoing a period of considerable change, with further changes to GCSE specifications scheduled for examination during the 2011/2012 academic year. In 2009, the requirement for all students to take statutory tests in science at the end of Key Stage 3 was rescinded. The former DCSF had made commitments that, from September 2008, students gaining level 6 or above in science were entitled to study the three separate sciences at Key Stage 4.
2. At present, five principal options are available to meet the statutory National Curriculum requirements for science. Most students follow one of these options, and six of the schools visited offered all of the following routes:
 - core science (single award) GCSE
 - core science plus additional science (double award) GCSE
 - core science plus additional applied science (double award) GCSE
 - biology GCSE, chemistry GCSE and physics GCSE (triple science)
 - vocational science (BTEC level 2 qualification or OCR), the equivalent of two GCSEs.

3. The schools selected for this study covered the full variety of science curriculum provision in a range of different school contexts. All but one of the schools visited had changed the curriculum they were offering to their current Key Stage 4 students compared to the curriculum they had offered in 2007.

The curriculum offer in the survey schools

4. In 33 of the 45 schools visited, students had started Key Stage 4 courses in Year 9. In 15 of these, students completed Key Stage 3 by the end of Year 8, sometimes called 'fast track' science or an 'accelerated Key Stage 3'. Inspectors found two models:
 - Model 1: all students are expected to complete the compulsory core science plus additional science by the end of Year 10. They then embark on additional studies, for example units of AS science or a single separate science GCSE or a non-National Curriculum science GCSE such as astronomy.
 - Model 2: some students begin a triple science programme in Year 9 that is planned to last for three years but using only 'double' time. This permits these students to retain access to other non-science curriculum options at Key Stage 4.

However, some students expressed some irritation at one school's attempt to spread the Key Stage 4 science curriculum over three years, and students had gained the impression that the two science GCSEs they already had taken early in Year 10 (core plus additional) were 'worth nothing, disappointingly'. They did not have an option to stop studying separate science in Year 11.

5. The majority of the school leaders reported that the demise of the Key Stage 3 statutory tests had freed the curriculum in Key Stage 3, allowing for:
 - a greater emphasis on the development of science skills
 - more varied classroom experiences
 - a greater concentration on making science engaging and enjoyable.

The schools welcomed the increased flexibility and all of those visited were genuinely trying to use it to increase students' engagement in, and enjoyment of, studying science. The degree to which the schools had embedded these approaches varied as a function of the length of time they had been offering this revised Key Stage 3 approach. None of the schools visited was considering reducing the time allocated to science. Those already providing it considered that an early start to triple science courses gave sufficient time for students to study all three sciences without compromising the breadth of the curriculum; this was because they were using only 'double option' time but spread over three years. This helped to reduce tensions about the choices of courses that

students wanted to follow in addition to their science courses. For example, two students in a school that had not adopted this early start strategy wrote in their questionnaires of their regret that triple science in triple time had forced them to drop another Key Stage 4 subject.

6. Of the schools visited, 34 were providing a triple science pathway, which was usually only for more able students. Ten of the remaining 11 schools were to start such provision in 2010. One of the schools, which was emerging from an Ofsted category of concern, currently provided only one pathway, the vocational double award, for all its students. However, outcomes for science students in this school had risen very strongly from a low base as a result of this policy. This school will also offer triple science from 2010. Other schools that had previously provided just one science course now provided at least two options. The most common combinations were 'core plus additional science' (double award science) and triple science.
7. It was evident that some of the schools visited were not aware of the statutory requirement to provide either 'core plus additional science' (double award) or the separate sciences, before offering further pathways as set out by the former DCSF.³ The confusion may arise because all the five principal pathways described in paragraph 2 meet the National Curriculum requirements for science at Key Stage 4. Schools thought that meeting these requirements would be sufficient. The restrictions defined by the (then) DCSF were published in December 2009, two terms after the Year 10 students observed for this survey had been assigned to their Key Stage 4 courses.
8. Staff in the science departments observed were aware that the GCSE science specifications were due to change and some were delaying making changes until the 'new' range of GCSE specifications was available. Staff in the schools starting GCSE during Year 9 were particularly anxious to see how different the new specifications would be because their current Year 9 students were already on the path to complete the awards in 2012. Schools expressed concerns associated with the costs of setting up new courses as new text books and revision guides became necessary.
9. One of the schools visited, in a socio-economically deprived area, had managed to provide a range of courses that met the needs of all its students and had provided information, advice and guidance of a quality that left students very content and secure in their choices. The range of courses included triple science, single award science, core plus additional science (double award), core plus additional applied (double award), BTEC science, and BTEC courses in horticulture, and fish husbandry. The courses had a range of starting dates which were deemed necessary for the different groups.

³ *Curriculum provision in secondary science* (01101-2009BKT-EN), DCSF, 2009; nationalstrategies.standards.dcsf.gov.uk/node/257282.

Information, advice and guidance

10. Most of the schools visited steered students strongly into one of their available science pathways. Direction to the courses in Key Stage 4 was explained to students most often on the basis of the course assessment, ways of working that suited students' different attitudes to learning and testing, and the aim of getting the best GCSE grade (or equivalent) that was possible for them. Inspectors found that most current Year 10 students were following science courses well matched to their aptitudes, and sufficiently broad enough to permit successful progression to further science study in Year 12.
11. Students' routes beyond Key Stage 4 were not strongly considered in the information, advice and guidance given to them in Key Stage 3. Nevertheless, the schools were generally mindful of the need to preserve opportunities at 16+ for all their students, irrespective of ability, and inspectors found only one current exception (explained in paragraph 6). The schools were also aware of the level 2 threshold entry requirements for level 3 courses, and rightly considered, on an individual basis, if a particular pathway might limit a student's overall GCSE-equivalent score.
12. The schools said that they provided information, advice, and guidance about the alternative Key Stage 4 pathways, and the vast majority of the students accepted their direction to a course without undue concern. Students spoken to during the survey reiterated the position of their school by saying that they were not given freedom of choice about which of the available science courses they were currently studying, but neither did most of them demand it. The schools said that they did listen to anyone who was unhappy with their recommendation; this was borne out by the students. The school leaders interviewed used phrases such as 'in the best interests of students' or 'likely to bring the greatest success' at GCSE or equivalent. By that, they meant highest examination grade or equivalent.
13. The schools that offered a vocational pathway did so because teachers felt that the continuous assessment of coursework better matched a student's preferred examination style. A school gave a typical explanation of this by saying that 'students who are not very good at tests' may do better with the coursework-only examination model of the vocational pathways. All the other routes included some element of written examination. More often than not, students following this coursework-only route were of middle to lower ability (mindful of the exception in paragraph 6). Demonstrating higher academic grades in science has been defined, until recently, by end of key stage examinations, creating a self-fulfilling model that skews students who are 'good at exams' towards examination-rich science courses.
14. The school where all students were once only entered for BTEC had done so in response to an award system that it believed gave a greater possibility of

gaining more points in their overall school performance table if such a policy were adopted. That school recognised that the model compromised the future choices of students capable of A-level separate science and had subsequently changed policy, in line with the recommendations of the former DCSF.

15. Irrespective of the scope for science curriculum choice, and the generally limited freedom of choice, most of the students said they were happy with their science courses. Inspectors found that the vast majority of the Year 10 students were studying science courses that would permit them to fulfil their expressed career intentions. Only one of the 195 Year 12 students that inspectors met was disappointed with the pathway that he had been directed to follow three years before at Key Stage 4. He suggested, correctly, that the applied science Key Stage 4 course which he followed was not suitable preparation to study separate sciences at A level. A very few written comments highlighted the critical responsibility of schools to ensure that students retain freedom of choice for future careers. One Key Stage 4 student wrote:

‘The school stretched the truth when explaining what GCSE we were taking and told us too late that it was wrong for our aspirations.’

Several more students wished that they could have studied triple science but said they were prevented for a number of reasons. They said, for example:

‘Not enough students wished to do triple science.’

‘The groups were chosen using English scores and my handwriting was bad.’

16. The transition from Key Stage 3 to 4 is generally associated with activities relating to ‘options’ during the spring term of Year 9. Science is part of that process but, as a compulsory subject, it did not feature as strongly as the foundation subjects in the options events held by the schools visited. Information sent to parents usually referred to the range of science courses offered, but most students had already felt strongly advised to accept the course their school had provided for them. More often than not, this reflected teaching groups: students in ‘top sets’ were steered towards triple science; students of middle and lower academic ability were advised to study core plus additional science (double award). In the 34 schools where triple science was available in 2009, it was provided to all students gaining Level 6 at the end of Key Stage 3, generally without much choice. These schools said that students with lower science levels could also take triple science ‘if they really wanted to work very hard’, but it was not encouraged. In these schools, the academically able pupils found themselves in the triple science sets as a matter of routine.
17. Recruiting students to the vocational pathways was usually ‘by invitation only’, as one school identified the students who it thought might benefit. Often, but not exclusively, this was related to the examination format of the course, where

the outcomes were determined by coursework only. Students appear to concur. One student wrote:

'My teacher told me that there wasn't going to be many tests because I worry and don't do very well so I chose BTEC. And it was quite easy to pass.'

Another wrote:

'I enjoy science nationals because it is just coursework and we have a nice file to keep it in.'

But a third wrote:

'It would be better if we got real GCSE grades instead of the equivalents of pass-merit-distinction.'

18. The single award route tended to be available for students whose other Key Stage 4 options demanded more time, such as students following 14 to 16 work-related programmes that demanded a lot of curriculum time and did not leave sufficient time to study double award science. More often than not, students who were following single award courses were of lower academic ability. Their schools had constructed an effective personalised Key Stage 4 curriculum designed to retain the students' engagement in education and ensure their progress.
19. Half the schools visited had taken some care to adjust the readability of the paperwork associated with option choices. This was done primarily by limiting the amount of information. The information had usually been written by the head of faculty. But some schools had used an examination board's own course information, modified to some extent, with its emphasis on the weightings of the coursework and written examination components. Inspectors did not meet any students who said they had made a 'choice' based on such information, either at Key Stage 4 or in the sixth form.
20. Where students did express an oral view to inspectors, they often said that triple science was for able students, or already had some notion of 'needing science' in a future career and therefore triple science would be the best option. These students' information came from the Connexions service, a careers library and careers computer databases. It was clear from discussions with students that, compared with other subject option choices, a particular science examination course was not an important part of a typical Year 9 student's thinking. Nevertheless, most students said they enjoyed science at Key Stage 3.
21. It was rare to see students being offered an applied science route for career reasons, and some schools that did provide applied science were not clear about what courses at level 3 would be subsequently available to students.

There was the same lack of clarity about level 3 courses available to students following BTEC or OCR level 2 qualifications. In a few cases, this had led to students following the wrong Key Stage 4 course, but this was rare. Inspectors agree with schools that the kind of science course followed by students is less critical as long as the direction by the school of students to a course ensures that post-16 options for each student remain open. This was the most common situation in the survey schools, since most of the students aiming for level 3 qualifications were following suitable Key Stage 4 science courses.

22. The data from the Year 10 survey questionnaire showed that 42% of students said that they had not received guidance about their courses from any source. Very few (6%) of the questionnaire returns mentioned the involvement of a careers adviser in relation to science. Forty-one percent of respondents answered that their science teacher had provided advice and guidance about science course details. Twenty-two percent of the students recognised how science might suit their future career.
23. The students provided a number of suggestions to make information, advice and guidance more useful. They would have liked:
 - more 'taster' sessions that illustrated the differences between science courses
 - to meet more scientists from a range of careers as role models (several schools already had excellent schemes to promote such contact)
 - a clearer explanation of what their Key Stage 4 choices meant for their possible post-16 science-related studies, particularly for those embarking on Key Stage 4 vocational science courses
 - better feedback on how they could improve their science work to attain higher standards.

The students on vocational pathways had a very good understanding of their present progress and what they needed to do to improve. Post-16 students mentioned their surprise at the level of mathematics needed to understand A-level science fully.

Post-16 factors

24. For most of the science faculties observed, the GCSE grade at core and additional science, or triple science, was the major entry requirement to post-16 separate science courses at AS level. Most of the schools visited demanded a grade B in science before admitting students, unless they assessed a student as having good potential, despite a lower grade. Some of the schools were considering A grades as a requirement for starting physics AS level and most recognised that grade C in mathematics would be a bare minimum additional requirement. None of the schools visited offered a level 3 science vocational

course. Some provided A-level applied science, which was available to students from any Key Stage 4 science course.

25. Guidance to post-16 courses was more robust than at Key Stage 4; all the 195 sixth form students inspectors met said that they had had interviews with senior staff and had a greater personal contact with Connexions advisers than at Key Stage 4.
26. Electronic analysis of a sample 217 of the 621 hardcopy responses to the Year 12 questionnaire indicated that 19% of the post-16 students had gained information about science courses from a careers adviser. Only 8% felt that they had not received enough information, advice and guidance from the available resources. Forty-four percent had received information from science teachers and almost 45% had valued the information, advice and guidance from their parents or carer. Forty-three percent of the respondents said they had been given information about careers they could do with science qualifications. Seventy percent indicated that they were provided with information about what could be studied in Year 12 and 13 science courses.
27. There was more specific information about matching a science qualification to a career pathway for post-16 study compared with that available for Key Stage 4 options. Despite the relatively high proportion of students who said that they had access to information, advice and guidance, only half said they had received enough information, with a further third admitting that they had received some. Most of the students interviewed experienced the motivational combination of their enjoyment of science lessons and their ambition for science qualifications for a future career; students' views showed that enjoyment of science was firmly linked to aspirations and achievement. One student summed up the consensus of sixth-formers by declaring 'science is hard, but interesting and fun'. A very few students wished that the information available to them before taking up science had been clearer about how difficult the subject could be. Only 2% of the 217 sixth form student questionnaire returns sampled were not happy with their course.
28. All the students in the schools visited who were studying A-level science had either followed a science double award, or triple science, Key Stage 4 course. But the post-16 take-up did not directly correlate with the numbers of students on these different courses. The anecdotal assumption that triple science leads to a greater uptake of separate science A level was not evident in the survey schools. For example, the school with the highest proportion of students studying A-level sciences had recruited the students solely from the core plus additional (double award) science courses. The students reported that their Key Stage 4 science lessons were very enjoyable, engaging and included a large amount of practical work. That element of teaching through practical experience continued into the sixth form; the students were very successful at A-level science and many went on to university courses. The school was a

specialist science college, and had invested wisely in high-quality laboratories with plenty of equipment. The department was filled with interesting displays and artefacts, and it celebrated students' science work. In contrast, in a different specialist college, despite the majority of Key Stage 4 students studying triple science and being content with their experience, very few continued into A-level science because other subjects had been even more enjoyable and challenging at Key Stage 4. That school was experiencing challenges in being able to teach all science lessons in specialist laboratories.

29. The teaching and learning environment played an important part in influencing the choices made by students to study science post-16. For example, one school was acutely aware that, despite large numbers of Year 11 students gaining very good GCSE grades, very few chose to study science at 16. The school organised scientists to visit the school to talk about science careers, students went to University days explicitly designed to attract students to a science career, and there was a regular after-school science club offering dramatic experiments and activities. The department enjoyed excellent physical resources, spacious and well-equipped laboratories and a full complement of expert scientists as teachers. Despite these laudable efforts, however, students told us that they did 'copying in every lesson' and were not planning to volunteer for more in the sixth form.

Reality versus rhetoric

30. Inspectors spent some time in science departments, taking a snapshot of science provision across the 45 schools surveyed. They were looking to see if the learning environment matched what the school said about the science provision. Inspectors saw short episodes of more than 150 lessons, and noted a wide range of quality in the teaching and learning. The strongest features occurred where students were fully engaged in activities such as practical investigations, or group discussion, or well-managed whole-class teaching in which they all contributed views. Weaker elements principally resulted from didactic exposition by the teacher to a passive class. Both features were observed in more or less equal proportion. One student summed up a general view by writing:

'I like doing science that involves experiments and investigations rather than sitting in a classroom answering questions.'

31. Students' written work varied in quality and challenge, not always in relation to likely GCSE grade outcomes. In general, the more academic classes often emphasised note-taking, sometimes including dictation and copying using extremely expensive, but poorly used information and communication technology such as interactive whiteboards. Students had mixed views about this practice. Some students accepted the conventional view that having correct notes mattered when it came to revision, but one sixth-former correctly observed:

'We are being restricted from learning to our full potential by not being allowed to make notes our way' (they were being forced to copy verbatim).

In other, more engaging examples, students had to re-work information into their own words or try to apply their existing knowledge to new situations.

32. Five schools were currently trying to deliver triple science in double time, and reduced practical work to the minimum necessary to meet course examination requirements. Students remarked that this compression placed a high workload on them at the expense of enjoyable classroom experiments. They still attained good examination grades.
33. Group work, particularly where students had to present their findings to a wider audience, led to creative and often very entertaining responses. This approach was believed to take more time, yet the schools visited which incorporated such strategies had no more hours each week dedicated to science than any other school. What was clear from all the discussions with students was the importance of teaching science using a whole range of strategies that placed practical investigation at the heart of illustrating scientific concepts. Students said this was what they enjoyed most about science. The survey schools that adopted such an approach had the highest numbers of students who chose science post-16. As one student said, 'Science is something you do'. Typifying the expectation and frustration of many other students were comments such as the following:

'Science doesn't excite me; we should blow more things up.'

'We should do more practical [work] in lessons, because you understand it better and can also have fun at the same time.'

No student suggested that there should be less practical work, or wanted more copying.

34. The amount of time that students spent in practical learning at Key Stage 4 varied greatly between the schools visited. For a few, practical work was limited to the necessary GCSE assessment tasks. For others, particularly for students embarking on a longer Key Stage 4 course starting at some point in Year 9, practical work was a substantial element in most of their lessons and much enjoyed. In all the settings seen, practical work was usually the main reason why students found science to be enjoyable.
35. As students progressed into the sixth form, some expressed the enjoyment of the intellectual challenge of finding out how things worked and of realising how much we do not yet know about the natural universe. For these students, the school had been successful in inspiring a sense of awe and wonder. Most of the sixth form students enjoyed their science and also recognised its usefulness for

future careers. A few were tolerating science because they had to study it for career purposes. Other sixth form students, who had aspired to follow science-based careers such as physiotherapy, had changed their minds because they considered their science subject(s) at A level to be more difficult than others. For students studying just one science at AS level, biology was the most popular. For students not studying science, the reasons they gave were linked more to their commitment to and enjoyment of other subjects and their preferred career choices, rather than any widespread dislike of science at Key Stage 4.

36. A few schools and their students reported a lack of resources; at its worst this required science to be taught outside laboratories for a minority of lessons. As a result, few chose science for their studies post-16. These schools had limited equipment and drab facilities in science, with little by way of enlivening displays. Nevertheless, academic standards were very high because the students worked conscientiously towards their target grades, despite the relatively unappealing learning environment. This could be attributed to a strongly positive culture of high expectations from the school and parents, resulting in success in the predominantly test-based science courses being followed.
37. In most settings, however, science was clearly an important curriculum area. Inspectors explicitly reported good learning environments in 13 of the schools visited. Laboratories were clean and well decorated, equipment was up-to-date, and displays were fresh with examples of students' excellent work. Ample technical support permitted high levels of practical work to operate simultaneously. In contrast, four departments were drab and uninspiring places to study science. The remainder were fit for purpose. For a few of the schools, the recruitment of specialist staff had been difficult historically but, in all the schools visited, science lessons were now being taught by specialist staff.

Notes

Her Majesty's Inspectors visited 45 secondary schools during a week in February 2010 and held discussions with senior staff, subject leaders in science and teachers. Inspectors also met 422 Key Stage 4 students and 195 sixth form students. They scrutinised documentation relating to transition between Key Stages 3 and 4, and from Key Stage 4 to post-16 courses. They also observed parts of more than 150 science lessons.

The schools were selected by looking at their 2009 science examination outcomes at Key Stage 4 and, where available, at sixth form level. From this information, it was possible to deduce the nature of the science curriculum that schools were providing to the Year 11 cohort in 2009, the courses having begun in 2007.

Inspectors saw as wide a range of science curriculum models as possible, recognising that the model might well have changed since 2007. The schools

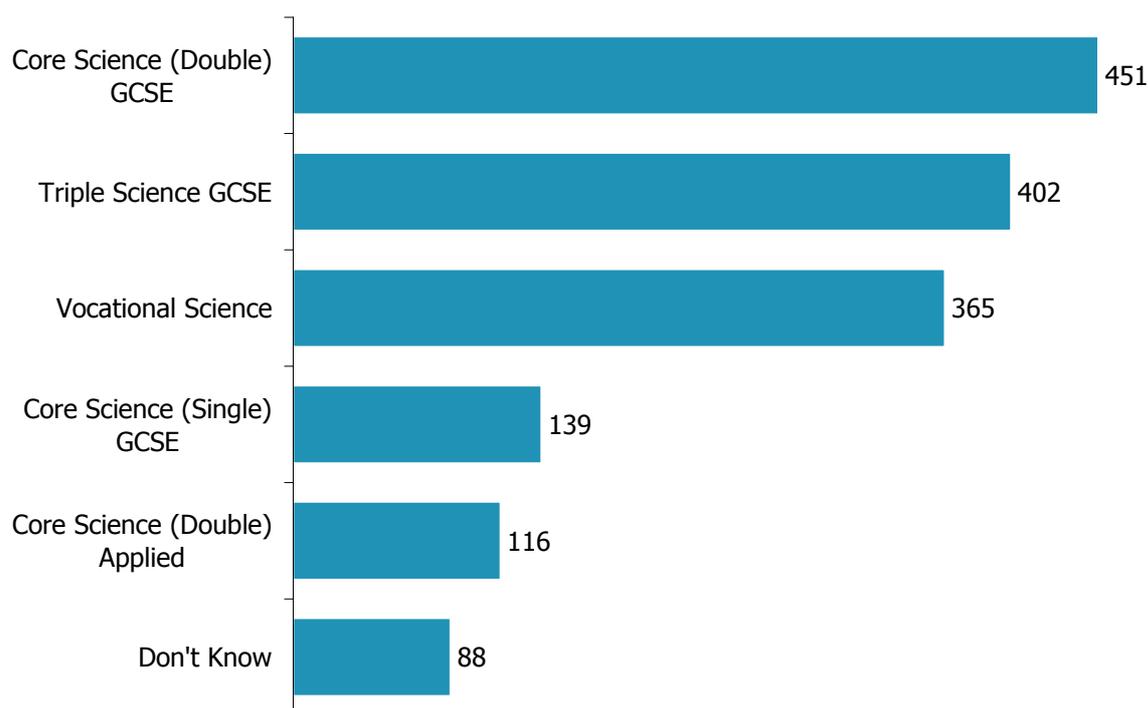
included those with only one science curriculum (in 2007), schools with a high proportion of high-attaining students, and those with a low proportion, schools with large and small sixth forms or with no sixth form. Inspectors also visited selective schools, secondary modern schools, single sex schools, and comprehensive schools.

All students at Key Stage 4 in the schools visited and, if available, in the sixth form completed a short questionnaire that asked for their views on the information, advice and guidance they had received in the previous academic year. Some of the schools managed successfully to organise the questionnaire electronically. A total of 1,623 Key Stage 4 student questionnaires recorded electronically were analysed in detail. Comments were noted from a further 3,290 hardcopy versions of the questionnaire. Sixth form students returned 621 hardcopy questionnaires, from which comments were noted and 217 of the questionnaires were analysed electronically.

Annex A: Survey data

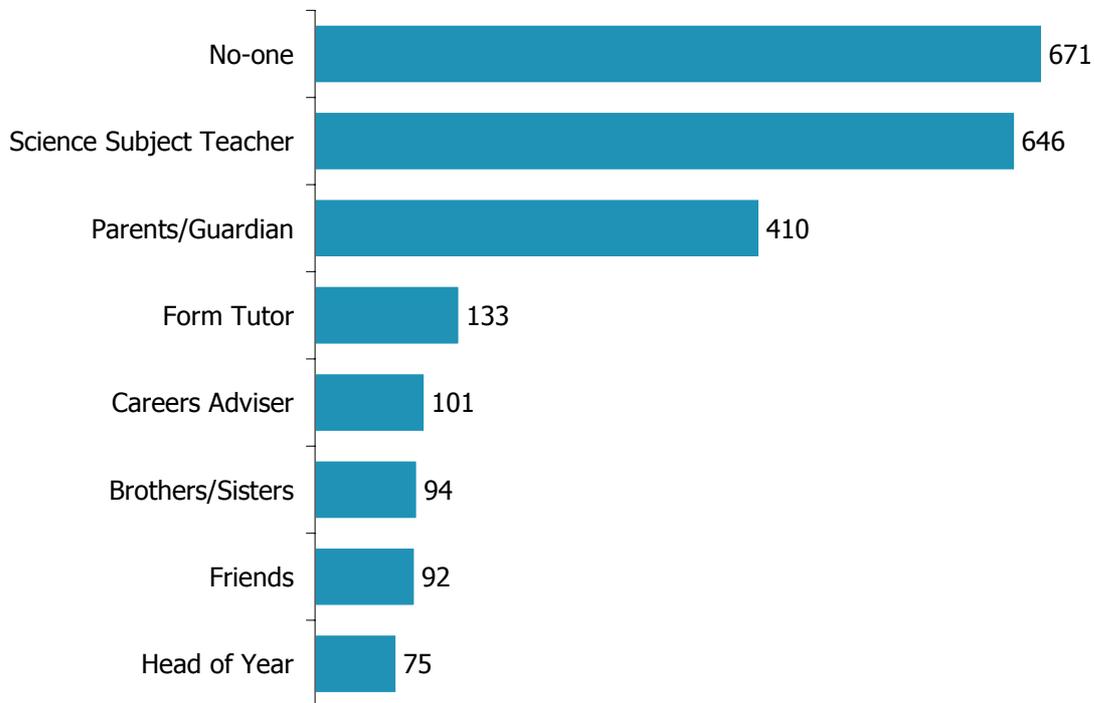
The schools visited returned 1,623 electronically readable Year 10 student questionnaires, which had been partially or fully completed and could be analysed. Summary charts are shown below for two of the questions responded to by the Year 10 students.

Figure 1: Responses to question ‘What science course are you following?’ (number of responses)



Seven respondents did not provide an answer to this question.
Data is based on 1,568 responses (55 responses were spoiled and not included in the analysis).

Figure 2: Responses to question 'Who gave you advice and guidance about choosing a science course?' (number of responses)



10 respondents did not provide an answer to this question.

Data is based on 1,591 responses (32 responses were spoiled and not included in the analysis).

Please note: This question asked respondents to choose more than one category where appropriate; therefore figures will not total 1,591.

Annex B: Schools visited

School name	Local authority
Abraham Guest High School	Wigan
Addington High School	Croydon
Archbishop Tenison's CofE High School	Croydon
Arden School	Solihull
Balcarras School	Gloucestershire
Bishop Ullathorne Catholic School	Coventry
Boroughbridge High School	North Yorkshire
Brayton College	North Yorkshire
Brentwood Ursuline Convent High School	Essex
Caludon Castle School	Coventry
Cannock Chase High School	Staffordshire
Coppice Performing Arts School	Wolverhampton
Culcheth High School	Warrington
De La Salle School	St Helens
Easington Community Science College	Durham
Great Baddow High School	Essex
Hodge Hill Sports and Enterprise College	Birmingham
Hodgson School	Lancashire
Hounslow School	Hampshire
Hull Trinity House School	Kingston upon Hull
Joseph Whitaker School	Nottinghamshire
Moorside High School	Staffordshire
Penryn College	Cornwall
Raynes Park High School	Merton
Ringwood School	Hampshire
Ripon College	North Yorkshire
Saint Aidan's Church of England Technology College	Lancashire
Sandwich Technology School	Kent
Sheldon School	Wiltshire
SS John Fisher and Thomas More Roman Catholic High School	Lancashire
St Cuthbert's Catholic Community College for Business and	St Helens

Enterprise

St Francis Xavier School

St John Fisher Catholic College

St John's Marlborough

Summerhill School

The Arnewood School

The Dukeries College

The Folkestone School for Girls

The Heathfield Foundation Technology College

The Hollyfield School and Sixth Form Centre

The Snaith School

The Westgate School

Tudhoe Grange School

Whitgift School

Wolfreton School

North Yorkshire

Staffordshire

Wiltshire

Dudley

Hampshire

Nottinghamshire

Kent

Sandwell

Kingston-upon-Thames

East Riding of Yorkshire

Hampshire

Durham

North East Lincolnshire

East Riding of Yorkshire