# STUDENT REVIEW OF THE SCIENCE CURRICULUM

# CONSULTATION PROCESS

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## THE CONSULTATION PROCESS

This report describes the process by which a student-led review of the Science curriculum took place as part of Science Year in England.

The two key reports generated by the Review are available to download at www.planet-science.com/sciteach/review.

These reports were produced as a working collaboration between students and Planet Science, the Science Museum in London and the Institute of Education, University of London.

The following people contributed to this report:

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## THE ORIGINS OF THE REVIEW

The review arose out of a proposal from the Science Museum in London to celebrate Science Year (2001–2) in an innovative way. The Science Museum has always seen part of its mission as being to educate and inform, and this role in education has been recognised with many awards. So, it decided to involve students in a novel consultation on school science education.

The history of school science teaching in England and Wales over the last hundred years has been a fascinating one. Until the advent of the National Curriculum in 1989 there was great variability in the content and extent of what was provided. The introduction of the National Curriculum changed that, though precisely what is to be included within the subject, how it should be taught and how it should be assessed have been areas of deep contestation (Black, 1995).

Consultation has always been part of the curriculum design process. However, consultation rarely seems to include, in any meaningful way, the principal client group of the science curriculum – the students themselves. The Science Museum proposed to challenge this inertia. It must be possible, the museum thought, for students to be able to take meaningful control of a consultation process on school science.

The original proposal needed the active promotion of two or three organisations. In this case the Nuffield Foundation gave its backing to the proposal and the Director of Science Year was instrumental in supporting the proposal through its funding mechanisms. The relationship between the Science Museum, Science Year and the Department for Education and Skills (DfES) was crucial. It was vital for the proposal that the initial promoter of the consultation, the Science Museum, did not itself have a 'curriculum axe to grind' and was outside the mainstream school education processes.

It was also important that the consultation would be hosted by an organisation with a high profile reputation, not least so that the students participating in the process could feel that their work would be important, valued and public.

By the time the project had received outline approval, the 2001/02 school and college year had begun. While it might have been advantageous to pilot the proposed consultation methodology, the exigencies of the tight time frame available to complete the consultation meant that it would have to be largely correct first time. Some alterations could occur as the process developed, but there was little room for manoeuvre.

From an early stage it was agreed that the Student Review would be conducted by 16–19 year-olds who had completed their GCSEs the preceding summer (most of whom would therefore be 16–17 year-olds.). It would be a web-based questionnaire targeted at KS4 and 16–19 year-old students. It would be designed by students who were both scientists and non-scientists. It would, as far as possible, have gender and ethnic balances that reflected the national cohort. The target group of 16–19 year-olds was considered to be the 'guinea-pig' generation, having generally been the first set of students to experience each of the various education reforms experienced in England and Wales since 1989.

## TAKING YOUNG PEOPLE SERIOUSLY

The notion that young people might be responsible for carrying out a consultation exercise on a subject that concerns them hardly seems radical. And yet young people are all too rarely consulted, let alone allowed to design such processes. In cases where young people have been consulted about their views of the Science curriculum, it has invariably been found that they are highly articulate, insightful, take the process seriously and produce valuable findings (e.g. Osborne & Collins, 2000; Reiss, 2000).

A number of studies have explored ways of consulting with young people (e.g. Rudduck et al., 1996; Holden & Clough, 1998; Chawla, 2001; Driskell, 2001). In general, these approaches have built upon such pre-existing approaches as participatory rural appraisal and other deliberative and inclusionary processes (e.g. Pimbert & Wakeford, 2001). We are, however, unaware of any previous exercise in which young people have designed and implemented a web-based questionnaire study such as this. In addition, while the analysis of the data and the great bulk of the writing of this and the associated reports was principally done by the project manager, assisted in the later stages by Michael Reiss, young people were involved throughout the process as described below, and directed what data they wished analysed.

The consultation reported here fits with the Convention on the Rights of the Child, which contains a preamble and 54 articles that address children's rights to participation in their societies and decisions that affect their lives. Since its adoption by the United Nations in 1989, the Convention has been ratified by all member states of the United Nations, including the UK, except Somalia and the USA. This makes it the most widely accepted international treaty (Auriat et al., 2001).

The Convention defines as a child anyone under the age of 18 years, thus including those who designed and those who completed the questionnaire reported here. Section 1 of Article 12 of the Convention states that:

Parties shall assure to the child who is capable of forming his or her own views the right to express those views freely in all matters affecting the child, the views of the child being given due weight in accordance with the age and maturity of the child.

Given the amount of time that young people spend in schools, and the importance of schooling to their lives, it seems clear from this Article that children should be consulted about their schooling more than is generally the case.

## GETTING STARTED

The Science Museum decided that it did not have the full set of skills nor the staffing available to manage the project in-house. The Science Museum does, however, have a wide range of specialist capabilities from graphic design to data processing and these were drawn upon during the project. The review period worked to a fixed completion date of 19th March 2002. This was to fit around 'National Science Week' and the summer AS module examinations.

The Science Museum decided to seek an external national project manager who would have a proven record of delivery, recent experience with the 16–19 age group and the interpersonal skills to work successfully with a wide range of clients from politicians to school teachers and their students. It was not considered important that the project manager be a scientist by training, though an awareness of the Science curriculum might prove useful. The person

appointed would have to ensure that any of his/her own views on the Science curriculum did not intrude into the process of consultation.

The first major consideration was the nature of the consultation. Explicit in the submission to Science Year from the Science Museum had been the use of the Internet as the medium of data collection. The issues to resolve were:

- How could the consultation process be truly student-led?
- What would generate sufficient interest in the Internet-based survey?
- How could the consultation process reach into all areas of England?

It was thought that the Science Engineering Technology Mathematics Network (SETNET) would be a good host for reaching across England. SETNET goes into all the regions and has a central secretariat in London:

> SETNET is the Science Engineering Technology Mathematics Network and has 58 member organisations representing Government, industry, the engineering professional institutions, education and education charities. It is one of the outcomes of a Government initiative – Action for Engineering. SETNET is about ensuring that there is a flow of well-motivated, high quality people from schools who have an interest in, and an understanding of, engineering related subjects.
>
> **What are SETNET's aims?**
>
> - To present a coherent message to teachers and industry about the schemes and initiatives available to enhance and extend the key curriculum subjects of science, technology and mathematics.
> - To bring about collaboration between the various organisations to influence more effectively the teaching of engineering related subjects.
> - To ensure a more effective communication system for schools and industry. (from SETNET website http://www.setnet.org.uk/whatis_index.html)

The individuals across the country who make up SETNET vary in nature and experience, which means, inevitably, they offer a varied capability to assist in the review. The advantage of SETNET is that its representatives generally already have a good working relationship with state schools and are able to respond to national initiatives.

It was decided early on that there had to be a student consultative base in all the English regions and in London. SETNET was asked to identify one SETPOINT in each of the regions which might have the skills, capabilities, resources and time to be involved in the consultation process through the hosting of a local conference. An outline fee was agreed.

Initially, it had been proposed that there would be a nationally-led advertising campaign about the consultation from the Science Museum, with local advertisements in the regions. These would be used to recruit local student representatives who would form part of a national coordinative team of students. These students would then work in their local areas with SETNET to generate interest in the consultation and help host the regional meetings.

After debate this model was rejected. Essentially it was seen to be a 'top-down' model with a high risk of adults taking over the process. It seemed highly unlikely that students in schools and colleges would have anything but a marginal interest in the final questionnaire if they had not themselves been instrumental in determining the questions and web design. Without their personalised stake in the project, the regional students would be unlikely and unwilling ambassadors for the project in their own schools and colleges. Finally, the regional students would almost certainly want to select and would benefit from selecting from their own number those they felt confident would take the results of their regional consultation forward to the national group of students.

The immediate implication of this decision was that there would be no initial high impact awareness of the consultative process and success would rest critically on the work of SETNET and the regional meetings.

By early October 2001, the following still needed to be planned and done:

- Scheduling of the regional meetings.
- Preparation of documents about the project.
- Selection of a national group of students.
- Meeting of the national group of students to finalise the web-based questions.
- Designing and hosting the questionnaire.
- Getting students to complete online questionnaires.
- Data analysis
- Writing an interim report for the 19th March 2002 conference.
- Other preparations for the19th March 2002 conference.

SETNET was initially slow to respond to the invitation to host the regional meetings. In the end, the average time for the organisation of each regional meeting from start to finish was three weeks. There were substantial difficulties in three regions.

Important structural decisions were taken on the nature of the invitations to the regional meetings. Because the client group was 16–19 year-olds who had recently finished their GCSE studies, the regional SETPOINT co-ordinators were briefed as follows:

> The regional meetings will generally be between 20 and 40 young people. Some regions may have less young people and some may have more. The regional meetings will reflect the post-16 Level Three course take up in your region. Generally the figures I am working to (for A/AS Levels) are:
>
> - 40% maintained school sector
> - 17% sixth form college sector
> - 30% private schools sector
> - 13% the traditional FE sector
>
> There needs to be a gender and ethnic balance that reflects your region. To reduce the difficulties in assembling the students and to give the students a 'friend', I am seeking two or three students from each institution attending. At least one of these students should be a non-scientist. The minimum number of institutions on average is likely to be: 4 maintained schools, 1 SFC and 2 private schools but this really will vary from region to region. You will be expected to draw in representative institutions from anywhere within your region giving due thought to the travel issues to the meeting venue.

Most regional SETPOINTs had little or no regular existing contacts with their sixth form colleges (SFCs) and further education colleges. None had any contacts with their private sector schools and colleges.

The project manager set up the initial contacts with the SFC sector through a combination of standardised email and personalised conventional post. Not all SFCs were contacted. The project manager identified an appropriate college principal, and using the list of all colleges and principals, discussed with this principal which colleges were both likely to respond to an invitation to a regional meeting and were geographically close enough. In addition, this 'pre-approach' was used to identify a 'personal detail' or 'commitment to education or Science, etc.' about each college principal which it was hoped would make them more likely both to read the introductory letter and to respond.

In the event, contact by non-personalised email proved unsuccessful, with fewer than 10 principals responding. However, the targeted and personalised letters proved to be very successful and many SFC students came to the regional meetings.

A similar technique was used with private sector schools. The HMC and Girls' Schools Association provided full lists of their members and, after advice, schools were identified and targeted. Because 30% of students taking A/AS levels are in the private schools sector, the project manager judged it crucial that a reasonable number of high profile private schools be involved with the project. The private sector, like the SFC sector, proved mostly ready and willing to take an active part in the project.

It was the local regional meeting organiser (SETPOINT) who decided which local state secondary schools to approach.

It was important to strive to achieve a reasonable balance of ability, gender and ethnicity. However, in some regions nearly every SFC and private school approached agreed to participate – the London and South-East regional meetings were three times the size originally envisaged, which skewed the balance considerably.

Separately, Science Year and the Science Museum also announced the project through their regular mailings. The result of this was a few (five) requests from schools and colleges not already contacted to participate.

Once these organisational details had been finalised, the next and most important stage was how to engage the students in the project.

## ENGAGING THE STUDENTS

The 16–19 year-old age group is not an easy client group with which to engage. They may have left school and will certainly no longer see themselves as pupils, they are young adults and they want to be taken seriously.

Given the relatively short time-scale of the project, it was most important that the project at every point related to the students in a manner that would convince them that they were at its centre.

## GETTING INTO SCHOOLS AND COLLEGES

Except in a handful of cases where an alternative, effective internal contact was known, initial approaches to obtain students for the regional meetings were made to head teachers and principals. Background research was undertaken to gain basic biographical details of the head or principal: length of period at the school or college, gender, age, degree background, etc. 'Cold-calling' or equivalent letters are notoriously ineffective in generating a positive response. It was vital for the project that the head of the institution read carefully about the proposed project and referred the matter on appropriately.

> Dear John <cut>1,
>
> I am seeking the assistance of yourself and some staff at <cut> SFC to help contact 16–19 students who themselves can help the Science Museum.
>
> As a major part of its contribution to Science Year, the Science Museum is organising a student and pupil-led review of the Science National Curriculum. This is not an official study, although both the DfES and QCA are keenly interested in the outcomes, but rather a vigorous contribution to wider debate, giving students a rarely-heard voice in their educational provision at this level.
>
> At this stage I need to identify just two or three articulate young persons on higher level courses (one non-science) who can join the regional design team. Their commitment will be two afternoons between now and February, email and 'chat' liaison with myself from time to time and some other liaison with their peers in other schools and colleges.
>
> I know half-term is soon, and the first regional conferences will be completed by mid-November. So, I am really urgently seeking <cut> SFC's assistance. If I am correct, your own background is in Physics, and I thought you would be particularly receptive to this project.
>
> 1 <cut> means that information has been removed to ensure anonymity.

Where the head of the institution or head of department, were enthusiastic and decided that this was an activity worth participating in, the institution took part.

If the letter to the head of the institution was passed on to a Head of Science, then usually the school or college found three scientist students to take part in the project – in some cases more students were offered. This was, of course, not the intention. It was decided inappropriate for the project manager to deny participation to students who had been identified by them and who wanted to take part. But inevitably this meant that there was a likelihood of a surfeit of science students.

If the details were passed down through the head of year or tutorial system, then usually the request for a balance of science and non-science students was met. In the end though, two-thirds of those participating in the regional meetings were science students. However, not all of these were just studying science and the balance at the regional meetings of subjects being taken was more even than might have seemed likely.

## COMMUNICATING WITH STUDENTS

The first issue was communication with the client group. For obvious reasons it was only possible initially to approach the students through their schools and colleges. In this initial approach, wherever practicable, the schools and colleges were invited to make available to the project manager the email, ICQ, AIM and mobile 'phone numbers of the students.

Data protection and related issues were, of course, paramount. Many schools and colleges dealt with this by giving the students the email address of the project manager at the Science Museum and inviting them to make their own contact with him. However, some schools interpreted the request for student contact details as an intrusion.

In the first instance, it proved to be quite difficult to obtain mobile 'phone details. School and college email addresses also proved to be problematic because often the students used personal web mail accounts instead. These email addresses were often unknown to both schools and parents. These email addresses were also frequently changed or could 'fill up' and then reject further postings.

However, when an email contact disappeared, it could generally be re-established via a message left at the school or college.

It had been the intention to include closed 'chat sessions' with the students about some of the results and their interpretations. However, these were never established.
It is worth noting that students respond to a text message on their mobile almost immediately, but may not check their email inbox for several days.

All the regional meetings were provided with a pro forma registration form on which to capture full biographical details of the participants:

MALE / FEMALE

School or college:
Name of teacher:

Email:
Chat handle:

Are you happy to be contacted directly via email/chat by the Project Manager Ian Murray?
YES or NO

If you are happy to be 'texted' over various follow up issues arising from this conference then write your mobile phone number below:
[ ]

Would like to be invited to a university Science Masterclass visit especially arranged for those attending this meeting – (the list of subject university departments would be posted to you later)?
YES or NO

Would you prefer to be contacted directly at home (useful for the National Conference, National Group and Masterclasses)?
YES or NO

..... If so, write your address in below. Remember to include your postcode.

We wish to credit you and your school/college on the Science Museum review website. We would like to list your school and your surname, e.g. J SMITH, Splendid Community College. Are you happy with this suggestion?
YES or NO

SIGNED _____ (student) DATE _____

It is important that your parents or teacher know the details of your registration above.

All data collected on this registration form will only used for the Science Museum Student Review of the Science Curriculum and its associated activities.

Example of Regional Form

Not all the regional meetings used this pro forma and the East Anglian meeting declined to collect any personal registration data on grounds of personal intrusion into students' lives. This made it very difficult to maintain contact with the students. Where the pro forma was used, every student was happy to have their name and school listed on a website (which subsequently happened). No student revealed a chat handle; most students gave their home address and most students who gave it could accurately remember their email address. About a third of students offered mobile phone numbers. In the end, 343 sets of biographical details were collected from just over 400 student participants in the regional meetings.

Maintaining contact with these students and those in their selected national group continued throughout the project. This became particularly important in the run-up to the national conference in March 2002. Students had already (as explained below) elected or been selected or volunteered to attend the national conference, but this had been done when the AS module examinations did not loom imminent. To encourage participation at the national conference, each student received a mail merge ordinary letter with a pre-pay return slip envelope. Their school or college received a list of those expected to attend to confirm permission for them to attend. 75% of the students thus approached confirmed their expected attendance. The initial letter had said that their travel arrangements would be handled centrally by the project manager, and this may have helped achieve the high confirmation rate.

Each student then received a conference mailing which included an invitation to submit a pre-drafted question to QCA and awarding body attendees. This was also intended to cement commitment to attendance and help manage the final conference programme.

After the national conference, email was used by a number of students to send thank you messages.

What became very clear was that the process of good communication with the students, made them feel wanted, important and valued. This was on top of the organisational benefits of good communication.

## RUNNING THE REGIONAL MEETINGS

The first interactions with the review process for the students were the regional meetings. It was vital that these be good experiences. Because of the nature of the arrangement with the SETPOINTs across the country, it was not possible, nor would it have been wise, to rigidly impose a single format on the meetings. Guidelines were prepared on how the day ought to be used, time allocated and discussion topics engaged in as follows:

The Regional Meetings will:

- Produce a set of no more than 20 questions which the students in that region have decided that they wish to ask of their peers with an emphasis on the constructive and positive and which are in accordance with the purposes of the review.
- Produce questions which may be free format answer, option box answer, check box answer.
- Produce questions which will be simply expressed and pertinent.
- Commend design issues for the way the questions might be presented on the web (but this is a minor outcome).
- Determine two students with two reserves who have the time, skills and inclination to represent the regional meeting at the National Group.
- Identify at least 15 students (with reserves) who will commit themselves to attendance at the National Conference.
- Produce a video record of the day.

And:

The meetings should be hosted at the local university or possibly on the premises of a significant industrial concern. The premises will need to offer about six workspaces for small group work, a room able to take plenary work and catering. You will be catering for the students and providing mid-morning and mid-afternoon breaks. Each workspace must be staffed and you will need to be able to affirm to me that you can meet staffing requirements. The students' own teachers should be the last port of call for the staffing. Generally, small group work should not exceed 10 students per group.

The meetings must have started by 10:00 and have finished by 16:00. There must be at least four and half hours in the day given directly over to the processes of reaching the outcomes. It is not a function of these regional meetings to be used for university recruitment, but of course I welcome a short 'Welcome' from the university. Trips around the campus are not appropriate, but the university may wish to 'open students' eyes' to new kinds of science study that the students might commend to their peers for consideration as KS4/3 studies in their 20 or so questions.

I am expecting the day to include:

- Ice-breaking activities and non-science exercises in good team-work, possibly even a short video before moving on to the gritty detail.
- Consideration of most, if not all of the issues below (including any additional issues of your own) by all or some of the students in small groups:
    - Subject specific curriculum content issues,
    - Preparation for life issues,
    - Issues of the personal and social relevance of science,
    - Ideas for new topics of learning,
    - Depth versus breadth issues,
    - Relationship between technology and science curriculum issues,
    - Differences between primary and secondary science experiences and why,
    - Philosophy and ethics of science issues,
    - Coherence and revisiting of science topics issues,
    - Mode of delivery including practicals issues,
    - Maths competence issues,
    - Volume of learnt content issues,
    - Analytic against descriptive science issues,
    - Styles of learning issues.

From Guidelines for Regional Student meetings. Full guidelines are included at Appendix 1 and 5.

Following a visit to each region by the project manager, the local meeting organiser indicated how their own meeting would be handled. There were significant differences. These different meeting formats had a significant impact on both the final questions for the questionnaire and the interest the students showed in the overall process.

The selection process for the regional meetings meant that the participants would be significantly above the national average in ability and self-motivation. Despite a wish to have at least half of them being non-scientists, the way schools and colleges internally allocate responsibilities for conference invitations such as this one meant that, as discussed above, only a third were non-scientists. There was also a significant gender bias towards females.

The primary intention was not that the project be statistically representative. For instance, it was considered more important that two or three students came from the same institution rather than only one (which would have allowed for a greater balance of institutions). This was because the project manager wanted the students to feel sufficiently socially comfortable as soon as possible on the day to allow as much work as possible to be done on the question-generating tasks.

Each regional meeting had adult facilitators whose task was to manage a small group of students in their discussions on the Science curriculum and in their generation of questions. It had been thought that it would be better if this were not done by teaching staff from the students' own schools or colleges. However, there were a few instances where teaching staff from the students' own schools or colleges helped, but there was no obvious interference with the student discussions.

Each regional meeting had a social, ice-breaking task. These were mostly collective problem solving tasks, but the 'lie game', in which you tell two truths about yourself and one lie, worked very well at giving the students social confidence in each other, as did building straw towers in Bradford.

Facilitators generally used briefing notes on how to manage their group (see Appendix 1). At the University of Bath, this format was rejected in favour of a fully free format forum. This did produce some of the most challenging questions for the web survey – unfortunately not all usable. However, free format discussions need highly skilled facilitators to keep the students on task and to time. It was obvious that the Bath team had facilitators with the appropriate skills.

In Cambridge, the format for the day meant that students had a very long time before lunch. This affected both the quality of the questions and the perception of the meeting.

Evidence of successful engagement with the students in the regional meetings comes from several sources:

- Negligible drop out from the meetings once started – only one student in Surrey University went AWOL.
- Positive returns from the evaluation questionnaires.
- High take up of the national conference places.
- High involvement with the final web-based questionnaire from schools and colleges that had been present at the regional meetings.

There were lots of examples of good practice in the regional meetings. They all had one thread in common: once the students had understood an issue, they were left to discuss it in any way they wished provided they realised that they had to draft a possible question at the end of the discussion. In practice, this meant that some groups generated lots of questions, while others submitted just a single well thought out one.

The meeting in Liverpool John Moore's University asked the students to sketch on large sugar paper how they thought their questions ought to be presented on the web. This approach worked well and was reflected later in a very high web response rate from the Liverpool area.

Many of the facilitators had reasonable doubts that they could manage their groups because of their lack of understanding of the curriculum issues. This fear proved ill-founded. The students certainly understood the issues, and the facilitators were able to focus on encouraging all to participate. This was particularly important in the Surrey meeting were there were representatives from the Mary Hare Grammar School for the Deaf, and in Liverpool where there were representatives from the RNIB Worcester New College for the Blind. It was particularly difficult – but successfully managed – to have group discussions with the seriously deaf because the room acoustics were poor, the deaf students needed to lip-read, and it meant a degree of self-restraint on the part of other group members to avoid 'barging in' with their comments.

In general, the more active and participatory the regional meeting, the more this was reflected in the final responses to the web-based survey. The North-West, Yorkshire, South-East and London were particularly successful. Where regional meetings provided certificates of attendance, this was appreciated. The national meeting certificates were specially prepared and individualised and students were pleased to claim them.

## NOTES ON THE SUCCESS OF REGIONAL MEETINGS

In summary, the key to a successful regional meeting seems to have been:

- Good pre-conference preparation and contacting of students.
- A well organised day with several breaks and a good lunch.
- High-status location (the university locations were generally best).
- A good ice-breaker session.
- A 'hands-off' approach from the facilitators in managing the content of the discussion (but not hands-off on engendering participation).
- A plenary session in which students could present to other students and argue for their favoured questions.

The characteristics identified of the less responsive schools and colleges were:

- Poor internal communications.
- High staff sickness rates or obvious high stress levels.
- An inward-looking ethos.
- An over-concern for the welfare rather than the education of the children.

The regional meeting with the lowest attendance (in single figures) was at Teesside University. Special factors were at play: the meeting had had to be rescheduled twice and relocated once and the local SETPOINT organiser was about to go on leave, there were many non-responsive schools and colleges. However, from the very small meeting there were added to the national group of students two excellent young people.

## THE NATIONAL GROUP OF STUDENTS

A national group of students was required to help steer the project to completion. Their key duties would be to analyse the responses of their peers to both the regional meetings and the survey, to help prepare interim and final reports about the project, and to present the results of the curriculum review on behalf of their peers to government ministers and other stakeholders at the final March conference. The national group could either have been recruited from a national advertisement or similar selection process and then help set up the local groups and the regional meetings, or it could have derived itself from the processes of the local and regional meetings. The latter route was chosen.

The project manager took the decision not to dictate the method of selection of the national group to those running the regional meetings. Partly, this was because the regional meetings varied so much in size and format. A single formalised system, given that regional meeting attendance had been largely self-selecting, would have been inappropriate.

In no regional meeting was there time spent on a complex voting system. In most cases, those students willing to undertake the role were invited to stay on for a few minutes as the regional meeting was drawing to a close and to volunteer. The nature and duties of the role were explained. Some then withdrew and usually 'straws' were then drawn for the remainder.

It had been a worry for the Science Museum how it would be possible to establish a national group balanced with respect to gender, ethnicity and course choices (at least in respects to science/ non-science). The advice of the project manager was that under current legislation any attempt to engineer or to be seen to engineer for gender and ethnic balance might be construed as illegal.

In the end, the national group composition was as follows:

- 12 females and 11 males.
- 4 from minority ethnic groups.
- 8 non-scientists.
- 16 from state-funded institutions, 7 from private schools.

There had been nine regional meetings and the intention was to have two representatives from each region. However, the London and South-East meetings had been so large that four representatives were chosen from each. The haphazard nature of the national group selection process did prove to be successful, possibly in part because it was continually emphasised that any person for whom it would prove to be too much of a conflict with their academic studies could not undertake the role.

The national group was involved in three different roles:

- Attendance at national meetings involved in finalising the set of questions for final web-uploading.
- Interpretation of the data.
- Presentation of the results at the final conference.

All these roles required attendance in London for meetings, and for the national conference the students were accommodated overnight. Being a national representative became a real learning and 'growing up' process for the representatives themselves. The project manager recognised and supported this.

There was no way of knowing whether a group so haphazardly selected would prove capable of working well together. There had been no psychological or other input to match personality profiles, etc. However, the national group worked well together despite very considerable variation in their social backgrounds.

Group socialisation was important, so ample time was given at national meetings for the students to talk and eat together. In addition, the students usually travelled to London in pairs and so had already had time to get to know at least one other member of the group before arriving for the first national meeting.

The national group was a very task-orientated group. This was not a discussion forum, but one which had to select and commend the final questions for the web, advise on how they might be presented, process results, interpret findings, produce graphs, write reports, etc.

With the national group it was possible to maintain coherent contact, mostly by email. All members of the group had each other's email addresses and home and mobile phone numbers. Some of the students also revealed their AoL AIM, ICQ or MSN 'handles'. For one student this proved to be a key method of supporting her when the pressure of other work meant that she might have been unavailable to attend.

Students had access to the project manager throughout the project. The project manager also communicated directly with the students' parents to brief them about the demands the project would put on their child. The students also emailed and texted each other. This provided a web of support across the country, which held the national group together and produced an enormous team spirit, as was evident when the students ended up making a presentation to a House of Commons Select Committee.

The national group met on three occasions: (i) to choose and prioritise the questions for the questionnaire from the sets produced by the regional meetings; (ii) to analyse and interpret the data; (iii) to present the findings at the national conference.

The students all had a good command of basic IT skills - being able to plot and interpret graphs and create Powerpoint presentations - but only some of them had sufficient knowledge of statistics and Excel to be able to process the final data themselves. However, it had been the right decision not to make such knowledge a selection criterion for the national group as it would have prejudiced certain students.

The solution was that the project manager undertook the core 'pivot-table' analyses in Excel and presented indicative results from the data set to the students at the second national meeting. At this meeting there was a teaching session to brief students as to why cross tabulations were important and on how to extract meaning from the tables. Later the students emailed the project manager with appropriate requests for further data where they suspected correlations might exist.

It had been hoped that each national group representative might be the focus of a small regional committee to organise support for the review in their region. This proved over-optimistic, not least because of the time demands it would have imposed.

When the national conference was held, the report presented to Baroness Ashton was sub-titled 'Initial Report'. In September 2002, additional funding was made available by Planet Science to complete the analysis and provide full reports. The project manager was joined by a science education academic who helped complete the analysis and interpret the findings. Planet Science identified three reports for publication: a short summary document, a report of the main findings placed in their academic and research context, and this process report.

Even at this new and final stage of the review process, it was important that the students be at centre stage. Students had debated the questions for the review, designed the review, completed the survey and done the initial analysis of the findings. The final analysis and reporting of the review would continue to be driven by the students.

In the autumn of 2002, a second national panel was convened. All the state schools and colleges that had participated in the original review were contacted and invited to nominate a post-16 student for this new national panel. The schools were advised that all nominees would be contacted and a balanced panel of similar composition to the original national group would be assembled. The schools were told that they could nominate a science or non-science student but that the project manager would ensure equivalence with the previous national group. About 20% of schools and colleges responded to this invitation, which produced just a few more student nominees than required. The gender, regional, subject and ethnic balance of the nominees was, as it happened, remarkably similar to the previous national group, and the first 17 nominees to reply were chosen.

The decision to exclude private schools as this stage was recognition of their over-representation in the earlier part of the review.

The new national panel of 17 students contained nine females and eight males. There were eight science students, five non-science students and four students doing a mix of Science and non-science subjects. One student was from a further education college, four were from SFCs and the remainder were from state schools. The students were predominantly first-year sixth but there were three second-year sixth formers. None of the students had completed the original survey. This new national group met twice in central London.

The lack of involvement of these students in the original national group was intentional and significant. It meant that they could be invited to look dispassionately at the evidence and the draft findings without any sense of 'personal ownership' of the results. If this second national group believed that certain findings were over- or under-emphasised, it could say so without concerns that there were personal 'axes to grind'. In fact, this second national group largely, but not entirely, concurred with the direction, basis and detail of the original national group's initial report.

A key activity of the second national group was to consider all the textual responses to the survey. None had been previously considered. The students selected representative textual responses that became the basis of many of the illustrative quotations in the summary and main findings reports. The students also drafted the conclusions for the main findings report and made the key recommendations.

The student-centred focus of the review was thus maintained to completion of the conclusions and recommendations. It had begun a year earlier with the initial invitations to participate in the regional conferences and had been maintained through each stage of the process.

## DEALING WITH THE DATA

Those planning the original submission to Science Year envisaged that the review had to be web-based, partly so as to collect responses from a large number of students and partly because it would be significantly cheaper than any other method. However, disadvantages of web-based surveys such as this include:

- They disenfranchise those with no, or poor, access to the Internet,
- They are self-selecting, though if IP addresses are captured some filtering or statistical corrections can be applied,
- They capture spurious respondents,
- It is difficult to filter out multiple submissions from the same respondent,
- They generally have poor completion rates.

The advantages of a web-based survey for this study were that:

- It would be easy to distribute the survey,
- It allowed hyperlinks to be made to and from the site,
- It was cheap to implement,
- It could be made visually entertaining,
- Data can be captured in a form that required no further data re-entry for further processing (see also Hewson et al., 2003).

The curriculum review achieved just under 5,000 hits in the six weeks that it was most active. This is low compared to many commercial sites, but for a specialist curriculum survey targeting this age group it was a significant success. Of those 5000 hits, there was a conversion rate of hit to completion of about 45%. Given that the survey took over 10 minutes to complete, this completion rate was extremely impressive. Professional IT staff at the Science Museum quoted a typical web-based completion rate of about 2%.

The curriculum review was overwhelmingly accessed at schools and colleges. Only some 10 IP addresses could be identified as being likely to be those of home PCs.

The issue of spurious respondents was captured, to a certain extent, in the final section where home country, age and post code had to be declared. It was also presumed that as the survey was difficult to find on the web and was of a specialised nature, it would be unlikely to prove attractive to spurious respondents. This proved correct. There were fewer than 50 respondents who were identified as being outside the target group.

The issue of multiple responses from a single respondent proved more intractable. It is the nature of school and college IT configurations that some or all of the following net access techniques are used:

- Unique public IP (Internet Protocol) addresses are statically assigned to stations,
- Net address translation techniques are used, with the school or college having a single or limited number of public IP's,
- Dynamic IP addresses are assigned.

As a result of these techniques, any attempt to filter or lock out multiple responses from the same IP address would prove problematic. In addition, even where static public IPs were assigned, a station set in a classroom or IT resource centre might within a short period of time be used by several students. Indeed, two or more students might simultaneously access the survey from the same PC in different windows.

Initially, it was considered appropriate to place a short time expiring 'cookie' on each station that would forbid duplicate response within a set time period. This, however, would generate non-functionality on a PC once a student got up from the station to give another student access to it. There was no time period, however short, that would not have given the survey the appearance – at least at some stage to some students – of non-functionality.

Multiple submissions were therefore dealt with at the data analysis stage. There were a few such cases revealed by:

- Identical IP,
- Identical sets of responses,
- Negligible time gap between submissions.

The survey was professionally designed. However, the national group were consulted at one of the meetings about the nature of the design and their approval was important. Some of their presentation suggestions were incorporated. The final survey was significantly more visually entertaining than most 'text-only' web-based surveys. However, the hyperlinks to other Science Year activities or freebies were largely ignored.

The survey was hosted on the Science Museum website using an ASP application. Responses were captured in a form that could be processed by Excel. Attempts were made to get other organisations in addition to Science Year, to provide links to the survey, but with little success. The full survey appears at Appendix 2.

## GETTING STUDENTS TO COMPLETE THE SURVEY

This survey was specialised and potentially uninteresting to respondents as curriculum discussions can often seem arcane to students, and curriculum issues are of considerably less pressing concern to them than their immediate tasks.

The project manager decided that there were two main solutions to the task of generating students to visit the website:

- To use the students who had attended the regional meetings as ambassadors for the survey.
- To write directly to those head teachers and principals previously contacted to generate teacher and tutorial support for the survey.

The Science Museum home page and that of Science Year directed students to the review site. Other traffic-generating mechanisms included Science Year's regular e-newsletters, some of the professional associations agreeing to place details on their education pages, and casual browsing.

Where students had provided email addresses, an attempt was made to contact them about the survey by email. This tactic did not prove widely successful. In some cases, though, students did email the project manager expressing enthusiasm and explaining how they would be helping the project.

The Science Museum IT staff tracked sources of hits to the site. Taken together, both referred hits from all other sites and casual browsing amounted to less than 10% of the total hits.

The technique used to maintain school and college interest for the project was to write simultaneously to students and principals / headteachers. Though the letter was a letter of thanks, it was also intended to further engage both the school or college and the student with the project. The student was invited to contact the head teacher with a view to discussing how to promote the web survey inside the school or college. No follow-up was undertaken of the actual success of this strategy, except that it became clear that the schools and colleges with large numbers completing the survey were often those with students who had taken part in the initial regional meetings.

Some schools and colleges that had initially been invited but had declined to take part in the regional meetings also received information about progress in the project. Students from some of these schools and colleges did indeed participate in the survey. As contact details of only the SFCs and certain schools in the private sector were held centrally, this contributed to the demographic skewing of the survey respondents.

As hits were registered, it became obvious that the normal mode of access to the survey was for a group of students to do the survey as part of some Science lesson or tutorial activity. There were individual hits from schools and colleges but this was not typical. The practice of students completing the survey in tutor groups helped maintain a balance of science and non-science respondents as tutor groups are usually subject-mixed.

It was decided to give small prizes to about 5% of completed surveys. Initially, there had been plans for a wide range of prizes, which might have involved some form of sponsorship. In practice this did not happen and the prizes were restricted to IMAX cinema tickets. The project manager had taken advice that the target age group would be far more motivated to complete the survey if there were given the chance to win a 'freebie' at the end. It is impossible to determine to what extent these prizes helped. Some students when asked said that it was an incentive. However, given that most respondents completed the survey as part of a classroom activity, the effect may have been less than originally anticipated.

## TIDYING, PROCESSING AND UNDERSTANDING THE DATA

The Science Museum web survey application was able to provide information to requests about how the results were progressing through simple aggregation. For analysis, the output was tidied up and imported into Excel. Three forms of data resulted:

- Those from questions where respondents could tick only one of the available boxes, e.g. 'At primary school, do you think there is enough Science on the curriculum?' where the mutually exclusive choices were 'Too much', 'About right', 'Not enough', 'Nowhere near enough' and 'Can't remember doing Science at primary school'.
- Those from questions where respondents could tick several of the available boxes (see, for example, questions 10 and 55 in Appendix 2).
- Those from questions where respondents gave textual (i.e. prose) responses.

The respondents did indeed take the time to provide some valuable textual responses, though some questions were more popular than others. By and large there were very few 'offensive' or 'spurious' responses. Reference to the word 'sex' combined with one or two 'odd' email addresses led to the data set being rejected when sent as an attached file to QCA, the Science Museum and several college and university servers. However across all the textual fields, including email fields (where students, as indicated above, do sometimes use 'odd' email addresses), there were just 30 rejections. Given the client group, this again was a considerable endorsement of the serious nature in which the questions were answered.

A serious debate was held with the national group of students about the amount of personal data that would be collected from the respondents. To aid in later validation and analysis of the data, Science Year and the project manager wished for slightly more personal data. The national group of students rejected this. For instance, neither birth dates nor data on ethnic background were collected.

Respondents were asked for their own name, home post code and school name. This allowed prizes to be distributed. The phone number of the school or college was obtained using Internet search engines; we then phoned the school / college and checked that the respondent was indeed a pupil there. We then informed the school over the phone that the respondent had been awarded a prize. This proved an excellent excuse to write to the headteacher or principal a letter of thanks and congratulation and generated more responses to the survey from the school / college. We never at any time asked for student postal addresses and always communicated with respondents to the survey via their school / college.

Before the survey was posted on the web, the students' proposed questions were shown to a professional in survey design who identified considerable problems with some of questions. For instance, four of the questions had 'don't care' as one of the options. However, the Science Museum and Science Year decided that there could be no interference with the questions chosen by the students. (Interestingly, respondents were sparing in their use of the 'don't care' options.)

To our minds, this issue goes to the heart of the extent to which young people are allowed to make decisions for themselves. Of course, one needs to prevent a young person from doing something that is about to cause them harm, particularly if they do not appreciate the risks involved. (This is the standard liberal argument as to why certain activities, such as cigarette smoking, should be banned in children but permitted in adults – e.g. John Stuart Mill's essay on Utilitarianism (Mill, 1861/1991).) But when we are talking about questionnaire design, more good is likely to flow from respecting all the hard work and quality thought put in by the students than by handing over their product to a professional for tidying up.

## EVALUATING AND UNDERSTANDING

The evaluation process took three forms:

- A short question on the questionnaire itself,
- A series of forms sent to a 10% sample of the regional meeting attendees who had supplied their name and address. (See Appendix 4)
- Discussions with some regional organisers and schools / colleges that took part.

### RESULTS OF THE EVALUATION QUESTION ON THE QUESTIONNAIRE

The short question on the questionnaire itself was suggested to the national group by the project manager and included after their agreement. The figures below show the mid-February 2002 results:

| A really good survey that hopefully people will pay attention to | An enjoyable survey that ought to give useful results | A reasonably fun survey but not serious enough | Not bad could do better | Boring – yuk |
|---|---|---|---|---|
| **368** | **538** | **104** | **252** | **175** |

Encouragingly, 63% of respondents either chose 'A really good survey that hopefully people will pay attention to' or 'An enjoyable survey that ought to give useful results'. Considering that most of the respondents seem to have been required to complete the survey as part of a tutorial activity, this is a satisfying endorsement.

When these responses were cross-referenced against other responses earlier in the survey, no discernible patterns emerged. This is encouraging in that it meant, for example, that females, those who had done triple-award science or those who felt negative about Science weren't much more likely to be positive (or negative) than other respondents about the survey.

### STUDENT EVALUATION OF THE REGIONAL MEETINGS

No attempt was made to evaluate the regional meetings at the meetings themselves. The project manager wanted the students to leave the meetings feeling that their contributions were entirely 'non-schooly'. However, evaluation forms were sent out in April 2002 to a sample of those who had attended the regional meetings back in November and December 2001. Impressively, over 60% of these were returned, some with detailed additional notes. Each letter had been personalised and included a simple set of evaluation questions (see Appendix 4). A pre-paid return envelope was also included. Additionally, whether a student sent back the form or not, each student received an IMAX ticket. This was intended to place the student under a certain moral obligation to respond.

All the students thought that the regional meetings, were well organised, that their views were treated with respect and that they were able to contribute to the review. This is a substantial endorsement of the regional organisers and their facilitators. Similarly, none of those who attended the national meeting described it as a waste of time. This is a similar endorsement of the national meeting, which was much more formal than the regional meetings.

About 25% of the students thought that the review would have no further impact on the future of the school Science curriculum. We hope that they underestimate the impact of their work.

15% of the evaluation forms showed that the students had not looked at the website. This is interesting given that these students were motivated and were a particular target group for completion of the web questionnaire. On the other hand, the fact that 85% of the students who attended the regional meetings did look at the website endorses the focus on them. 80% of those who had looked at the website did complete the survey, a higher figure, as one would expect, than for those who had not been to the regional meetings.

All the students endorsed doing such a curriculum review again. This suggests that there is a significant volume of untapped comment from students, which might be applied to other curriculum areas. The facilitators received a 100% endorsement with none of the students feeling that the adults had steered them towards conclusions in any way.

The students were more split in their views as to whether such a review could be conducted with 14–15 year-old students, with 40% rejecting the idea.

Given the concerns with the representational nature of the review, only one student thought that his peers were not representative. Where students had attended both regional and national meetings, there was a 50:50 split as to which the students preferred. However, when students were asked to say whether the regional meeting discussions or the resulting questions were more important to them, there was an 80% preference for the regional meeting discussions. This is an important endorsement of the decision to base the consultation 'bottom-up' from the regional meetings.

The evaluation letter also gave space for extra comments. A number of students used this opportunity. These comments are presented here (with full stops inserted and occasional spelling corrections); they are perceptive and add colour to the quantitative aspects of the evaluation.

About the regional meetings:

- The meeting was well organised and this helped in getting more people involved.
- Splitting up people from the same school was a good idea and the group size (approx 7) was ideal.
- Seemed to work quite well – intro, small group discussion and everyone together.
- Meeting was excellent but could have done with a later start due to trains.
- This type of meeting should be done regularly.
- It was well organised but a very long day, I had a lot of work to catch up on.
- Although I knew in advance, I found out the date and time only the day before.
- Well-organised, great facilities, and lots of learning worth.
- The informal atmosphere was good but the event was without real focus.
- ...structured but each group should have been given a specific set of topics to discuss and come up with a few questions on particular aspects.

About the national meeting:

- It was good to see the culmination of our work and that it did matter.
- No – the national meeting was not a waste of time but a session to communicate and express views.
- National meeting was a good opportunity to see a conclusion to the project and to see where the work had gone.
- Very interesting to see the higher level of the process.
- The national meeting wasn't as productive as the regional meeting but still worthwhile.
- It was important seeing the results meet those who matter, almost as much as producing the results in the first place.

About being treated with respect:

- The adults listened attentively to our views.
- The adults helped us and let us know what we were doing but did not influence any of the decisions. There was a lot of independent work needed.
- I was very pleased at the absence of any 'steering' by the adults involved – the discussions and questions came from the students with no prompting.
- The adults seemed interested in what we had to say – and led the discussion smoothly. Occasionally they picked up on the wrong idea and didn't really understand what we were trying to express.
- If they (the adults) had more information about GCSE Science, the results would be better.
- The adults helped us get back on track when we lost the point of the discussion and gave different perspectives of points raised – if they thought of something pertinent they would say so.
- The facilitators were fabulous.
- They didn't influence us but did make us make snap decisions and a meandering debate.
- Sometimes the adults were dismissive of certain opinions like the 'creationist theory was wrong'.
- Making a presentation in front of everyone was very useful.

About the future impact of the review process:

- The results will need to be more widely publicised.
- It will have an impact but the more publicity the better.
- I think the government will listen to us and change the course – the survey shows what kids want from their education and they are the ones who sit the exams.
- I would hope it does but it may take years to implement.
- Not 100% sure it will, but valuable improvements could be made if it does have an impact.
- I would hope so although I am not sure what affect the results will really have. I would love to be informed of any changes made following the survey.
- I certainly hope that we will be listened to but I fear that the government has already made up its mind. They think they know best and that we are only children.

About the website:

- I felt the questionnaire was too long, it became a bit tedious. I felt more would have filled it in if there were less questions. It was good how you could view the results so far.
- The website was fantastic.
- Terminology was confusing and misleading at times.
- Please remember that the Internet is not an easy option for everybody.

About doing the review again:

- By dividing specific stages of the curriculum – just KS3 or just KS4.
- Having gone through part of the A-level curriculum, I would certainly say it needs to be reviewed ... particularly the varying levels of content and difficulty for the same subject and qualification.
- 14–15s could do it but their lack of hindsight should be taken into account.
- It should be done again!
- It will keep the curriculum up-to-date and modern.
- 14–15 are not old enough.
- In a few years a follow-up would be good.
- Definitely do again – students have just been through the system and can offer the most valuable advice on how it could be made better.
- It was helpful having us non-scientists there.
- Those taking the exams and working in the system should have a more significant say in how it functions.
- Only after a gap of a few years – this will mean the topics we discussed can be considered and worked on.

About fellow students being representative:

- The students there were very bright. Representatives of lower ability including those who left school at 16 would give a broader view and are more likely to be those let down by the system.
- Didn't understand the question ... representative of what ???
- YES.
- On the whole I did – some had differing views on Qs.
- There were some doing sciences and others doing no sciences beyond GCSE level – however the transition i.e. doing only one science or some doing two was not representative nor were the awards done at GCSE.
- Fellow students were representative but non-scientist views were neglected.

About the regional meetings versus the survey:

- In the meetings views could be expressed in detail, the questions were much more limited in their outcome.
- The discussions enabled a multitude of points to be raised whilst the questions were in the end too general.
- The discussions gave lots of different views.
- The discussions were very useful.
- I felt I was able to air my views more in the discussions than in the web survey.
- The discussion was useful but more interesting was when the questions and results were put forward to people in the national meeting.

## VIEWS OF THE SCHOOLS, COLLEGES AND REGIONAL ORGANISERS

A full list of schools and colleges is included at Appendix 3.

As part of the evaluation, schools were visited in London and Bradford, SFCs in Huddersfield, Surrey and London, and the regional organiser in Bradford was interviewed. As a 'thank you' to these institutions in helping with the evaluation, each received an Intel digital Microscope from Science Year. This was part of the philosophy of the project that it is unreasonable to expect adults and young people to offer their time for no reward.

### John Kelly Boys Technology College

John Kelly Boys Technology College is a boys' comprehensive in north London with a very wide mix of ethnic backgrounds. The school had not been part of the schools initially selected, but one of it's A-level Science teachers had responded to the Science Year mailing and emailed the project manager asking to be included. The school is an affiliate of the technology colleges. Three boys went from the school to the regional meeting and one of these boys was randomly selected for the evaluation process as well.

The teacher, Tariq Ahmed, said that initially all three boys were reluctant to attend. One was a refugee from Afghanistan, another was a recent immigrant from Sri Lanka, another from Mumbai. Tariq said that the high status location of the regional meeting at Imperial College was vital in helping him persuade the students of the benefit of attending. He was able to convince them this was one of the world's centres of learning for science. They reported back to him their being 'over-awed' by the meeting and its location.

None of these students subsequently did the survey, nor did any student at the school. This was said to be partly because Tariq Ahmed himself is only 50% part-time at the school, partly because the sixth form is small, partly because of poor internet access and partly because of language difficulties once internet access has been gained.

Tariq felt that teacher involvement was vital in encouraging participation, but that the head of the institution must be involved to help steer involvement. The status of the Science Museum helped establish the validity of the project and was important in Tariq making his approach to the project manager after reading the Science Year mailing.

### Farnborough Sixth Form College

The college receives many invitations to participate in national and regional projects, this project's success in penetrating the college derived from the targeted mailing to the principal. Even so, the college would not have participated had the project only been a survey. It took part because the survey was obviously part of a larger and more interesting process.

The college feels that it is a 'responsive' college and does expect its students to travel long distances to take part in events. However, it did not have the time to chase up students and get them to participate. Nevertheless, the project sounded sufficiently interesting for several students to come forward as a result of a general distribution through the Science tutorial system. The students attended the Surrey University meeting and all reported back very positively about the process. Indeed, one student from the college subsequently joined the national group.

The survey was only marginally engaged in. The college did not take a policy decision to do or not do the survey, but announced it a couple of times through tutor groups and science classes. There were thus few respondents from the college.

The college felt that the project had sidestepped the pressure points of examination workload and that the timing of all events was sensible. The college had considerable sympathy with the project, feeling that science has too much factual content and too little syllabus time.

The college added that it does receive many A* GCSE students in Science who do not have sufficient understanding to continue Science at A-level: they have a conceptual gap despite being good students. The college feels that these students consciously reject continuing in Science because it is easier to get the high AS/A2 grades (As and Bs) in 'softer' subjects, and their ALICE data reflects this. The college noted that it is usually the bright students who worry the most about their understanding of their Science learning.

### Strodes College

Strodes College is a small SFC in Surrey. It supplied three students to the Surrey University meeting from an initial commitment of five. The students who did attend thought the meeting was excellent and one of the students also attended the national meeting. He reported that this too was an excellent experience.

The college did not have many respondents to the survey. As with Farnborough College, there was no institutional directive to participate in it and it was mostly down to reminders from the Head of Physics. The college does have some classroom Internet access for science students.

### Hanson Technology College

Hanson Technology College is a comprehensive in north Bradford. It is an affiliate of the technology colleges. Mukesh Nor is the faculty head who organised participation in the project.

The school took part in the project as a result of the approach from David Ross of the Yorkshire SETPOINT. They had a good working relationship and a long track record of taking part in Science events.

Mukesh identified the fact that the students were made to feel special as very important. The high status location at Bradford University was essential. The personalised letters to the students were also important.

Mukesh reported that the web survey was not, for the students or the school, the most important part of the project, even if the subsequent results were interesting. Information was distributed through the school sixth form networks and there were some replies. He suggested that foreign languages would be a good second area in which to do such a curriculum review.

For the school, it was very important that the Science Museum was leading the project. If it had been a DfES or examining authority-led project, there would have been far greater reluctance to take part. He did stress that one of the 'carrots' for the young people engaging in the review was the trip to London.

### Dixons City Technology College

Dixons City Technology College is one of the original technology colleges in new premises in an industrial area of Bradford. It has lots of open access IT facilities for the Internet. It had also been approached by David Ross of the Bradford SETPOINT and had been keen to take part in the review.

There was close teacher involvement in encouraging students to volunteer for the regional meeting, which was oversubscribed.

The college was going to do a full directed tutorial involvement in filling in the survey. Inevitably, in the week allocated for this tutorial activity, the school suffered a full network crash which took most of the week to recover from. Many students filled in the survey anyway as a result of the encouragement from the students who went to the regional meeting and the college apologised for its lower than expected participation in the survey.

The college said they encouraged student participation in the review process by highlighting its usefulness in adding it to their UCAS form.

### Huddersfield New College

Huddersfield New College is a SFC. The college had responded to an invitation to participate from the project manager but felt that there had not been enough initial information about the project: its processes and outcomes had seemed unclear. The head of the Science faculty was invited by David Ross from Bradford SETPOINT to host and run the Bradford University meeting. The college was thus very closely involved in the formative stage of the project.

The initial travel arrangements to Bradford from Huddersfield and the process of reclaiming travel expenses centrally from the Science Museum were identified as a small problem area. Subsequent direct mailing of train tickets to the students via the college was felt to be good.

The use of an ice-breaker at the regional meeting – the building of spaghetti towers in competitive groups – was considered very good. There was regret that the details of the regional meeting discussion at Bradford were not captured. Rob Walker felt that the discussions themselves were the high points of the review process even though the designated outcome of the regional meetings was the production of questions for the survey.

Like many institutions, subsequent participation in the survey was very limited. This was due partly to the loss of impetus between the regional meeting and being advised that the web survey was up and running. Somehow the review needed to have kept the impetus alive in the intervening period. Key skills was the tool used to get involvement in completing the survey.

The college certainly had sufficient open access IT for students to do the survey, but the views of the staff were that it was too long, though visual presentation was good.

### Woodhouse Sixth Form College

Woodhouse Sixth Form College had the highest participation in the survey of any college. Julie Warren, senior tutor, explained that the college had decided that one of the key skills units of the post-16 curriculum could be well covered by the college's involvement and responses to the curriculum review. In supplying students for the London meeting at

Imperial College, she had consciously met the requirement for a balance of scientists and non-scientists. Many students, at least 15, had come forward. Approaching the principal with a targeted letter had worked but might have been followed up with a phone call to identify where the letter had ended up in the college system.

Julie was complimentary about the day at Imperial College and the students gave positive feedback on their return. The students thought that they really had been listened to and had appreciated the certificates. The college had had no problems in releasing email and phone numbers with the permission of the students.

Julie stressed that adequate access to technology in a school or college was vital if the project was to succeed. This certainly was the case at Woodhouse SFC. The college had no particular interest in the final outcome of the review and had not looked at the pdf file on the Internet that reported the initial findings. The exercise, she thought, had been interesting and warranted a repeat effort in about five years time. She also considered languages as a good second area for such a review and agreed that it should be confined to those on first year post-16 courses.

The small size of the college had made it easy to respond quickly and fully to the invitation to participate in the project and Julie could see the difficulties larger institutions might have had in this respect.

### SETPOINT Yorkshire in Bradford – David Ross

The Yorkshire meeting was the only one in which the regional SETPOINT organiser contracted out an external meeting organiser: in this case to Rob Walker from Huddersfield New College.

David Ross' view was that the financial organisation and basis of the review was fine. The project manager, following due negotiation, had met additional and unexpected costs above those contracted for. The meeting itself was not hard to organise. Apart from the financial arrangements with Bradford University, which proved unfortunate, all the administration worked well.

David Ross observed that in his experience it is easy to produce a website but harder to get the website constructively used. He believed that the curriculum review project had been surprisingly successful in getting 'hits' and completed questionnaires to its web-based survey. He fully endorsed the processes of the review and indeed emphasised that the success of the curriculum review relied on building not just an internet web page but a 'web of people' with a commitment to the project. He felt that this had happened. In Bradford he had consciously brought in the city technology colleges and city learning centres as part of that web.

David suggested that the review ought to have made active use of the Beacon School network, as he feels these schools would have responded constructively to invitations to visit the website. David emphasised the importance of personal contact in building a web of commitment. Emails and 'phone calls were, he felt, insufficient in building the will to participate in such meetings, though he acknowledged that the review had succeeded despite its small central staffing.

David did suggest that a small payment to attend would have been a good idea. The most common way of doing this is to meet all the transport costs and a little more for the day, and to do this on a contractual basis. Merely meeting subsequent transport claims does not generate a financial incentive to attend and is open to abuse. Had attendance been on a contractual basis, it would have been less likely that there would have been much drop out.

David considered the problem of lack of attendance from unresponsive or 'failing' schools to be particularly intractable. In these cases he felt that the collection and return of students should be centrally organised with minibuses or taxis. These schools used such organisational difficulties as reasons for non-attendance. Such schools needed several preliminary visits to gain support for a project and, in his words, 'it could be up to ten times more expensive to gain the support of these schools and colleges'.

On reviewing the regional meeting, David felt on reflection that too much time had been spent on the team-building exercise which, when combined with a latish start, had reduced the amount of time for the main activities. However, he acknowledged that the spaghetti tower team building at Bradford University had been particularly successful. He thought that it ought to have been possible to start the evaluation process at the meeting itself. He suggested that the project manager might have predicted or mapped expectations for the meeting against final outcomes.

David firmly believed that the status of a university location for such meetings was important and worth paying for. In Bradford it had worked well and the students had been suitably impressed.

## HOW VALID IS THE SURVEY?

The students who attended the regional meetings and who made up the national group can be considered reasonably representative of enthusiastic AS students in England in 2001/02. In the national group, gender balance was as close as it could be; the proportion of minority ethnic students (4 out of 23) was about twice that in the general population of England. The proportion of science students, though, was markedly higher (by a factor of about three), and the proportion from private schools was also higher than in the national AS cohort (by a factor of about 1.5).

The students who completed the survey did not constitute a truly representative sample. In particular, there was a substantial over-representation (by a factor of about three) of submissions from private schools. Web-based surveys are intrinsically unsuited to obtaining samples which need to be stratified by such variables as social class, gender and geographical area. However, it is probably fair to say that the survey provides a snap-shot of the views of students with adequate internet access either at their school/college or at home. In the accompanying report which presents the findings of the survey there are a number of places where we break down responses by such variables as gender and whether the respondent had taken single, double or triple award GCSE. Such an approach corrects for imbalances in the numbers in these various categories.

Perhaps more important than questions of representation, are questions about how seriously those completing the survey took it. Reference has already been made to the small number of rejected textual responses. Reading of all the textual responses indicates well under 1% are manifestly inappropriate. In addition, a certain amount of internal cross-checking shows that, for example, over 99% of the students who claimed to be attending a girls' school said they were female.

Validity is not something a survey either has or does not have. There are degrees of validity. We see this study as validly complementing others that have looked at what young people think of the Science curriculum in England. The students seem to have taken the survey seriously and it is reasonable to assume that their replies are a genuine reflection of their views. The particular virtues of this survey are that it was driven by the young people themselves and, by the standards of most existing research in this area, had a large sample size.

## CONCLUDING REMARKS

The impact of this educational research was increased by the Parliamentary Select Committee on Science and Technology having started a review of KS4 Science. A commonality of interest was established between the select committee and the student review of the curriculum. The Select Committee was able for the first time formally to take evidence from this age group which it did at the Science Museum itself (see House of Commons Science and Technology Committee, 2002). All the oral evidence given by the students to the Select Committee was listed, and the students' evidence became a key component of the Committee's report.

The findings of the review were reported by a number of national newspapers and on television. This gave those involved in the project a sense of having participated in something of significance and value. Most of the first national group were also interviewed by their local papers which brought appropriate publicity to their own schools and colleges.

A project such as this requires the commitment and enthusiasm of a great many people. This came from many schools and colleges, from Science Year and the Science Museum, from all those students who completed the survey, from the British Association, QCA, the Nuffield Foundation and the various professional societies and awarding bodies, and, above all, from the students who participated in the regional and national meetings, without whom the review would never even have got off the ground.

We are deeply indebted to all those who took part in and helped with the review and made it such a success.

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# APPENDICES

## APPENDIX 1. SOME NOTES FOR FACILITATORS AND GROUP MEETINGS

### The Health Warning

Nothing which follows is prescriptive. Each group of students will be different and the skill of the facilitator is to manage the outcomes and requirements of the process with the diverse students in a group. Please treat everything that follows as a useful suggestion which you may wish to draw on.

### General Comments

- The topics being covered are hard for students, so ensure that you understand before you start the topic and the possible outcomes.
- In any group session of about an hour it is highly unlikely that the group will manage to process more than three topics (c. 20 mins each).
- Each 20 minute (or so) topic session may be divided into:
    - brainstorming the understanding of the issue (e.g. 5 mins with post-it notes etc.),
    - general discussion of the subject and the form of question that would most tease out a valid set of answers (8 mins or so),
    - drafting of the question (5 mins or so),
    - then passing the question to another group for a 'test answering' of the question (5 mins or so).
- Each discussion group will be in single figures (c. 8 students)
- Each member of the group needs to be steered towards making a contribution – difficult when the timing is so tight – so facilitators need to spot those who may be feeling 'isolated' early.
- At the end of the full session the group may want to prioritise their own questions.
- Each discussion group needs to have sufficient students who are socially similar so that no-one feels 'alone'. It is better (for instance) for there to be 'all-girls' groups if it means that in other groups there can be two or three boys each. The same applies for gender and social origin. If you spot someone who would be better in another group – act early to re-arrange.

It is the intention that all of the topics are covered (and any additional topics that the students may wish to consider), but it is simply not possible nor desirable that a group tries to cover all the topics itself – see above. It is important that most of the topics are covered at least twice so that the plenary sessions can lead to a genuine consideration by the students of the best approaches to a particular discussion area. In some regions the fewer numbers of students or difficulties with a topic area may mean that it is only covered once – but let's hope that does not happen often.

## A NOTE ABOUT THE QUESTIONS GENERATED

The format of the questions is dictated by the software available for web questionnaires.

An option box question is one which has a number of mutually exclusive answers:

**Whether it is right to test on animals should.....**

| | |
|---|---|
| Always be discussed in a science lesson | ( ) |
| The science teacher should decide if it is be discussed | ( ) |
| The students should decide if it is be discussed | ( ) |
| Science lessons should not be used for moral discussions | ( ) |

A check box question is one in which there are mutually inclusive answers:

**How do you generally find that you really learn your science – tick all that apply**

| | |
|---|---|
| Curling up with a science textbook in bed | ( ) |
| Watching a classroom video | ( ) |
| Browsing the Discovery Channel | ( ) |
| Going on a visit | ( ) |
| Doing a practical | ( ) |
| Listening and copying off the board | ( ) |
| From doing my homework | ( ) |

A free format text box question is one in which any answer is acceptable provided it 'fits' in the space available:

**Tell us about one good biology experience you had.** ( )

It is important that the students understand that the most easily processable data comes from option boxes followed by check boxes, but that free format text boxes often can give insightful and the most interesting responses. It is acceptable, of course, to add a free format text box as a follow-up to an option or check box.

# THE TOPICS

## SUBJECT SPECIFIC CURRICULUM CONTENT ISSUES

It will not be possible for any group to discuss all the branches of science in 20 minutes, so a group should have a 'lead' subject (e.g. Physics) and a fall-back subject (e.g. Biology). Students may well have a lot to say about the content of what they studied, but they have not got the time to get into detailed topic areas – so a facilitator should steer the group away from a question such as:

**Do you want to study the blast furnace?** YES / NO

However it might well be appropriate to ask a question such as:

**In Physics GCSE how much did you enjoy studying mechanics?** A LOT / SOME / NOT A LOT / NOT AT ALL

The difficulty in this discussion will be for the group to decide what to ask about and an early prioritisation is needed. If they want to submit more than one possible question, fine.

## PREPARATION FOR LIFE ISSUES

Students need to explore what they understand about a subject preparing you for life – bearing in mind that another topic that they may (or may not be) discussing is the personal and social relevance of the science curriculum. This discussion covers the general issues. Points that may come up in the initial brainstorming are whether the curriculum should indeed 'prepare for life', how much of normal life is 'scientific', etc. However it may be appropriate to include in this discussion issues such as 'is it important to understand the possible origins of the universe' or 'how an aeroplane flies' or 'why plants grow'. Almost certainly this topic will generate 'talk' but it will be a difficult topic to generate a question on and here a 'check box' approach may be appropriate allowing respondents to indicate areas where they thought the science curriculum did prepare them for the outside world – lets be positive please.

## ISSUES OF THE PERSONAL AND SOCIAL RELEVANCE OF SCIENCE

Unlike the preparation for life issues, this topic covers the particular. It might cover issues as detailed as 'helping me service my motorbike' or 'understanding why aspirin works' or 'helps me understand my periods' or 'explains why my fish die in the tank'. This topic does lend itself to a free format type question, as each student's personal and social relevance of science will be different and drafting an option box or check box type question will be very difficult indeed. Almost certainly the students will generate lots of practical brainstorming examples – could be fun.

## IDEAS FOR NEW TOPICS OF LEARNING

Of all the issues to be discussed, this is the most likely to initially draw a 'blank'. However in any discussion group there may well be a student who has developed a hobby or interest in a subject that they might like to test acceptability on their fellow students: – e.g. astronomy – should it be on the GCSE curriculum; or e.g. cancer – should it be studied in greater depth. Of course most students don't know what they have not had an opportunity to study. At A/AS they may just have started on fresh topics that they feel might have been interesting in their KS3 and KS4 studies. This session lends itself well to a short brainstorm and some clever facilitator leadership, but if it draws a blank, don't worry, move on.

## DEPTH VERSUS BREADTH ISSUES

This topic area is different from the volume of the learnt content and the facilitator will need to focus the group on the contrast between depth and breadth, not whether there is too much breadth, so to speak. As these students are generally the more articulate and able students it is likely in their preamble discussion that they may express sentiments of having wanted to 'get their teeth more into' a subject. The facilitator needs to remind students of the less able students who will also be studying the curriculum. This may be a point at which students might want to discuss how the GCSE tiers of the various papers are focused. In practice, however, this is an easier topic around which to create a suitable question and the facilitator may need to hurry this one along to allow time for the more difficult topics.

## RELATIONSHIP BETWEEN TECHNOLOGY AND SCIENCE CURRICULUM ISSUES

In this topic discussion I am hoping to generate possible questions that will tease out whether technology is now the 'appliance of science' and whether an interest in the science curriculum has suffered (or not) from the creation of a separate 'applicative' technology curriculum. In essence, have a lot of the fun topics left the science curriculum? Obvious issues are to do with electronics and 'gears' etc. but could also include elements of earth sciences etc. in Geography etc.. So the questions generated may be either general or specific but are unlikely to be open ended.

## DIFFERENCES BETWEEN PRIMARY AND SECONDARY SCIENCE EXPERIENCES & WHY

This is quite an easy topic to discuss in that most students ought to remember fondly their primary experiences of science. Understanding what may be the causes or even the symptoms of why their secondary experiences may have been different will be harder to tease out. So here one may be expecting the students to generate questions which check box features of their primary learning they liked. A set of mutually exclusive questions is unlikely. This issue could benefit from an open ended follow-up question perhaps.

## PHILOSOPHY AND ETHICS OF SCIENCE ISSUES

Here the discussion and range of questions may follow a number of different paths. It might follow the route of the purity of science unencumbered by moral precepts. It may wish to ask whether certain topics would have benefited

from scientists offering ethical dimensions. It might wish to identify who ought to cover ethical issues in science. It may wish to explore the issues of the theory of knowledge and whether they ought to be investigated. Students are almost certain to have an 'ethical' or 'moral' view on science questions of the day but they need to remember that their own views do not matter – what does is how to elicit the views of their peers on what ought to be in the curriculum.

### COHERENCE AND REVISITING OF SCIENCE TOPICS ISSUES

This is difficult. What we are asking of the students is to determine in brainstorming whether they understand how the whole science curriculum hangs together and whether the subjects and topics link with an understandable sense of progression of learning and content. Then having understood the concept (let us say) of the spiral view of the curriculum, design questions which other students can sensibly answer. I suspect many groups that tackle this will either have difficulty or need 'extra time' to complete. It could be tackled through a series of mutually exclusive options about how and when to progress on with a topic but it might be best questioned by an illustrated open ended question in a free format text box.

### MODE OF DELIVERY INC. PRACTICALS ISSUES

This contrasts with the styles of learning issues later. What we are looking for is what students enjoy. They will find brainstorming different modes of delivery relatively easy, as they should between them have experienced a 'full set'. I suspect that this question best lends itself to a check box mutually inclusive approach asking students to identify their (perhaps) three preferred modes of delivery of the curriculum to themselves. If this is going well, move on and bank the question as soon as possible, but this question will be an opportunity to involve all the group and bring in the quiet ones.

### MATHS COMPETENCE ISSUES

All students expect some maths in science and this in itself is an issue worth exploring: whether the maths (of science) turns some students away from science. There is known to be a particular issue to do with chemistry and maths in that many who wish to add chemistry to biology are unprepared for the maths content of chemistry. That issue might be worth considering by the facilitators. This issue arises less in physics – it may be a case of self-selection. This issue might also be explored by the degree to which the maths curriculum prepares students for maths in science or not. It could generate a specific question, such as about graphing, or a general question. I suspect that this question lends itself to an option box approach.

### VOLUME OF LEARNT CONTENT ISSUES

There is a suspicion that science has the highest volume of rote learnt content in the KS3/KS4 years – even if this was not intended by the original curriculum planners. Students will want a good 'natter' about how much work they had to do and again facilitators ought to let the brainstorming run if only to use this issue to bring in all the persons in the group. The question generated might be subject specific, i.e. just about physics, it might compare each of the sciences, it might compare the volume of the sciences to another subject or it might try to have a mutually exclusive answer teasing out the volume of learnt work. Facilitators should bring the group round to focus down because the 'natter' might run away.

### ANALYTIC AGAINST DESCRIPTIVE SCIENCE ISSUES

Here we are looking at what they are actually learning – is it how things work or why things work, so to speak. Certainly there is a lot of evidence that introducing more description of processes has connected well with drawing girls into science, but there is also much casual evidence that being able to describe a process may not mean that the process is understood. Brainstorming around this ought to help the group understand the issue. In terms of generating a question, this could also either be subject specific, or more general about what science is – analysis of processes or being able to describe the processes. Generating the question may well be more difficult than understanding the issue and the facilitator will need to steer the group to a conclusion.

## STYLES OF LEARNING ISSUES

It would be useful if the students could detach the mode of delivery they enjoy to how they actually best acquired scientific knowledge and understanding and could assert that they had 'learnt and understood' a topic. Is this via the teacher-led work, is it curled up with a book in bed? The sample question earlier gives a range of learning methods and the students ought to have little difficulty in brainstorming a good set of these. I don't see many difficulties in identifying a question.

## TEACHER TURNOVER

Though this is not on the main list, it would be nice if students could phrase a question about how much teacher turnover may have affected their enjoyment and learning of science. Strict facilitator control will be needed to ensure we do not stray into 'how good the teacher was', but stay with the effects on learning of having either more than one teacher for a subject or many different teachers over a period of time.

## APPENDIX 2. THE SURVEY

This is the survery as it appeared on the Science Year website.

**Lets jump straight in with the more controversial questions!**

Take your time - be honest - we students are processing the answers.

**1. At GCSE, did / do you find that the Science you learn?**

| | |
|---|---|
| Tests your understanding of Science | O |
| Tests your memory of the subject | O |

**2. Should GCSE Science MOST be? [tick just one]**

| | |
|---|---|
| Based on real life | O |
| Taught for the sake of general knowledge | O |
| Be based on relevant issues | O |
| Taught with a view to post-16 studies | O |
| Don't care | O |

**3. Which of these would you like to see included in GCSE Science?**

| | |
|---|---|
| Astronomy | O |
| History of Science | O |
| Ethics of Science | O |

Here is my suggestion: >>>>>>>>

**4. Do you feel that what you learn is exam led?**

| | |
|---|---|
| Yes | O |
| No | O |

Please comment>>>>>>>

**5. In Science would you rather learn?**

| | |
|---|---|
| A little about a lot of different topics | O |
| A lot about fewer topics | O |

**6. Which of the following below will (or would have) improved your GCSE grade in Science?**

| | |
|---|---|
| Smaller class size | [ ] |
| More practical experiments | [ ] |
| Better text books | [ ] |
| Relating the Science to everyday life | [ ] |
| None of these | [ ] |

Please add your suggestion: >>>>>>>>

**7. Does / did practical and experimental work help you to UNDERSTAND your Science topics?**

| | |
|---|---|
| Yes | O |
| No | O |

**8. How do you MOST prefer to be assessed / examined in Science**

| | |
|---|---|
| Module exams and tests | O |
| Through practicals | O |
| Through 'terminal' exams at the end of the course | O |
| Through coursework | O |
| By continuous assessment | O |
| Through an oral examination | O |

**9. Which of the following would MOST interest you, if introduced into the pre-16 Science curriculum?**

| | |
|---|---|
| Diet | O |
| Science and the environment | O |
| The history of Science | O |
| A wide range of personal health issues | O |
| Controversial theories: e.g. GM Foods | O |
| Topical issues such as cloning | O |

Please add your suggestion: >>>>>>>>

**10. Which THREE of these methods of teaching and learning do you find the MOST USEFUL and EFFECTIVE in helping understand your school Science?**

| | |
|---|---|
| Taking notes from the teacher | [ ] |
| Looking at videos | [ ] |
| Reading the text books | [ ] |
| Taking my own notes from books etc. | [ ] |
| Copying notes from the board | [ ] |
| Doing a Science investigation | [ ] |
| Making a Science presentation in class | [ ] |
| Researching Science on the Internet | [ ] |
| Going on a Science trip or excursion | [ ] |
| Doing a Science experiment in class | [ ] |
| Having a discussion / debate in class | [ ] |

**11. Which THREE of these methods of teaching and learning do you find the MOST ENJOYABLE as part of your school Science?**

| | |
|---|---|
| Taking notes from the teacher | [ ] |
| Looking at videos | [ ] |
| Reading the text books | [ ] |
| Taking my own notes from books etc. | [ ] |
| Copying notes from the board | [ ] |
| Doing a Science investigation | [ ] |
| Making a Science presentation in class | [ ] |
| Researching Science on the Internet | [ ] |
| Going on a Science trip or excursion | [ ] |
| Doing a Science experiment in class | [ ] |
| Having a discussion / debate in class | [ ] |

**12. Is it right to include CONTROVERSIAL issues such as genetic engineering or cloning on the Science syllabus?**

| | |
|---|---|
| NO - definitely not | O |
| YES - definitely | O |
| Don't Mind | O |

**13. When studying Science at school, is there enough emphasis on the MORAL AND ETHICAL IMPLICATIONS of Science?**

| | |
|---|---|
| TOO LITTLE emphasis | O |
| ENOUGH emphasis | O |
| TOO MUCH emphasis | O |

**14. Do you think the introduction of discussions about philosophy and ethics (such as animal testing) would make GCSE Science more attractive as a subject?**

| | |
|---|---|
| NO - definitely not | O |
| YES - definitely | O |
| Don't Mind | O |

You're quarter of the way through!

Going a little crazy and want to take a break?

Try our Crazy Custard experiment…

**In this section we drop in a few questions about Maths.**

We know already that some find Maths easy - others find it impossible. What do you think?

**15. Should you be given the choice to do dissection in Biology?**

| | |
|---|---|
| YES | O |
| NO | O |
| No opinion | O |

**16. Would your Physics learning benefit from practical engineering examples such as how a motor car works or how a computer is made?**

| | |
|---|---|
| NO | O |
| YES | O |

**17. Does the Science syllabus have too much overlap between Physics, Chemistry and Biology - or is the balance about right?**

| | |
|---|---|
| Too much overlap | O |
| Correct balance | O |
| Not enough overlap | O |

**18. Did / do you struggle with your school Science due to a lack of understanding in Maths?**

| | |
|---|---|
| NO | O |
| YES | O |

**19. Should your Science teachers cover Maths in their lessons?**

| | |
|---|---|
| NO | O |
| YES | O |

**20. Can you do well in Science without doing much Maths?**

| | |
|---|---|
| NO | O |
| YES | O |

**21. Has your Maths syllabus prepared you for the following in Science?**

| | | |
|---|---|---|
| Graphs | YES O | NO O |
| Re-arranging equations | YES O | NO O |
| Using formulae properly | YES O | NO O |
| Calculations | YES O | NO O |

**22. Do you think the Science curriculum should contain less or more theory?**

| | |
|---|---|
| Less theory | O |
| More theory | O |
| Correct balance | O |

**23. Do you think the Science curriculum should contain more or less real life practical examples?**

| | |
|---|---|
| More real life practical examples | O |
| Less real life practical examples | O |
| Correct balance | O |

**24. Do you think issues concerning the para-normal should be included in GCSE Science - such as telepathy or phantoms?**

| | |
|---|---|
| NO | O |
| YES | O |

**25. Would you like to see more emphasis on the practical USES of Science and Technology?**

| | |
|---|---|
| NO | O |
| YES | O |

**26. In the past students were given more opportunities in Science to use and apply technology (such as making radios) Would this approach help / have helped or encouraged you to study Science?**

| | |
|---|---|
| Definitely | O |
| Maybe | O |
| Definitely not | O |

**27. If the practical content of the course was increased - how would it MOST improve the learning experience?**

| | |
|---|---|
| Provide deeper appreciation of Science | O |
| Make understanding theory easier | O |
| Give greater enjoyment of Science | O |
| Make you more motivated | O |

**28. Currently (or when you did your GCSEs) - when you learn new theory was it backed up by practical experiments?**

| | |
|---|---|
| Nearly always | O |
| Just sometimes | O |
| Very rarely | O |
| Almost never | O |

You're now half way through the questions !

Don't think that's funny? See if you can do better with Laugh Lab...

**Its back to Primary School for a few of the next questions ....**

The years of sweet innocence - or were they?

**29. At primary school should Science?**

| | |
|---|---|
| Be more practical | O |
| Have more theory | O |
| Be more visual (videos etc) | O |
| Be more IT based | O |

**30. At primary school did Science?**

| | |
|---|---|
| Put you off Science | O |
| Encourage you to do more Science | O |
| Not influence you either way | O |

**31. At primary school, do you think there was enough Science to prepare you for the work you do at secondary school?**

| | |
|---|---|
| Too much Science at primary school | O |
| Too little Science at primary school | O |
| About the right amount of Science | O |

**32. If something was missing from your primary Science - what was it?** >>>>>>>>

**33. At primary school, do you think there is enough Science on the curriculum?**

| | |
|---|---|
| Too much | O |
| About right | O |
| Not enough | O |
| Nowhere near enough | O |
| Can't remember doing Science at primary school | O |

**34. Would you have benefited from a more challenging Science GCSE course?**

| | |
|---|---|
| YES | O |
| NO | O |
| Don't care | O |

**35. In Biology which of these areas of study do you MOST prefer?**

| | |
|---|---|
| Study of animals | O |
| Human biology | O |
| Plant biology | O |
| Don't care | O |

**36. Which of these BEST describes how relevant GCSE Science is to your everyday life?**

| | |
|---|---|
| It helps me understand current affairs and news stories | O |
| It just helps my further studies in Science | O |
| It helps to find out how things around me work in an understandable level | O |
| It is totally irrelevant to my everyday life | O |
| It will prepare me for my career | O |

**37. In GCSE Science, did/do you understand the majority of information?**

| | |
|---|---|
| YES | O |
| NO | O |

**38. In GCSE Science, should more emphasis be on understanding WHY or on learning HOW things work?**

| | |
|---|---|
| More on WHY | O |
| More on HOW | O |
| Don't care | O |

**39. There should be more scope for topics of personal interests in the GCSE Science syllabus**

| | |
|---|---|
| Strongly agree | O |
| Agree | O |
| Unsure | O |
| Disagree | O |
| Strongly disagree | O |

**40. Is revisiting Science topics from year to year?**

| | |
|---|---|
| Interesting | O |
| Useful | O |
| Neither | O |

**41. There are too many facts to remember in GCSE Science**

| | |
|---|---|
| Strongly agree | O |
| Agree | O |
| Unsure | O |
| Disagree | O |
| Strongly disagree | O |

Well done - you've finished seventy five percent of the questions !

To bring you back down to earth, check out our update on the earth-shattering Giant Jump...

**Get your brains in gear for the final push to the finish....**

Now its time to put GCSE Science fully in the spotlight ...

**42. When learning something in Science (eg plant growth or moles or atomic structure) do you understand?**

| | |
|---|---|
| usually understand how the process or system works and can describe it | O |
| usually understand why the process or system works and can explain it | O |
| sometimes understand how the process or system works and can roughly describe it | O |
| sometimes understand why the process or system works and can sort of explain it | O |
| seldom understand how or why the process or system works | O |
| never understand how or why the process or system works | O |

**43. In GCSE Science, do you usually understand?**

| | | | | |
|---|---|---|---|---|
| How Science formulae are formed | YES | O | NO | O |
| When to use Science formulae | YES | O | NO | O |
| How to use Science formulae | YES | O | NO | O |

**44. What do you think about the amount of facts you have to learn in Science?**

Put your opinion here >>>>>>>>>>>

**45. Were you given the choice of exams in studying for GCSE Science?**

| | | | | |
|---|---|---|---|---|
| Three separate Sciences (triple award - Biology, Chemistry, Physics) | YES | O | NO | O |
| The double award Science | YES | O | NO | O |
| The balanced Science (single award) | YES | O | NO | O |

**46. Which (with hindsight) would you have preferred to study?**

| | |
|---|---|
| Triple award | O |
| Double award | O |
| Single award | O |

**47. With hindsight would you like students to have the choice of which award to study?**

| | |
|---|---|
| YES | O |
| NO | O |

**48. You are sometimes presented with an independent project you must do (like coursework). Can you usually use your current knowledge and previous understanding to?**

| | |
|---|---|
| Get working easily and quickly to apply what I've already learnt | O |
| After being stuck for a while work out the resources to research and then work independently | O |
| Get stuck, remain stuck - wouldn't know where to start | O |

**49. Do you think the workload in your GCSE Sciences is less than, similar or more than other subjects?**

| | |
|---|---|
| Less work | O |
| More work | O |
| Similar to other subjects | O |

**50. Do you find GCSE Science? [tick all that apply]**

| | |
|---|---|
| Relevant | [ ] |
| Interesting | [ ] |
| Off putting | [ ] |
| Stimulating | [ ] |
| Scary | [ ] |
| Easy | [ ] |
| Difficult | [ ] |
| Boring | [ ] |
| Thought provoking | [ ] |
| Useful | [ ] |
| Irrelevant | [ ] |

**51. Do you feel that GCSE Science lessons make you curious about the world and interested in finding out more?**

| | |
|---|---|
| YES | O |
| NO | O |

**52. If you chang(ed) teachers during your GCSE Science studies do you experience?**

| | |
|---|---|
| No change | O |
| A welcome change (fresh start) | O |
| Benefits from covering the same work from a different perspective | O |
| Wasted time due to repetition of the work | O |
| Pressure on finishing the syllabus and coursework | O |

**53. What topic do you find MOST irrelevant or boring in GCSE Science?**

Please comment>>>>>>>

**54. What topic do you find MOST interesting in GCSE Science?**

Please comment>>>>>>>

**55. For those that have taken their GCSEs and NO LONGER study Science**

or

**For those taking their GCSEs who already know they NO LONGER wish to study Science after GCSEs.**

**Your feelings about Science subjects after GCSEs, is due to? [Tick up to three that may apply]**

| | |
|---|---|
| The GCSE Science lessons are/were boring | [ ] |
| The choices of your friends | [ ] |
| The influences and experiences of your teachers | [ ] |
| The GCSE Science subjects are/were difficult | [ ] |
| Your future career thoughts don't need Sciences after GCSE | [ ] |
| You have other subjects you enjoy more | [ ] |

Almost there - just one page to go!

But what will you do when its all over. Take one last break with some hot career tips...

**You've done the survey - you want the freebies ?**

Seriously - we need a little about you if we are going to make the curriculum planners sit up and take notice of us.

Give as much background as you can.

**Your Name:**

**Your Email Address:**

**Country:**

**Your Postcode:**

**Your Age:**

| | |
|---|---|
| 11-13 | O |
| 14-16 | O |
| 16-19 | O |
| 26-35 | O |
| 36-45 | O |
| over 45 | O |

**Your Gender:**

M O F O

**Are you studying GCSE science at the moment?**

Yes O No O

**Which GCSE award did/do you study?**

| | |
|---|---|
| Single | O |
| Double | O |
| Triple | O |

**Name of your school (if you are still a student):**

Type of school:

| | | | |
|---|---|---|---|
| Boys | O | State | O |
| Girls | O | Private | O |
| Mixed | O | | |

**For those who have not yet finished GCSEs - are you considering studying Science after GCSEs**

Yes O No O

**For those who have finished GCSEs - are you still studying or working with Science subjects**

Yes O No O

**Hundreds of us students throughout England helped design this questionnaire - see all the schools and colleges where we all came from. We hope we have covered quite a lot about our GCSE studies - please tell us how we did:**

| | |
|---|---|
| A really good survey that hopefully people will pay attention to | O |
| An enjoyable survey that ought to give useful results | O |
| A reasonably fun survey but not serious enough | O |
| Not bad, could do better | O |
| Boring - yuk | O |

# APPENDIX 3. SCHOOLS, COLLEGES AND STUDENTS PARTICIPATING IN THE REGIONAL MEETINGS

**All Saints High School**
Kristin
Scott
Richard

**Ampleforth College**
Paul
Katherine
Hannah

**Ashford Girls School**
Helen
Fleur
Helen

**Bablake School**
Amanda
Laura

**Bede College**
Andrew
Ashley [National Representative]
Gavin

**Bedford School**
Ashwin [National Representative]
Adam

**Bedford High School**
Joanne
Joan

**Beechen Cliff School**
Thomas

**Birkenhead High School**
Jayde
Charlotte
Charlotte
Joe
Hannah [National Representative]

**Bishop Luffa School**
Charlotte
Anna
Richard

**Bishop Reindorp School**
Alice
Debbie
Jenny

**Brighton & Hove Sixth Form College**
Jenny
Liza
Steven
Lucy

**Bristol Grammar School**
Timothy
Charlotte
Thomas

**Bromley High School**
Christina
Catherine

**Calday Grange Grammar School**
Michael
Tom
Christopher

**Channing School**
Florence
Catriona
Jessica

**Charterhouse School**
Michael
Charles
Joshua

**Cheltenham Ladies College**
Sophie
Miranda

**Chesterfield High School**
Stuart
Kieran

**Christ's Hospital School**
Lara
James
Daniel

**City of London School** (girls)
Samantha
Nabigha
Lauren

**Clacton County High School**
Ibrahim
Jonathon
Trevor

**Colchester Sixth Form College**
Philippa
Anika [National Representative]
Joe

**Cotham School**
Tommy
Alex

**Cox Green School**
Laura
Stephany
Prya

**Croydon High School**
Jennifer
Hannah
Arthee

**Derby Tertiary College**
Armann
Farzana
Mark
Jo
Matt

**Dixons City Technology College**
Aws
Shanket
Joel [National Representative]
Shaheeda
Ansuya
Saheema

**Downe House School**
Lucy
Liby
Katy
Kate

**Dudley College**
Mark
Mehtab

**Eastwood Comprehensive School**
Andrew

**Ecclesbourne School**
Holly
Sarah
Christopher [National Representative]

**Ermysted's Grammar School**
Sam [National Representative]
Jonathan
James
Ben

**Esher College**
John

**Fairfax School**
Edward
Liam
James
Neil

**Farnborough Sixth Form College**
Mark [National Representative]
Victoria

**Farnham College**
Ellie
Siarrad
Graham

**Frankley High School**
Nicola
Paul
Josh

**Fullbrook School**
Peter
Alix

**Gordon's School**
Negeen
Janis
James
Ben

**Great Cornard Technology College**
Zoe
Graeme
James
Aimee

**Guildford High School**
Lucy [National Representative]
Meg
Jess
Catherine

**Hanson School**
Qasim
Sandeep
Gurbinder
Matthew

**Heathfield School**
Nisha
Shreena
Nisha

**Highfields School**
Robert
Melanie
Sarah

**Holland Park School**
Jad
Tzveta

**Huddersfield New College**
Ahmed
Shazad
Michael
Chris

**Hulme Grammar School** (boys)
Peter

**Hulme Grammar School** (girls)
Helen
Sabrina
Nicole

**Ilford County High School**
Luke
David
Nicholas
Paul

**Imberhorne School**
James
Becky
Helen
Paul

**Ipswich School**
Sam
Sebastian
Ruben

**John Kelly Boys Technology College**
Shalin
Mojib

**John Leggott College**
Gareth
Katherine
Tania

**King Edwards School**
Christopher
Xanthe

**King Edward 6th Camp Hill School**
Sarah
Farzana
Rebecca

**King Edward 6th Upper School**
Helen
Alex
Ben

**Kingdown School**
Claire
Melanie
Claire

**Latymer Upper School**
Georgina
Emily
Christopher

**Leicester High School**
Trishna
Tejal
Alexandra

**Long Eaton Community School**
Toni-Marie
Rhoda [National Representative]
Adam

**Long Road Sixth Form College**
Ben
Alexis [National Representative]
Emma
Jonathon

**Luton Sixth Form College**
Hannah
Emily

**Mark Rutherford Upper School**
Amrit
Matthew

**Mary Hare School for the Deaf**
Rachel
Ben
Dominic

**Netherhall School**
Hannah
Laura
Edward

**North Westminster School**
Alla
Joseph
Anamul
Melina
Sajad [National Representative]

**Old Palace School of John Whitgift**
Annabel
Zahra
Sarah

**Oundle School**
Gabriel
Alex
Philip

**Paston College**
David
Michael

**Perse School**
Margaret
Galer
Kylie

**Peter Symonds College**
Gareth
Rosie

**Peterborough High School**
Hannah
Rachel

**Pimlico School**
Ria
Sam
Lindsey
Jareth

**Putney High School**
Jill
Victoria
Lucy

**Queen Elizabeth Sixth Form College**
(Darlington)
Vicki [National Representative]

**Quintin Kynaston School**
Mustafa
Helena [National Representative]

**Rainford High School**
Adam
Claudia
Christopher

**Rainhill High School**
Laura
Ian

**Ralph Allen School**
Helen
Robert

**Range High School**
David
Inger
Michael
Helen

**Redland High School**
Clare [National Representative]
Verity
Charlotte [National Representative]

**Roedean School**
Olabisi
Elizabeth
Anana

**Royal High School** – Bath
Hayley
Nicola
Lucy
Naomi

**Rydens School**
Thomas
Kirsty

**St Albans School**
Matthew
Sam

**St Albans High School**
Eleanor
Ruth

**St Augustines School**
Saied
Bamshad
Rubens [National Representative]

**St Francis Xavier's Sixth Form College**
Catherine
Matthew
Ben
Kevin

**St Edmunds School**
John
Edward
Alicia
Robin

**St John Bosco High School**
Rachel
Diana

**St Mary's School**
Shireen
Natalie
Victoria

**St Mary's School**
Felicity
Camilla
Ciara
Giuilla

**St Peter's School**
Claire
Ted
Phebe

**St Teresa's School**
Fern [National Representative]
Delvene
Clare

**Sherborne School**
Louisa
Alice

**Shrewsbury High School**
Sian
Rhiannon
Kayleigh [National Representative]

**Solihull Sixth Form College**
Amy

**South Hampstead High School**
Zoe
Elise
Fiona
Urvashi

**Strodes College**
Pardeep
Alice
Nicholas
Lewis

**Sutton Coldfield Grammar School** (girls)
Sofia
Yasmin [National Representative]

**The Alice Ottley School**
Hannah
Victoria
Catherine

**The Maynard School**
Claire
Vicki

**Tomlinscote School**
James
Sam

**Torquay Boys Grammar**
Christopher
Alexander

**Tudor Hall School**
Olivia
Sophia
Kimberley

**Uppingham School**
Peter
Henry
Jane
Upton Hall
Michelle

**Waseley Hills School**
Jordan
Karen
Emily
Natalie

**Wimbledon High School**
Mitali
Mette
Joanna

**William Morris Academy**
Wais

**Winstanley College**
Anna
Ben [National Representative]

**Wirral Grammar School** (girls)
Sophie
Chamali
Hannah

**Woldingham School**
Katherine
Fenella
Lucinda

**Woodhouse Sixth Form College**
Simon
Benicio
Yepoka

**Worcester New College for the Blind**
Steven
Michael

**Worthing Sixth Form College**
Rob
Holly
Tim [National Representative]
Karl [National Representative]

**Writhington School**
Reuben
John

**Yateley School**
Jennifer
Steven
Jay

**Yeovil College**
Farah
Eilis
Richard

## APPENDIX 4. EXAMPLE OF AN EVALUATION FORM SENT TO A SAMPLE OF STUDENTS WHO HAD ATTENDED THE REGIONAL MEETINGS.

**SCIENCE MUSEUM STUDENT REVIEW EVALUATION**

[ North West region ] [ Attended science museum national conference as well ]

Dear Hannah,

You have been randomly selected by the computer to be part of a small group invited to help evaluate the project for future reference.

I already appreciate all the you work you did for the National Group, I thought you were all very professional. You are on record of course as having attended the regional meetings. I enclose a very short set of questions about the meetings and the web survey which I would appreciate your answering and posting back in the envelope supplied. In advance, I enclose a free ticket to the Science Museum IMAX giant screen. It can be used for any showing. (It can be used at a local IMAX but you may need to have us confirm its validity to the local IMAX.)

Some teachers and schools may also be contacted but at the moment I do not know if we shall also be contacting BIRKENHEAD HIGH SCHOOL as well. I hope you enjoyed the day on March 19th. I hope you enjoyed the day on March 19th.

PLEASE RETURN THIS LETTER IN THE ENVELOPE SUPPLIED

Yours sincerely,

Ian Murray

**Please (RING) the answer you prefer. Please make any extra comment in the box overleaf next to the appropriate question. These extra comments are most important.**

| | | | |
|---|---|---|---|
| 1. | Was the North West region meeting well organised | Yes | No |
| 2. | If you attended, was the National Meeting a waste of time. | Yes | No |
| 3. | Did you feel that your views were treated with respect and that you were able to contribute to the review? | Yes | No |
| 4. | Do you think that the curriculum review will have any impact on the future of the school science curriculum? | Yes | No |
| 5. | Did you look at the web site? | Yes | No |
| 6. | Would you recommend that this type of survey is done again? | Yes | No |
| 7. | Did you complete the web site survey? | Yes | No |
| 8. | Were the facilitators helpful in managing the meeting? | Yes | No |
| 9. | Are you now following a largely science course? | Yes | No |
| 10. | Should this type of survey be done with 14 & 15 yr olds? | Yes | No |
| 11. | Did you feel your fellow students were representative? | Yes | No |
| 12. | Which did you prefer – if you attended both? | National meeting or Regional Meeting | |
| 13. | Which was more important to you, the discussions leading up to the final questions, or the questions themselves? | The discussion or The questions | |
| 14. | Did the adults present at the North West meeting steer you towards making a question you did not really agree with? | Yes | No |

## APPENDIX 5. PART OF PRE-READING FOR SOME OF THE REGIONAL MEETINGS

**SCIENCE EDUCATION FOR THE FUTURE**

SCIENCE EDUCATION: the remaining problems

This is a shortened version of a longer research work but it is useful pre-reading for this conference.

THE CHANGING CURRICULAR POSITION OF SCIENCE has not been accompanied by corresponding change in the content of the science curriculum, in particular at secondary level. This has remained fundamentally unaltered and is, essentially, a diluted form of the 1960s GCE curriculum. The predominant aim of science courses of the 1960s was to provide a basis of knowledge for future specialism in science. Our future society will need a larger number of individuals with a broader understanding of science both for their work and to enable them to participate as citizens in a democratic society.

Since the 1960s, a succession of scientific and technological developments with unforeseen environmental and societal consequences, such as DDT, Chernobyl, Thalidomide, CFCs and the depletion of the ozone layer have tarnished the image of science. In addition, scientific developments have led to public unease about their implications, such as genetic manipulation and cloning. To sustain a healthy and vibrant democracy, such issues do not require an acquiescent (nor a hostile and suspicious) public, but one with a broad understanding of major scientific ideas. There is a growing tension between school science and contemporary science as portrayed in the media, between the needs of future specialists and the needs of young people in the workplace and as informed citizens.

These problems are structural and underlying ones. However, they show themselves in a number of more readily visible ways.

Too many young people complete their compulsory science education with apparent success, and yet still lack any familiarity with the scientific ideas which they are likely to meet outside school. Even for those who 'succeed' with the current curriculum, the kind of 'understanding' they achieve does not equip them to deal effectively and confidently with scientific information in everyday contexts.

The current curriculum retains its past, mid-twentieth-century emphasis, presenting science as a body of knowledge, which is value free, objective and detached – a succession of 'facts' to be learnt, with insufficient indication of any overarching coherence.

School science particularly at secondary level, fails to sustain and develop the sense of wonder and curiosity of many young people about the natural world. This interest and inquisitiveness, which characterises many primary school children's, diminishes at secondary level. The apparent lack of relevance of the school science curriculum to teenagers' curiosity and Interests contributes to too few young people choosing to pursue solely courses in science.

The science curriculum can appear as a 'catalogue' of discrete ideas, lacking coherence or relevance. There is an over-emphasis on content, which is often taught in isolation from the kinds of contexts, which could provide essential relevance and meaning. Insufficient emphasis is given to showing the tremendous intellectual achievement such ideas

represent, and how they have transformed our conception of ourselves and the world we inhabit. The existing stress on content limits the study of components such as the nature of science; the role of scientific evidence, probability and risk; and the ways in which scientists justify their knowledge claims all of which are important aspects necessary to understand the practice of science.

The National Curriculum separates science and technology

There is relatively little emphasis, within the science curriculum on discussion or analysis of any of the scientific issues that permeate contemporary life.

There is a lack of variety of teaching and learning experiences leading to too many dull and uninspiring lessons. Sometimes routine practical work is used where other learning strategies might be more effective. Even investigations, an innovative practice introduced by the National Curriculum itself, are in danger of succumbing to routine teaching as a consequence of perceived assessment requirements.

Single award science courses have nearly all of these problems more acutely and are insufficiently differentiated from the double science courses, in either their intent or content.