House of Commons

Science and Technology Committee

Practical experiments in school science lessons and science field trips

Ninth Report of Session 2010–12

Volume I

Report, together with formal minutes

Ordered by the House of Commons
to be printed 7 September 2011

HC 1060-I
Published on 14 September 2011
by authority of the House of Commons
London: The Stationery Office Limited
£0.00

The Science and Technology Committee

The Science and Technology Committee is appointed by the House of Commons to examine the expenditure, administration and policy of the Government Office for Science and associated public bodies.

Current membership

Andrew Miller (*Labour, Ellesmere Port and Neston*) *(Chair)*
Gavin Barwell (*Conservative, Croydon Central*)
Gregg McClymont (*Labour, Cumbernauld, Kilsyth and Kirkintilloch East*)
Stephen McPartland (*Conservative, Stevenage*)
Stephen Metcalfe (*Conservative, South Basildon and East Thurrock*)
David Morris (*Conservative, Morecambe and Lunesdale*)
Stephen Mosley (*Conservative, City of Chester*)
Pamela Nash (*Labour, Airdrie and Shotts*)
Jonathan Reynolds (*Labour/Co-operative, Stalybridge and Hyde*)
Graham Stringer (*Labour, Blackley and Broughton*)
Roger Williams (*Liberal Democrat, Brecon and Radnorshire*)

Powers

The Committee is one of the departmental Select Committees, the powers of which are set out in House of Commons Standing Orders, principally in SO No.152. These are available on the Internet via www.parliament.uk

Publications

The Reports and evidence of the Committee are published by The Stationery Office by Order of the House. All publications of the Committee (including press notices) are on the Internet at http://www.parliament.uk/science. A list of reports from the Committee in this Parliament is included at the back of this volume.

The Reports of the Committee, the formal minutes relating to that report, oral evidence taken and some or all written evidence are available in printed volume(s).

Additional written evidence may be published on the internet only.

Committee staff

The current staff of the Committee are: Glenn McKee (Clerk); Dr Stephen McGinness (Second Clerk); Dr Farrah Bhatti (Committee Specialist); Xameerah Malik (Committee Specialist); Andy Boyd (Senior Committee Assistant); Julie Storey (Committee Assistant); Pam Morris (Committee Assistant); and Becky Jones (Media Officer).

Contacts

All correspondence should be addressed to the Clerk of the Science and Technology Committee, Committee Office, 7 Millbank, London SW1P 3JA. The telephone number for general inquiries is: 020 7219 2793; the Committee's e-mail address is: scitechcom@parliament.uk

Contents

Report

Summary

We began this inquiry because of a perception that health and safety concerns are preventing science practicals in schools and fieldwork and field trips. What we found was that the perception was to a large extent misconceived. Instead, we found concerns, from a broad range of organisations, that students are not receiving the practical science education necessary to produce the next generation of scientists.

It is clear that the provision of practical classes, and how those are supplemented with fieldwork and field trips, varies from the excellent to the dull or non-existent. On health and safety, we found no credible evidence to support its oft cited explanation for decline of practicals and work outside the classroom. While "health and safety" may be used as a convenient excuse for avoiding practicals and work outside the classroom, we consider that there are more fundamental reasons why many students are receiving poor practical science experiences during their school education.

First, there is the availability of teachers who are well-trained and confident. We accept that this Government as well as the last have been addressing the chronic problem of recruiting the relevant people but there is a need to focus on what happens after teachers are recruited. The Government needs to provide strong encouragement to schools in facilitating science teachers to maintain and develop the knowledge and practical science skills necessary to provide students with a high quality science education.

Second, science teachers need fit for purpose facilities and the support of qualified and experienced technical support. We recommend the Government ensure schools provide quality science facilities to match the level of its aspirations for science education. We reiterate the call of our predecessor committee to provide a career structure for technical staff.

Science is a practical subject. If students are to follow a scientific career, either through university and on to research or to work in the new technological businesses of the future, they will need to understand how the knowledge and facts that they acquire in classroom lessons have been gathered and agreed. They cannot and should not do this exclusively second hand, through books without direct practical experience both in and out of the classroom.

Effort is not only required from students and teachers but from the Government and regulators. Practical science is relatively expensive and carries little cachet for parents comparing schools. Without encouragement it will lose out. The inspection regime and the requirements set for examination boards need to drive higher quality with more and better practical lessons for science students.

We have also found that, while there is a plethora of material, information and events to supplement school science, a lack of coherence makes these much less likely to be used and useful to practising teachers, though our e-consultation indicated that this kind of intervention could have a high impact on students choosing to study science. We urge the science community to work towards greater coherence in its provision of educational materials and, more specifically, to utilise the STEM Directories that already exist. We also

recommend the Government secure the future of the Directories to facilitate the provision of these vital contacts between schools and practising scientists.

Finally, we are convinced of the need for more students to study science subjects and urge the Government to provide a detailed strategy on how their preferred tools of exhortation and facilitation will lead to increased numbers of students studying science in schools and what level of increase we can expect to see.

1 Introduction

1. There have been persistent reports in the press that that science practicals and field trips were in decline and that the reason was health and safety concerns.[1] Despite ongoing work by the Health and Safety Executive[2] and a campaign by the Royal Society for Chemistry aimed at allaying concerns,[3] the persistent nature of these stories convinced us that this was an issue that needed examination.

2. Science practicals in the classroom and field trips should be the activities that link students' theoretical learning in schools with the practical application of science to the world at large and, later, in the workplace. We also had a concern that any decline in practicals and fieldwork could be a symptom of, if not directly linked to, a wider decline in the study of science in schools. Education is a devolved issue and, following the line of much of the evidence sent in response to the inquiry, this report is mainly focussed on England but comparisons with Scotland are important.

3. The reasons why children study science raises issues that go wider than this report. We note that, despite a range of research on the subject, there is currently no widely accepted research on the reasons why children choose to take up, or not to take up, science at certificate levels. Professor Dillon of King's College London provided us with research in this area which is part of an ongoing research programme into this subject.[4] We hope that the Economic and Social Research Council-funded *Targeted Initiative on Science and Mathematics Education*[5] will provide the Government with a solid foundation upon which it can build greater participation in STEM[6] subjects. This is an issue we shall monitor and we may return to it later in the Parliament.

4. Given the importance of science education to the UK economy and the need to encourage children to participate in science, we decided to hold an inquiry into practical experiments in science lessons and science field trips. When we received evidence it appeared that *field trip* can have a generic meaning covering all work outside the classroom and a specific meaning. To avoid confusion, within this report we will refer broadly to *learning outside the classroom* when referring to both field work and field trips but will deal separately with them at some points. For the purpose of this report *fieldwork* is taken to mean activity outside the classroom organised by the classroom teacher independently of third parties, usually to undertake curriculum related activity; *field trip* is taken to mean an activity where the students are taken to an outside location where they will either see

[1] For example, "School lab health and safety rules 'could stop future scientists'", *Times Online*, 5 October 2009, www.timesonline.co.uk/tol/life_and_style/education/school_league_tables/article6861136.ece and "Warning over red tape for science field trips", *BBC Online*, 19 January 2011, www.bbc.co.uk/news/education-12229394

[2] "Myth of the Month", December 2010, *Health and Safety Executive*, www.hse.gov.uk/myth/dec10.htm

[3] "Surely that's banned", *Royal Society of Chemistry*, October 2005, www.rsc.org/images/Surely_thats_banned_report_tcm18-41416.pdf

[4] "Science Aspirations and Career Choice: Age 10-14", Professor Justin Dillon, ASPIRES interim summary, January 2011 www.kcl.ac.uk/sspp/departments/education/research/aspires/aims.aspx

[5] The Targeted Initiative on Science and Mathematics Education (TISME) is a programme of research funded by the ESRC in partnership with the Gatsby Charitable Foundation, *The Institute of Physics and the Association of Science Education*. www.tisme-scienceandmaths.org/

[6] Science, Technology, Engineering and Mathematics

something science related, such as touring the Natural History Museum, participating in a learning activity run by a third party, such as participating in an Earth Lab Workshop at the Natural History Museum or attending an event such as the Big Bang (the UK Young Scientists & Engineers Fair).

5. We issued a call for evidence on 5 April 2011 on the following questions:

a) How important are practical experiments and field trips in science education?

b) Are practical experiments in science lessons and science field trips in decline? If they are, what are the reasons for the decline?

c) What part do health and safety concerns play in preventing school pupils from performing practical experiments in science lessons and going on field trips? What rules and regulations apply to science experiments and field trips and how are they being interpreted?

d) Do examination boards adequately recognise practical experiments and trips?

e) If the quality or number of practical experiments and field trips is declining, what are the consequences for science education and career choices? For example, what effects are there on the performance and achievement of pupils and students in Higher Education?

f) What changes should be made?

g) Is the experience of schools in England in line with schools in the devolved administrations and other countries?

6. The Committee received 47 written submissions.

7. We took oral evidence from five panels of witnesses over three evidence sessions. On 15 June we took evidence from practising teachers: Kevin Courtney, Deputy General Secretary, National Union of Teachers, Dr Stuart Hitch, Earth Science Teachers' Association affiliated teacher, Greg Jones, National Union of Teachers affiliated teacher, Professor Chris King, Earth Science Teachers' Association, and Darren Northcott, National Official (Education), National Association of Schoolmasters/Union of Women Teachers.

8. On 29 June we took evidence from two panels of witnesses in organisations providing support to teachers and schools in the delivery of practicals and learning outside the classroom. The first panel explored support to individual teachers: Paul Cohen, Director Initial Teacher Training Recruitment, Training and Development Agency, Annette Smith, Chief Executive, British Science Association, Dr Phil Smith MBE, Co-ordinator, Teacher Scientist Network, and Dr Steve Tilling, Field Studies Council. The second panel considered wider school issues: Beth Gardner, Chief Executive, Council for Learning Outside the Classroom, Professor Graham Hutchings FRS, Chair, SCORE (Science

Community Representing Education), Sir Roland Jackson, Chief Executive, British Science Association, and Steve Jones, Director, CLEAPSS.[7]

9. Third, we took evidence on 4 July, first from David Knighton, Reporting Inspector, Ofsted, Kevin Myers, Deputy Chief Executive, Health and Safety Executive, Dennis Opposs, Director of Standards, Ofqual, and Nigel Thomas, Director, Education and Skills, Gatsby Foundation, followed by Nick Gibb MP, Minister for Schools, Department for Education.

10. Finally, we wanted to have views from students at school. In cooperation with The Student Room website, we opened an e-consultation to hear views from students regarding their school science practicals experiences and field trips. The e-consultation ended on 8 July 2011 and a summary of the main points from the exercise is set out in an annex to our report.

11. We would like to thank those who provided written and oral evidence to this inquiry. In addition, we extend our gratitude to Quintin Kynaston School in London for accommodating us on a visit conducted as part of our inquiry on 23 June.

12. In this report we examine whether there is value in practical science and field trips and if there has been a decline in quantity or quality in either of these. In chapter 2 we examine the value of practical science, any concerns about its provision, in particular whether health and safety legislation hinders the provision of practical science in schools and learning outside the classroom. Chapter 3 examines a wide range of issues. We consider other issues (than health and safety) raised as potential hindrances to providing quality science experiences and what might be done to address these within the current Government's education policy. Finally, in chapter 4 we look at the role of the wider science community in supporting teachers and providing routes to engage and enthuse students to take up science at certificate levels.

[7] CLEAPSS is an advisory service providing support in science and technology for a consortium of local authorities and their schools including establishments for pupils with special needs.

2 Practical lessons and field trips

The value of science practicals and field trips

13. Before considering whether science practicals and field trips were in decline, we asked whether they were essential or simply a desirable addition to the science curriculum. The written evidence we received was overwhelmingly in support for practical science. For example, the Scottish Schools Equipment Research Centre[8] told us that:

> Science is not simply a body of knowledge. It is also a way of thinking, of approaching problems, planning investigative work and evaluating evidence. Many of these skills can only be developed experientially through experiments and observations.[9]

The Campaign for Science and Engineering in the UK made the point that:

> science and engineering are critical to the UK's social and economic future [...] this country must strengthen its medium- and high-skills sectors in order to be competitive. [...] Consequently it is essential that the government places a greater emphasis on improving practical skills in schools.[10]

We heard similar messages from SCORE (Science Community Representing Education),[11] the British Science Association,[12] the Association for Science Education[13] as well as a range of academics,[14] science related trade associations[15] and teacher unions.[16]

14. Ofsted told us that "in the schools which showed clear improvement in science subjects, key factors in promoting students' engagement, learning and progress were more practical science lessons and the development of the skills of scientific enquiry".[17] They pointed out that "where students progress in science was no more than satisfactory, the opportunities for them to design and carry out experiments were limited; too much of the practical work was prescriptive, with students merely following instructions".[18]

15. In its written evidence SCORE explained that good quality practical work should have three overarching purposes:

[8] An organisation, similar to CLEAPSS, in providing practical advice to schools on practicals and associated health and safety issues but focussed on Scotland rather than England and Wales. www.sserc.org.uk

[9] Ev w7, para 1

[10] Ev w55, paras 2 and 5

[11] Ev 79

[12] Ev 48

[13] Ev 90

[14] For example, Ev w26 [Dr Philip Wheeler and Dr Graham Scott, University of Hull]

[15] For example, Ev w24 [Association of the British Pharmaceutical Industry]

[16] For example, Ev 76 [The National Union of Teachers]

[17] Ev 104, para 1

[18] As above

- to enable and enhance the learning of scientific concepts;
- to engender an understanding of the scientific process; and
- to develop laboratory skills.[19]

16. We had a similar response on the need to get outside the classroom. The evidence for the positive effects of fieldwork, similarly, came from a wide range of witnesses. We were told about the benefits of getting students out of the classroom by individual teachers,[20] science organisations,[21] official bodies such as Ofsted[22] and the Minister himself.[23] The Learning Outside the Classroom Manifesto, introduced by the previous Government, summarised the benefits from working outside the classroom and they included:

- improving academic achievement;
- providing a bridge to higher order learning;
- developing skills and independence in a widening range of environments;
- making learning more engaging and relevant to young people;
- developing active citizens and stewards of the environment;
- nurturing creativity; and
- providing opportunities for informal learning through play.[24]

17. Myscience, the government funded organisation that runs the Science Learning Centres to provide continuing professional development for science teachers, told us of the value of field trips:

> Trips provide a valuable means by which learning in school can be transferred to different settings. They encourage pupils to make connections between knowledge they have gained in their science lessons and the "real" world, as well as linking different areas of the curriculum; both desirable outcomes which can be difficult to achieve within the normal school setting. Trips can also provide an effective way to help pupils see the scope and range of STEM-related jobs, breaking down stereotypes and providing exposure to the wide range of careers which STEM qualifications can lead to.[25]

18. EngineeringUK, a not-for-profit organisation promoting the contribution of engineers, engineering and technology to society, spoke strongly in favour of field trips as allowing students to see what value science qualifications might have for future career paths:

---

[19] Ev 79, para 2

[20] For example, Ev w1[Rosie Clift]

[21] For example, Ev 48, para 4 [The British Science Association]

[22] Ev 104, para 1

[23] Q 176

[24] "Learning Outside the Classroom Manifesto", *Department for Children, Schools and Families*, 2006

[25] Ev w14, para 1.3

> The Big Bang [science fair] had a positive impact on how likely children are to want to become an engineer. Three fifths of boys (61%) aged 12-16 interviewed at The Big Bang said that their visit had made them either 'a little more' or 'much more' likely to want to become an engineer. The proportion amongst girls of the same age was similar, at 58%.[26]

19. The Field Studies Council explained to us the value of practical science out of the classroom (fieldwork):

> Teachers working with the [Council] also note that the experience of using 'messy' primary data outside the classroom (i.e. less easily sanitised, managed and orderly than its indoor or virtual equivalent) is very powerful in demonstrating the real strength of scientific methodology (How Science Works).[27]

20. Finally, putting the study of science subjects in context, the Secretary of State for Education, in a speech to the Royal Society in January 2011, said that:

> For any politician anxious to ensure the next generation enjoy opportunities to flourish in an economy that is growing, in a nation that is confident and in a society that believes in progress, there is no escaping the centrality of mathematics and science.[28]

In its written evidence to this inquiry, the Department for Education said that "science is a critically important subject for this country".[29]

21. We agree on the importance of science to the UK economy and, given the overwhelmingly positive nature of the evidence provided to us on the value of practical experience both in and out of the classroom, **we conclude that both practical lessons and learning outside the classroom are essential contributors to good quality science education.**

Concerns about science practicals and field trips

22. The written and oral evidence provided to us covered issues concerning both the quantity and quality of practicals and learning outside the classroom. Organisations such as SCORE and the Association for Science Education cited the following factors as contributing to a decline in the quality of practical science: the pressures of managing a busy curriculum,[30] the difficulty in finding time for specialist continuing professional development[31] or time to get out of the classroom[32] and teaching practical classes largely

[26] Ev w45, para 13

[27] Ev 55, para 19

[28] "Michael Gove speaks to the Royal Society on maths and science", Department for Education website, 29 January 2011 www.education.gov.uk/inthenews/speeches/a00191729/michael-gove-speaks-to-the-royal-society-on-maths-and-science

[29] Ev 45

[30] For example Ev 79 [SCORE]

[31] For example Q 37 [Dr Phil Smith]

[32] For example Q 56 [Annette Smith]

focussed on passing the examination rather than furthering the three overarching aims[33] (set out above at paragraph 15). We set out in more detail the significant decline in residential fieldwork at paragraph 73 but SCORE's written evidence summarised the position:

> SCORE acknowledges that in the UK more practical work takes place in science lessons than in most other countries (indicated by international comparisons such as TIMSS).[34] However, there remains concern among the science community that schools in general are not doing enough (or doing the right kind of) practical work and that its quality is uneven.[35]

Health and safety

23. As we explained in chapter 1, our initial impetus for this inquiry arose from concerns about health and safety on science practicals and field trips. However, although health and safety concerns featured in the evidence, it was not the predominant reason given for the decline in the quantity or quality of science practicals or field trips. A practising teacher told us that "health and safety issues linked with the blame culture" were providing "a disincentive to do anything that might have a risk" and that "attitudes of senior management who are wary of science and are risk averse" were aiding the decline of practicals and field trips.[36] In our report we first look at health and safety before considering, in the next chapter, the wider issues surrounding the provision of practical science experience in schools and what the Government and the wider science community could do to improve the situation.

24. We asked for evidence on the impact of health and safety as we needed to determine whether the legislation itself was a problem, whether there were indirect effects or whether the reports were simply wrong.

25. It is a common feature of today's society to hear of restrictions due to health and safety. It is not restricted to schools. The Health and Safety Executive told us that:

> there is a general issue in society about health and safety, which has effectively replaced mothers-in-law as something that comedians know will get a cheap laugh. Most of it is based on perception, myth, and inaccurate reporting or recording of things. There is that background in society; it is not just a "school" thing.[37]

26. The Health and Safety Executive's perspective was shared by our predecessor Committee when it considered the impact of health and safety on practical science lessons some ten years ago:

---

[33] For example, Ev 77, para 4 [The National Union of Teachers]

[34] Trends in International Mathematics and Science Study, run by the International Association for the Evaluation of Educational Achievement

[35] Ev 80, para 1.5

[36] Ev w2, para 2 [Jane Giffould]

[37] Q 106

> there is a widely held belief that practical work in schools is now constrained by health and safety regulations. This is simply not true. Indeed, we have heard that the introduction of risk assessment as standard practice enables a wider range of experimental work to be carried out than previously.[38]

27. More recently, health and safety was considered by the Children, Schools and Families Select Committee in its 2010 inquiry into *Transforming Learning Outside the Classroom.* The Committee noted evidence from the Countryside Alliance that indicated "that health and safety concerns were still the main barrier to learning outside the classroom for 76% of teachers".[39] However, the report added that it "was suggested to us that, among school leaders, health and safety is sometimes used as an excuse rather than a reason for not offering trips or practical work".[40]

28. The Countryside Alliance's survey was not, however, supported by the Association for Science Education and the Council for Learning Outside the Classroom, which have recently surveyed teachers on the barriers to practicals. Neither of these studies indicated health and safety as the main barrier. The Council for Learning Outside the Classroom found cost the greatest barrier (57%), health and safety issues next (46%) and then the stress of organising (41%). They played down the health and safety issue as "many barriers associated with the health and safety requirements are perceived rather than real, as teachers are confused about the legal requirements around risk assessments, ratios etc".[41] The Association for Science Education found the major concerns for teachers that militated against working outside the classroom were a lack of time (52%), the requirements of examinations and assessment (45%) and the demands of the curriculum (38%); health and safety was well down this list of concerns (16%).[42]

29. In written evidence to the inquiry, there was a general acceptance, by teacher unions,[43] science organisations[44] and technical organisations,[45] that risk assessment was a necessary activity and in oral evidence it was pointed out that while "Fieldwork is inherently risky [...] the most risky thing you can do in fieldwork is to drive there".[46] The Health and Safety Executive told us that:

> there is no reason why health and safety should stop schools carrying out science experiments or field trips [...] all that is required in most cases are a few sensible precautions. [...] HSE has worked with educational science bodies over many years to establish and publicise what those precautions should be and to ensure that they are sensible, practical and proportionate.[47]

---

[38] Science and Technology Committee, 3rd Report of Session 2001–2002, *Science education from 14-19*, HC 508–I, para 137

[39] HC (2009–10) 418, para 29

[40] As above

[41] Ev 61, para 4.1.2

[42] Ev 92, para 16

[43] For example, Ev 77, para 11 [The National Union of Teachers]

[44] For example, Ev 79, paras 18-22 6 [SCORE]

[45] For example, Ev 72, para 3 [CLEAPSS]

[46] Q 15 [Professor King]

[47] Ev 92, para 3

In response to the 2010 Children, Schools and Families Committee's concerns about the use of health and safety as an excuse (see paragraph 27), the Coalition Government said that it was "ready to explore how to increase school freedom in this regard by, for example, reviewing the constraints flowing from unnecessary Health and Safety red tape".[48] New guidance to schools, published on 2 July 2011, stated that:

> School employers should always take a commonsense and proportionate approach, remembering that in schools the purpose of risk assessment and management is to help children to undertake activities safely, not to prevent activities from taking place. They cannot remove risk altogether and they should not require needless or unhelpful paperwork.[49]

30. As a Committee we are always cautious to draw a conclusion from the absence of evidence. In this case, however, we were struck by the fact that in the responses to our call for evidence we have received no detailed cases showing that health and safety legislation had directly prevented a sensible and reasonable science practical in a classroom or an out-of-school activity. **We found no convincing evidence that health and safety legislation itself prevents science practicals or field trips.**

31. Instead, the evidence before us had a strong undercurrent showing an indirect influence of health and safety on school science and field trips. We heard anecdotal evidence that a fear of health and safety influenced the delivery of practicals and field trips. In oral evidence, Steve Tilling of the Field Studies Council told us that "it is true to say that, when we worked, for example, in inner London, health and safety was being used as an excuse not to do outdoor science and fieldwork".[50] Annette Smith of the Association for Science Education added that a teacher who "feels less confident in taking a practical or a fieldwork activity" would be more likely to "overly rely on the paperwork" thus perpetuating the story that health and safety itself is the issue.[51] Nigel Thomas of the Gatsby Charitable Foundation explained that:

> Anyone who has been involved in science education over the last 20 years has heard persistent anecdotal evidence that health and safety perceptions have an impact on the range and quality of practicals undertaken in school science lessons. You can debate whether teachers use it as an excuse or they genuinely have a misconception that something is banned or unsafe, but I think there is widespread anecdotal evidence to suggest that it has an effect.[52]

32. The effects of the perception of health and safety were not, however, uniform or necessarily of general application. Beth Gardner, Chief Executive of the Council for Learning Outside the Classroom, pointed out that: "You can get two very similar schools with very similar catchments and similar resources. One will be very good at learning

---

[48] Education Committee, 3rd Special Report of Session 2010–12, *Transforming education outside the classroom*, HC 525 Appendix 2 para 5

[49] "Health & Safety, Department for Education advice on legal duties and powers for local authorities, head teachers, staff and governing bodies", *Department for Education*, 2 July 2011, media.education.gov.uk/assets/files/pdf/d/departmental advice on health and safety for schools.pdf

[50] Q 66

[51] As above

[52] Q 106

outside the classroom and one will not have embraced it at all".[53] She indicated that these differences are down to the differences between individual teachers.[54]

33. A lack of knowledge among teachers may also be the reason why health and safety is mentioned as not allowing practical experiments inside and outside the classroom. In oral evidence, witnesses repeatedly told us that health and safety was not a concern to experienced, knowledgeable teachers.[55]

34. Ms Gardner highlighted the existence of the Learning outside the Classroom Quality Badge, awarded to providers of learning experiences outside the classroom that meet a set of quality standards set by the Council for Learning Outside the Classroom. She told us that "one of the reasons behind setting up the Learning Outside the Classroom Quality Badge[…] is [that it is] one badge, making it easily recognisable for teachers looking at the quality of education as well as risk-effectiveness".[56] Professor King of the Earth Science Teachers' Association told us that the badge, which "has been very effective",[57] was only one part of the *Learning Outside the Classroom Manifesto*.[58] He explained that the other strand that was supposed to cover fieldwork had not been as well developed:

> the Outdoor Manifesto [...] was supposed to have two main strands. One was the badging strand, and that has been very effective. The other thing was supposed to be supporting teachers to do fieldwork more effectively. What happened there was, that a lot of money went to consultants, some things were put on the website and nothing happened beyond that. So that strand never took off in the same way that the other one did. I think that is what we need to focus on now.[59]

We have received no evidence of anything similar to provide clear assurances about classroom practical activities.

35. We are clear that teachers should never have to decide between following interpretations of health and safety rules or the delivery of an interesting and engaging practical lesson. Paul Cohen from the Training and Development Agency told us: "There is a balance there between being aware of [health, safety and safeguarding requirements] but also being able then to go ahead and do it and not just to say, 'It's all too difficult'".[60] From the evidence we received we reached the following conclusions. First, it is self evident to us that teachers should have access to resources that enable them to make well-informed, quick and easy decisions about health and safety to allow more time to focus on the delivery of educational benefits. Second, it appears that teachers may cite health and safety when they are unsure of their ability to carry out a field trip or believe that the volume and nature of paperwork will outweigh any benefits of taking on the trip.

---

[53] Q 86

[54] As above

[55] For example, Qq 6, 13, 42, 43, 52, 66 and 119

[56] Q 87

[57] Q 8

[58] Guidance produced by the then Department for Children, Schools and Families in 2006, www.education.gov.uk/publications/standard/publicationdetail/page1/DFES-04232-2006

[59] Q 8

[60] Q 53

36. On the latter we are convinced that good training and guidance should not only provide teachers with the information and skills to carry out the work but also work toward dispelling any myths about health and safety. We examine teachers' skills in more detail at paragraphs 45 to 48 and 56 to 60.

37. The Learning Outside the Classroom Quality Badge has been successful in its aim to move some of the health and safety burden for field trips from schools to providers making it easier for teachers to make decisions about learning outside the classroom activities. We see value in a central scheme, like the Quality Badge, to allow teachers quickly and easily to assess health and safety for other practical activities outside the classroom and practical classes inside the classroom. **We recommend that the Government work to establish a central repository or facility (or network of such facilities with a common interface) which will contain details and guidance on standard experiments. This facility should provide access, for member schools, to any CLEAPSS[61] provided health and safety guidance for those experiments.**

[61] CLEAPSS is an advisory service providing support in science and technology for a consortium of local authorities and their schools including establishments for pupils with special needs.

3 The elements of successful school science

The Government's approach

38. When Nick Gibb MP, Minister for Schools, gave evidence to us, he recognised the value of practical science. We agree with him that: "Being able to measure accurately is an important skill that children need to acquire during their school career. Conducting experiments is an important way of ensuring that they have those skills".[62] Annette Smith of the Association for Science Education explained that the acquisition of those skills was key to persuading students to engage, "If we want young people to really engage with science, good-quality, thoughtful, well-planned and well-prepared practical work is the way to do it".[63]

39. In the White Paper, *The Importance of Teaching*, published in November 2010 the Government stated that it "is our ambition that Academy status should be the norm for all state schools, with schools enjoying direct funding and full independence from central and local bureaucracy".[64] In oral evidence, the Minister explained that he did not consider that:

> it is the direction of travel of this Government to continue the approach of central prescription and initiatives. That really was the approach of the last Administration and we have tried to get away from that by putting more and more funding that was held centrally to provide those initiatives and get that money down to the school level so that the school can decide how it wants to spend that money on its priorities. Having said all that, my view is that field trips are essential, particularly in subjects like geography and geology. I also think that practical experiments in science are very important. We would want to encourage it but not to do so through a plethora of central initiatives and ring-fenced funding streams.[65]

40. Taking the Government's approach, we examined what incentives there were to increase the numbers of students choosing to study science subjects or to encourage schools to invest more in science as a result of the educational reforms. We received some evidence that senior management of schools might not have incentives to invest in science departments or to see them as an asset. Steve Jones of CLEAPSS was "not convinced that enough school senior leadership teams [were] sufficiently aspirational about what [they] could get out of [their] science department".[66] The need to engage the senior management of a school was highlighted by the evaluation of the Government sponsored *Getting Practical Programme*[67] which was published during the inquiry. That evaluation found that the benefits depended on who received the training (more effective if the trainee was the

[62] Q 158

[63] Q 77

[64] "The Importance of Teaching", *Department of Education*, Cm 7980, November 2010

[65] Q 176

[66] Q 95

[67] The Getting Practical programme was aimed at training 2000 teachers to bring about:
1 Observable changes in the emphasis given to practical science in schools and colleges.
2 Observable improvements in young people's perception of, and positive attitudes towards, science.
3 Observable changes in the confidence and attitudes of science teachers and other staff in using practical science as part of the teaching and learning process.

head of department rather than a newly qualified teacher) and whether there was support from the senior management team to implement the new ideas.[68]

41. We were also told that the devolution of power to schools might inadvertently increase the distance between school science teachers and the wider science community. When addressing the need to encourage better quality science practicals in schools Steve Jones of CLEAPSS suggested that: "It will be more challenging to do that, because your mechanisms for engaging with senior leaders as a group are possibly not as clear-cut in a system consisting of a lot of independent schools".[69]

42. We explored how these disincentives could be addressed within the Government's policy which the Minister summarised as: "Exhortation and facilitation, absolutely; we are very keen to do that. We are always talking to academics and universities, and encouraging a Reach Out Lab-type approach is the right one. Again, it is a bottom-up approach; it is about encouraging but not prescribing or organising from the centre".[70]

The role of government

43. Commendable as this approach is, we had concerns that it may not ensure that the Government achieves its ambition to improve school science and increase participation in STEM[71] learning and employment. Accepting that the Government is not going to manage schools centrally, we considered what encouragement and facilitation it could carry out and also whether there needs to be an enhanced role for "regulators" within the system to achieve the Government's policy for science. The Government:

a) sets standards for teacher qualifications and the training necessary for that status through the Training and Development Agency;

b) inspects and reports on schools against a common standard through Ofsted; and

c) defines the academic standards and skills necessary to gain a qualification at GCSE and A level through a common standard set by Ofqual.

44. We will explore how these various levers might be applied to address the issues raised.

Teachers' skills

45. One message that came back to us repeatedly was that many of the issues (for example, concerns over health and safety, confidence to innovate, knowledge of opportunities, ability to lead and integrate fieldwork) could be addressed by having good teachers. For example, Steve Tilling of the Field Studies Council said that: "If you have a very

[68] "Independent Evaluation Report Getting Practical: Improving Practical Work in Science", *Ian Abrahams and Rachel Sharpe, University of York; Michael Reiss, Institute of Education, University of London*, July 2011

[69] Q 96

[70] Q 199

[71] Science, Technology, Engineering and Mathematics

experienced science teacher who has done this before, health and safety will not be an issue".[72] The Minister told us that:

> One thing in which I believe very strongly is that, if you have teachers who know their subject extremely well, they will be better equipped to provide good practical experiments and lessons in chemistry and physics than a teacher who is grappling with the subject content.[73]

46. In their written submission, the Teacher Scientist Network told us that "good teachers are those who are confident teachers, up-to-date in their subject knowledge and practically adept themselves".[74]

47. We have been informed, however, that having the right subject specialists is an ongoing problem. The Royal Society, in its State of the Nation report "*Increasing the size of the Pool*", focussed on a lack of specialists teaching science subjects in England, Wales and Northern Ireland. The Royal Society considered that this was demonstrated by the fact that in "2009, 18%, 12% and 43% of all relevant institutions across England, Wales and Northern Ireland failed to present a single physics A-level candidate".[75]

48. In its written evidence the Department explained how it was addressing the recruitment of science qualified teachers:

> Latest evidence shows that only 14% of science teachers have a physics degree, 22% have a chemistry degree and 44% have a biology degree. *The Importance of Teaching* White Paper states the Government's intention to provide stronger incentives to attract the best graduates to come into teaching, including science.
>
> [...]
>
> [*The Importance of Teaching*] White Paper also reaffirms our commitment to more than double the number of participants in the Teach First scheme so that more schools are able to benefit from the talents of the country's best graduates. The majority of Teach First participants teach the most demanding shortage subjects. In addition, teacher training bursaries are continuing to be paid to graduates in the sciences.[76]

49. We pay tribute to the work that the Department has done in encouraging the recruitment of specialist teachers and the Department's continued support for good quality continuing professional development (CPD) available, for example, through the Science Learning Centres.[77] These need to continue and we hope that these will increase the number of suitably qualified entrants to the teaching profession.

---

[72] Q 52

[73] Q 160

[74] Ev 88, para 10

[75] "Increasing the size of the pool", *Royal Society*, January 2011

[76] Ev 45–46

[77] Science Learning Centres are a national network for professional development in science teaching. There are nine regional Centres in England and one National Centre, each with a number of satellite Centres to provide additional facilities. They are jointly funded by the Department for Education and the Wellcome Trust.

50. We note the Minister's commitment to peer-to-peer training through the teaching schools. He told us that:

> the best [continuing professional development] is provided from peer to peer and teacher to teacher so that teachers can observe high-quality teaching taking place. That is what the teaching schools, we hope, will deliver in due course.[78]

This may prove effective in the communication of best practice with regard to pedagogy.[79] There is, however, a difficulty. We received evidence that teachers are not keeping their scientific knowledge and skills up to date. Ofsted reported that teachers were not making good use of the Science Learning Centres[80] and other witnesses raised the problems of attending CPD due to cost,[81] the demands of the curriculum,[82] the consequences of the 2003 "rarely cover" agreement[83] and of the demands on teachers to use their CPD opportunities keep up with changes in pedagogy within the curriculum.[84]

51. A recently retired teacher also highlighted the declining use of the provisions of the Association of Science Education:

> [its] annual conference [...] is an excellent place to network with other teachers and to hear about up to date research. [...] over the years I suspect fewer and fewer teachers go due to costs and refusal of schools to pay for supply cover when the conference happens to fall in term time. [...] Most attendees work in science education but not in the classroom. Attending locally run courses is good but real inspiration comes from attendance at the [conference].[85]

52. Ofsted's recent report on science education, *Successful Science,* also made the point that:

> Where teachers had attended externally provided subject training, evaluation of the impact showed improved teaching and a sharing of good practice in their department. However, a lack of science-specific courses was limiting the capacity of some staff to bring about improvements.[86]

53. We are concerned that, if science teachers do not regularly have the opportunity to get the opportunity to attend CPD outside the peer to peer structure, their science knowledge

---

[78] Q 181

[79] The art, or science, of teaching; instructional methods.

[80] Secondary teachers in particular benefited from attending courses at the network of Science Learning Centres, but too few of the schools visited had taken advantage of this high-quality provision, "Successful Science", *Ofsted*, January 2011 p7

[81] Q 56 [Annette Smith]

[82] Ev 106, para 18 [Greg Jones]

[83] In 2003, a national agreement between the Government, employers and school workforce unions was designed to reduce the excessive workload that entailed teachers spending two-thirds of their time on administrative tasks. One element of this was that teachers should *rarely cover* for absent colleagues. While this was within the context of unexpectedly covering for absent colleagues the Committee believed that it also impacted on covering for planned absences such as trips and events.

[84] Q 37 [Dr Phil Smith]

[85] Ev w64, para 4

[86] "Successful Science", *Ofsted*, January 2011 p28

will deteriorate with consequent impacts on the provision of quality practical experience for students.

54. We considered whether school inspections could provide senior management teams with incentives to value subject specialist CPD to ensure that staff took full advantage of the opportunities available. Currently Ofsted only reports on subject specific CPD on a specialist science visit to a school. However, the Evaluation schedule for judgements made by inspectors of schools states that:

> Inspectors should evaluate[...] how well leaders and managers at all levels drive and secure improvement, ensuring high-quality teaching and learning, by using relevant information about the school's performance to devise, implement, monitor and adjust plans and policies.[87]

The need for a school to insure that its teachers are maintaining their skills would appear to be accommodated under this. We consider that this section should explicitly mention subject related CPD arrangements made by the school as part of their efforts to ensure high-quality teaching and learning.

55. **We strongly recommend that Ofsted report on how effectively schools provide opportunities for their science teachers to stay up to date with their science specialism, specifically in attendance of externally provided subject training, as part of Schedule 5 inspections under the current heading of "*The effectiveness of leadership and management in embedding ambition and driving improvement*".**

Newly qualified teachers

56. Several pieces of evidence submitted to us drew attention to the skill deficit of newly qualified teachers with regard to fieldwork and field trips.[88] Paul Cohen, Director of Initial Teacher Training Recruitment at the Training and Development Agency, told us that there are already "requirements around understanding, planning and operating fieldwork [...] built into the various standards that exist at the moment for newly qualified teachers" and "that the standards as a suite are being reviewed".[89] We were told that there is no requirement for student teachers to demonstrate their ability to lead and carry out a field trip or fieldwork.[90] The Association for Science Education strongly supported explicit inclusion of actual experience of fieldwork and field trips within initial teacher training.[91]

57. **We have not been convinced of the merits of an accredited course, which was advanced by Professor King of the Earth Science Teachers' Association[92] but we do recommend that all trainee science teachers should be expected to prepare successfully and lead at least one fieldwork session themselves, and to take part in a field trip before acquiring qualified teacher status.**

---

[87] "The evaluation schedule for schools", *Ofsted*, April 2011

[88] For example, Ev 55, para 15 [Field Studies Council] and Ev 63, Para 6.1.5 [Council for Learning Outside the Classroom]

[89] Q 39

[90] Q 83 [Beth Gardner]

[91] Ev 93, para 24

[92] Ev 52, para 6 and Q 7

Pay progression

58. After qualifying, teachers progress up a pay scale and should, on average, reach the top of this scale within six years.[93] It is possible to apply to go on to an upper pay scale and, at this point, there is an assessment of individual teacher skills to justify passing over the threshold to the new scale.[94] There are other routes for classroom teachers to progress their careers which require assessments by becoming an advanced skills teacher or attaining excellent teacher status.[95] Steve Tilling of the Field Studies Council questioned what practical skills should be required from teachers at these threshold points: "When you progress through threshold and through to an advanced skills teacher, there is no standard which underpins that development in terms of working outside the classroom".[96]

59. **The Government should require that, in order to advance over pay thresholds, a science teacher should demonstrate he or she has maintained the practical classroom skills, fieldwork and associated risk assessment skills necessary to be a good science teacher.**

Laboratories and technical support

60. As well as a lack of the teachers with suitable qualifications and skills, we were told that the design and standard of accommodation for science practicals was poor. CLEAPSS[97] said that: "Despite good advice [...] published by the Dept of Education [...] the design of science teaching spaces in new buildings is frequently poor".[98] The Royal Society for Chemistry has reported twice on the poor state of school laboratories.[99] Dr Kevin Smith of the Teacher-Scientist Network told us how his organisation attempted to address the shortage of science resource faced by affiliated teachers:

> We provide a Free-to-loan Resources Kit Club where schools from Norfolk, Suffolk and into Cambridgeshire come to us to borrow kit boxes which are free. It works like a lending library. This works, but it needs to be expanded. Obviously it is not going to work asking a teacher to travel 200 miles to borrow one kit box. We need more of those around the country.[100]

---

[93] "School Teachers' Pay and Conditions Document 2010 and Guidance on School Teachers' Pay and Conditions", *Department for Education*, August 2010 www.education.gov.uk/publications/eOrderingDownload/2010%20PandC%20All%20sections.pdf

[94] Qualified teachers who reach the top of the main pay scale can apply to be assessed against eight national standards and if they meet the standards, cross the 'threshold' to the upper pay scale. Teachers seeking to cross the threshold are assessed by their head teacher. The standards for Post Threshold Teachers, Excellent Teachers and Advanced Skills Teachers are pay standards and teachers who are assessed as meeting them also access the relevant pay scale.

[95] "School Teachers' Pay and Conditions Document 2010 and Guidance on School Teachers' Pay and Conditions", *Department for Education*, August 2010 www.education.gov.uk/publications/eOrderingDownload/2010%20PandC%20All%20sections.pdf

[96] Q 37

[97] CLEAPSS is an advisory service providing support in science and technology for a consortium of local authorities and their schools including establishments for pupils with special needs.

[98] Ev 72, para 2j

[99] "Laboratories, Resources and Budgets: Provision for science in secondary schools", *Royal Society of Chemistry*, April 2004 & "Improving school laboratories? A Report for the Royal Society of Chemistry on the number and quality of new and re-furbished laboratories in schools", *Royal Society of Chemistry*, October 2006

[100] Q 78

One response from a student to the e-consultation also exemplified the state of science laboratories:

> The one down side is that the college is shamefully underfunded in the physics dept. The hairdressing students get a nice new salon, the graphics students get shiny apple macs, the physics students get dusty old equipment held together with masking tape![101]

61. It was clear to us that well qualified, confident teachers need good laboratory space if they are to conduct high quality practical classes. We therefore wanted to assess what minimum requirements school laboratories had to meet and how resources were allocated to school science departments. We also wanted to explore how standards were reported. We were alerted to these issues when AQA, one of the examination boards that currently offer GCSE and A level science exams to schools, highlighted that they needed to be "pragmatic about the resources schools have for [practical activities]".[102] This suggested that there were no clear assumptions that could be made by examination boards as to the facilities that schools should be expected to have.

62. Some useful information may soon be available to the Government as the Science Community Representing Education[103] (SCORE) has

> embarked on a research project which will determine a baseline for the resourcing requirements of practical work. [...] The baseline will be in terms of laboratory facilities, technician support, fieldwork facilities and equipment and consumables for primary and secondary school science.[104]

63. The Minister was clear that "Secondary schools should have good quality laboratories, fume cupboards, technicians and all the chemicals and equipment they need to enable them to conduct experiments and students to take part in them".[105] We welcome his statement and, while central government should not be involved in the detail of local decision making in schools, we are concerned that the Minister added that "how schools allocate their capital is a matter for the schools and local authorities".[106]

64. We accept that spending decisions are not going to be made centrally but there must be clear incentives within the system to ensure schools are encouraged to upgrade sub-standard laboratory space. **A school providing science courses at GCSE and A level should be required to demonstrate, during Ofsted inspection, it has ready access to a basic suite of facilities such as fume cupboards to facilitate rigorous examination of science skills.**[107] **It would be incumbent on the Government to identify what a basic**

[101] Contributor to the e-consultation, www.thestudentroom.co.uk/showpost.php?p=32163183&postcount=40

[102] Ev w36, para 10

[103] A consortium of science organisations: Association for Science Education, Institute of Physics, Royal Society, Royal Society of Chemistry and Society of Biology

[104] Q 97, footnote 3 [Professor Hutchings]

[105] Q 170

[106] As above

[107] See paragraph 92.

suite of facilities would be for the benefit of both senior management teams and examination boards.

Technical staff

65. The availability of technical staff was also raised as a key element in the provision of quality practical experiences. Annette Smith of the Association for Science Education said that technicians "are absolutely key to practical science and outdoor science and in the classroom".[108] She was also concerned that when "schools are cutting budgets, they cut technicians before they cut teachers. As they form the bedrock of science education, they are incredibly important and we ought to concentrate on them considerably".[109]

66. CLEAPSS provided us with a copy of CLEAPSS Guide G228 *Technicians and their jobs*, which drew on the findings of a national survey of science technicians conducted in 2001 by the Royal Society and the Association for Science Education. The survey recommended:

a) a national framework for technicians' pay and job descriptions;

b) a common formula to determine the technician hours that schools need;

c) proper funding for technician training;

d) a nationally-recognised induction programme;

e) a recognised career structure; and

f) better overview of technicians jobs by heads of science and school governors.[110]

67. In his oral evidence, Steve Jones of CLEAPSS outlined the constraints when working with school technicians:

> They often work term time only. They do not have any opportunity to do any work inside the holidays to get on top of situations. Without that technician support, it really undermines the teacher's ability and willingness to do different, varied practical work. I would not say it is unique but it is a distinctive feature of science education in this country that there is proper technical support.[111]

68. The difficulties faced by science technicians are not new and have been raised by our predecessor committee,[112] the predecessor of the Lords Science and Technology Committee[113] and the Royal Society[114] in the past ten years. We consider that teachers

---

[108] Q 59

[109] As above

[110] "Survey of science technicians in schools and colleges", *Royal Society & Association of Science Education*, 2001

[111] Q 83

[112] Science and Technology Committee, 3rd Report of Session 2001–2002, *Science education from 14-19,* HC 508–I, paras 132–6

[113] Lords Science and Technology Committee, 10th Report of Session 2005–06, *Science and teaching in schools*, HL 257, paras 6.3 –6.12

[114] "Supporting success: science technicians in schools and colleges", *Royal Society*, January 2002 royalsociety.org/WorkArea/DownloadAsset.aspx?id=5836

supported by motivated and informed technical staff will spend less time on risk assessment and other bureaucracy and more on ensuring high quality teaching outcomes.

69. The Government sets the standard for qualified teachers and ensures there is an appropriate measure of expected pay and conditions of service for a qualified teacher.[115] We consider a similar standard should be set for school technicians. **We reiterate the recommendation of our predecessor committee for action to be taken to "address the appalling pay and conditions of science technicians and to create a career structure that will attract skilled and dedicated people to work as technicians".**[116]

Inspection

70. Ofsted told us that it does not specifically inspect the management of science laboratories and the relationship between science teachers and technicians unless "there was a reason to do so".[117] David Knighton, HMI Principal Officer in Ofsted, said that the "roles of technicians are absolutely key in science as they are in technology and other areas in schools" but we note that the Ofsted report, *Successful Science*,[118] when discussing poorly performing departments, makes no mention of technical support or whether that was a contributory factor.

71. **We recommend that, when carrying out a Schedule 5 inspection, Ofsted should explicitly report on the management of science laboratories and, during a specialist science visit, the relationship between teachers and technical staff in the planning and delivery of practical lessons should be a key part of that inspection.**

Fieldwork

72. Kevin Courtney of the NUT outlined to us how fieldwork was an essential part of understanding how laboratory skills and experimental theory can be applied to investigate natural phenomena:

> There are the [Training and Development Agency] adverts on becoming a teacher, which have inspirational features such as a teacher demonstrating the solar system in the playground. That might look a bit airy-fairy. However, if you want to talk to some kids about the speed of sound, you can do it on a white board, but, if you have enough space, you can take them out so that some children can knock two stones together and the others are far enough away to see the stones going together before the sound reaches them. It is so much more effective as a demonstration of the point if they can try and engage with that in trying to estimate the speed of sound. Being outside the classroom is often really important in getting the point over.

73. Steve Tilling of the Field Studies Council told us about the decline in residential fieldwork:

---

[115] The *Education Act 2002* gives the Secretary of State power to determine the remuneration of school teachers and other conditions of employment of school teachers which relate to their professional duties or working time.

[116] HC (2001–02) 508–I, para 135

[117] Q 122

[118] "Successful science", *Ofsted*, January 2011

> we take well over 20,000 scientists a year and have been for the last 70 years or so. I can tell you categorically that, over the last 20 years, there has been a decline in numbers of scientists going on not just our residential courses but also day courses. In terms of upper secondary groups, there has been a shortening of the experience. It is about half of what it was 15 years ago.[119]

The pattern of decline affects science students more than others. We were told that places in courses run by the Field Studies Council that were once taken up by science students were being replaced by geography groups[120] and that history students were three times more likely to go on a field trip than a science student.[121]

74. It of concern to us therefore that fieldwork, which links the academic side of science to the classroom theory, is where we have heard strongest evidence of a decline in quantity. Dr Tilling of the Field Studies Council, detailing the lack of quality demanded in fieldwork in science GCSE compared with geography, which has a statutory requirement to carry out fieldwork, explained that:

> GCSE for science in terms of fieldwork, for example, is a black hole. It is a neuro-inhibitor. All the practicals tend to be there to deaden the nerve senses, in comparison to geography. For example, in controlled assessment in geography, the students will be asked to make a comparison of the upper and lower regions of a river. It is that broad. They will go away and study the river. The comparison that is made in science, for example, might be a choice chamber experiment over 30 or 40 minutes with woodlice or earthworms. There is a different level of intellectual investment and the type of hands-on work that is going on.[122]

75. There was also concern that fieldwork was something that science students from poorer areas may miss out on. The Field Studies Council [FSC] in its written evidence said:

> In some FSC projects, for example working with [Key Stage]3 and GCSE groups from disadvantaged urban City Challenge schools (2009–2010) up to 80% of the 14-16 year olds had never been on a residential in their school careers (and neither had their parents).[123]

The Council's evidence indicated that greater curricular compulsion could increase numbers, pointing out that "75% of geography groups come from State funded schools, compared to 68% of Science groups".[124] It also indicated that the pupil premium could be used for these kinds of purposes to provide "equitable access by all students to the full range of effective science teaching and learning approaches".[125]

---

[119] Q 45

[120] Ev 53, para 5

[121] Ev 56, para 30

[122] Q 75

[123] Ev 56, para 36

[124] Ev 56, para 37

[125] Ev 57, para 44

76. **We recommend that Ofqual direct examination boards to require a fieldwork component to science courses in which students must collect data as part of fieldwork outside the classroom and prove a level of competence in its analysis and that the Government give clear guidance to schools on how the pupil premium might be used to meet this requirement.**

Field trips

77. As we explained at paragraph 4, we make a distinction between fieldwork and field trips: we define field trips as occasions where students would be taken to visit sites, or events, of interest. Field trips, in this report, focus more on generating enthusiasm and excitement about the subject rather than on directed learning.

78. A contributor to the e-consultation demonstrated the value of such events to students and to the engagement of students with science:

> We haven't been on many science trips, but I found the GCSE Science Live! event[126] utterly inspiring—there were lectures from Steve Jones, Maggie Aderin-Pocock and the like. The lecturers were all incredibly passionate about their subject and everybody who saw that lecture went on to do science at A-Level.[127]

79. The wider science community offers a wide range of schemes and events, often of high quality, to aid science teachers and schools. The CREST awards[128] provide an incentive for students to take part in extra-curricular science activities and recognise that activity by awarding certificates. The National Science and Engineering Competition[129] provides a forum for STEM based projects to compete for a variety of prizes in a national context. Launched in 2009, The Big Bang: UK Young Scientists' and Engineers' Fair[130] is an annual festival of science aimed at young people that culminates in a national event which hosts the finals of the National Science and Engineering Competition.

80. The British Science Association indicated that its CREST award scheme had been evaluated in 2006 by Liverpool University and shown that: "Students had gained knowledge and transferable skills [...] Teachers felt that CREST raised the profile of STEM in the school".[131] Evaluation of the Crest Awards showed that 32% of students who had taken part in the scheme indicated a greater interest in a career in science or in continuing studying science at a higher education level. Evaluation of the Big Bang event showed that 61% of boys and 58% of girls who attended were a little or much more interested in engineering as a career. Engineering UK said that "STEM employers, the net beneficiaries

[126] These are events organised specifically for GCSE students to experience talks by real scientists such as Maggie Aderin-Pocock, Steve Jones and Lord Winston - www.gcsesciencelive.net.

[127] Contributor to the e-consultation, www.thestudentroom.co.uk/showthread.php?p=32097378#post32097378

[128] CREST awards website, 12 July 2011, www.britishscienceassociation.org/web/ccaf/CREST/index.htm

[129] National Science and Engineering Competition, 12 July 2011, www.thebigbangfair.co.uk/nsec/

[130] The Big Bang Fair website, 12 July 2011, www.thebigbangfair.co.uk

[131] Ev 48, para 6

of skilled technicians and graduate engineers, can play a part in assisting schools and colleges to deliver better awareness of STEM career pathways and opportunities".[132]

81. We consider that there is a real need for students to be enthused by science if they are to take it up in greater numbers for GCSE, A level and beyond. The programmes and events we have identified and many not listed here, show how this can be done. The Minister told us that he was keen, as we have already noted, to engage in "exhortation and facilitation".[133] Promoting these programmes and events offers a golden opportunity for the Government to show what exhortation and facilitation can achieve. In our view, the Government has set out a clear policy that it will lead by example, what it calls exhortation and facilitation, not diktat from the centre. The Government must demonstrate how this policy will work and that it will deliver an increased number of students receiving a quality science education. **We recommend that, in its response to this report, the Government set out in detail how its "exhortation and facilitation" policy will work and what ministers will do that is distinct from their predecessors.**

Students taking triple science

82. The current curriculum requires students to take science to the level of GCSE. We are concerned that so few students are provided with the opportunity to take triple science and that these are likely to be the cleverest students. This may contribute to a perception that science is for clever students and may ensure that a range of students are, possibly unintentionally, steered away from considering science as a career path at an early age.

83. The Minister said that the Government wanted to see an increase in students studying scientific subjects:

> both at GCSE and A-level. It has been of concern to us that the numbers taking A-level chemistry and physics dropped from 1996 onwards. There has been a gradual reverse in that trend in recent years, which is welcome. One of the drivers behind the English baccalaureate is to encourage more young people to take the three sciences to GCSE, and that will lead them to being comfortable about taking their subjects to A-level. We also want to make sure that young people are selecting the right subjects at A-level if they want to go on to progress to scientific subjects at degree level.[134]

84. There will be an increasing need for people with a broad range of science skills to meet the needs of industry. These jobs will cover a range from the technician role to more specialised science and technical roles and so there must be a strategy to broaden access to science courses. To ensure people with suitable skills and qualifications are available to fill these jobs, more students need to take triple science and that those studying science develop good practical skills. **We conclude that the Government has to ensure that students appreciate that the practical side of the sciences, as well as the theoretical, can lead to employment opportunities and that the qualifications which are offered facilitate students from among a wider ability range to study triple science at school.**

---

[132] Ev w46, para 22

[133] Q 199

[134] Q 162

Parental attitudes to science

85. When visiting Quintin Kynaston School we asked whether a higher profile science department might be used to promote the school and attract parents. The science teachers and senior managers we spoke to were clear that parents are not influenced by a school's science provision. It is English and maths success that sell a school to parents. If more students are going to study science and the facilities that schools offer to those studying science are to improve, the emphasis needs to change. We see here an opportunity to change perceptions about how schools should be measured and ranked by parents. **We recommend that the Government seek to change this narrow perception of how schools should be measured against each other by promoting, for example in league tables, the various measures of science success such as the number of teachers in the school to achieve chartered status**[135] **and participation by pupils in, for instance, the Crest awards.**[136]

The impact of examinations

86. Myscience, the organisation that runs the Science Learning Centres, told us that:

> A high-stakes assessment culture often leads teachers to focus on only those limited skills that will form the basis of formal assessment. This has resulted in the implementation of practical work [...] designed not for its scientific credentials but [...] the scoring of maximum marks by as many pupils as possible".[137]

Ofsted highlighted, in its report *Successful Science*, that "inspectors note that schools in which practical work was too prescriptive were often influenced too much by the specific ways in which practical work and scientific enquiry skills were assessed for GCSE and, as a result, were less concerned with providing opportunities for wider-ranging investigations".[138]

87. The Department explained that it wanted to assess through formal examination "the ability to undertake effectively practical experiments in laboratory, field and other environments".[139] **We welcome the Department's commitment to assessment of practical skills in and out of the laboratory within the formal examination system. We recommend that the Department implement this within a five year timescale.**

88. Ofsted have told us that more practical lessons contribute to schools improving their provision of science subjects[140] and that poor schools tended to provide poor quality

[135] CSciTeach is a chartered designation which recognises the unique combination of skills, knowledge, understanding and expertise that is required by individuals involved in the specific practice and advancement of science teaching and learning. The Association for Science Education (ASE), as a licensed body of the Science Council, is empowered under the terms of its Royal Charter to award CSciTeach to individuals who meet the requirements. www.ase.org.uk/professional-development/ase-chartered-science-teacher-csciteach/

[136] See para 79.

[137] Ev w114–115, para 2.4

[138] Ev 105, para 4

[139] Ev 45

[140] Ev 104

practical work.[141] Assessment of practical work should therefore be devised to encourage good rather than perpetuate bad practice. In our e-consultation, students' responses to the value of practical work tended to suggest that practicals were limited and focussed very much on meeting the narrow requirements of examination board assessment. For example:

> The exams were all about jumping through hoops, and if I'd known how stupid and time-consuming the coursework was going to be, I might have chosen another subject altogether. Often you got no marks for knowing the topic, just marks for remembering certain phrases within the textbook.
>
> From what I hear from my teachers, there was a lot less 'explain', 'describe', and 'list the advantages of' questions back in their days, and it was all 'proper science' instead of trying to relate it to ethics, geography, social implications etc.[142]

And examinations that do not require practical class work may lead to strange incentives for students:

> I begged my teachers to stop doing practicals and teach on the syllabus. I wish they would stop trying to make it fun and just teach it because in the end all that matters is my grade. My grade depends upon my exams. My exams depend upon the syllabus. Anything else in my opinion is a complete waste of everyone's time.[143]

89. One examination board, AQA, told us that "in the AQA Certificates there is no controlled assessment; instead it is planned that practical skills will be tested in the written examination papers".[144] Another board, OCR, pointed out that "assessment of experimentation in the laboratory and field work is naturally limited by the need to allow tens of thousands of students across the country to undertake similar work and gain similar results"[145] and that "schemes of assessment in many cases assess the skills of the teacher in preparing candidates rather than the abilities of the candidates themselves".[146] In our visit to Quintin Kynaston School we were concerned to be told that, while Quintin Kynaston had explicitly chosen not to, it would be easy to choose a course that focussed on better results rather than better science.

90. Sir Roland Jackson of the British Science Association was concerned that there was a lack of imagination on how science practicals could be assessed:

> science teachers and curriculum developers need to look a little more outside science. Some of the techniques that we are talking about here are perfectly well understood by geography teachers that we have seen and perfectly well understood by, for example, art teachers. It ought not to be beyond the wit of assessors to think about

[141] Ev 104

[142] Quote from e-consultation, www.thestudentroom.co.uk/showthread.php?p=32060289

[143] Quote from e-consultation, www.thestudentroom.co.uk/showthread.php?p=32066900#post32066900

[144] Ev w35, para 5

[145] Ev w29, para 3

[146] Ev w29, para 6

> rather more open-ended techniques that allow people to demonstrate their scientific abilities creatively and not just the way that they can understand the theory.[147]

91. Ofqual told us that "[the examination boards] write their specifications to embody sufficient flexibility to enable each school and college to meet the requirements within the constraints of their resources, geographical location and expertise".[148] We are concerned that, if constraints of resources are taken into account, in particular the poor quality of some school laboratories (see paragraph 60), the result will be that examination boards will not expect the quality of practical work we think necessary in school science courses. To break what might be a cycle of decline, we recommended in paragraph 64 that there should be a minimum standard of laboratory facilities.

92. **To ensure the best possible use of these facilities, we recommend that Ofqual direct examination boards, within five years, to require an examination that properly assesses both students' laboratory skills and their technique and understanding of the experimental process.**

The curriculum

93. The Minister said that the science curriculum was to be slimmed down:

> We want to slim it down and focus on the core knowledge and concepts that we believe all children at school should acquire during that period. The review will also recognise the importance of the practical application of scientific skills, particularly things like measuring, and seeing experiments happen in real life will also be included in the curriculum.[149]

94. Time to get through the curriculum is commonly cited by teachers as a barrier to provision of good quality practicals and field trips.[150] **We welcome the Government's intention to slim down the science curriculum. The Government should seek to ensure that the time gained through the slimming down of the curriculum is used to broaden the teaching of science and its practical aspects rather than more time to revise courses for examinations.**

[147] Q 98

[148] Ev 65, para 9

[149] Q 159

[150] Ev 92, para 16 [The Association for Science Education]

4 Engaging with the science community

95. We wanted to know how well the science community provided the means for teachers to enhance and enrich the science they taught with opportunities to experience real science and to see the interesting things that science might lead them to in later life.

96. In evidence to the inquiry we have received notice of a plethora of resources, often produced independently by the science community, to support science in schools and to provide enhancement and enrichment opportunities.[151] Paul Cohen of the Training and Development Agency told us that:

> In preparing for this session, I was rather overwhelmed by the number of different organisations and websites that are available. I am not in a position to say whether that is confusing for teachers, but clearly it is a bit of a challenge to navigate if you are not an expert, I would have thought.[152]

Beth Gardner of the Council for Learning Outside the Classroom told us that:

> We are trying to have a coherent offer by the whole sector, because schools have told us that things are quite disparate out there, they are being approached by all sorts of different people and it is confusing.[153]

97. Written submissions to the inquiry mentioned or promoted resources or events that individual organisations offered to teachers and schools. We see a real danger that there could be too many choices and not enough guidance on what may be of particular use to teachers, possibly leading to teachers seeing enrichment and enhancement activities as too time consuming to evaluate or utilise properly.

98. Sir Roland Jackson, Chief Executive of the British Science Association, accepted that organisations like his Association, "who feel very passionately about particular areas of science" and want to make opportunities available to young people, could nevertheless result in confusion. He indicated, however, there was a recognition among such organisations that there had to be more coherence on provision.[154] Sir Roland cited the STEM Directories as an example of a project to create greater coherence among providers of enhancement and enrichment activity. He considered that co-ordination of resources was the science community's responsibility and did not think that "anyone can do it for us".[155]

99. We are surprised that not one of the written submissions to the inquiry mentioned the STEM Directories in any detail and only the Department mentioned them in passing. Not even the Royal Institution, which has been responsible for producing and delivering the

[151] Enhancement and enrichment activities is the catch-all term to cover the variety of provisions made by science organisations for field trips and fieldwork for schoolchildren

[152] Q 52

[153] Q 87

[154] Q 88

[155] As above

Directories, first in hard copy and in recent years as a website, cited the Directories to us as a useful tool for the dissemination of information. The Directories would appear to be an ideal central point for teachers to consult when considering what activities might be suitable for any particular group of students. In supplementary evidence requested from the Royal Institution, it said

> The Directories contain information about all the national and regional STEM [Enhancement & Enrichment] schemes, but not those at the local level. Also, one of the criteria in setting up the Directories was that there should be a 'warm body' at the end, i.e. online resources with no human contact were not included. We are fairly certain that nearly all [Enhancement & Enrichment] providers are included in the Directories. [...] The Ri believes that the Directories are an essential resource for the science teaching community, and it would be a great pity if funding could not be found to ensure that they have an increased profile in schools, are regularly kept up-to-date and are continually developed in response to teacher feedback.[156]

100. The Royal Institution has required some evaluation of all opportunities to be carried out and presented on the Directories website to allow teachers to get a better idea of the education opportunities provided.[157] We consider the STEM Directories to be exactly the resource that the Government needs to encourage. The Royal Institution has told us, however, that after the initial three year contract, the Government has only extended the contract for one year.[158]

101. **The Government should seek to secure the long term future of the STEM Directories as a tool to encourage good quality enhancement and enrichment activity, reduce gaps in provision and facilitate more providers and schools to participate. The relatively small amount of money involved should be found directly by Government or by encouraging sponsorship within the science community and providers of enhancement and enrichment activities.**

102. We have been told that the science community is keen to organise itself as far as communicating opportunities to educational establishments are concerned. **We recommend that science organisations build on the STEM Directories[159] and the similar Getting Practical website[160] as useful starting points in providing gateways through which teachers might more easily engage with enrichment and enhancement activities.**

[156] Ev w34–35

[157] Ev w34

[158] Ev w35

[159] The STEM Directories, www.stemdirectories.org.uk

[160] Getting Practical website, www.gettingpractical.org.uk

Conclusions and recommendations

The value of practical experience and good guidance

1. We conclude that both practical lessons and learning outside the classroom are essential contributors to good quality science education. (Paragraph 21)

2. We found no convincing evidence that health and safety legislation itself prevents science practicals or field trips. (Paragraph 30)

3. We recommend that the Government work to establish a central repository or facility (or network of such facilities with a common interface) which will contain details and guidance on standard experiments. This facility should provide access, for member schools, to any CLEAPSS provided health and safety guidance for those experiments. (Paragraph 37)

Continuing skill development for teachers

4. We strongly recommend that Ofsted report on how effectively schools provide opportunities for their science teachers to stay up to date with their science specialism, specifically in attendance of externally provided subject training, as part of Schedule 5 inspections under the current heading of "*The effectiveness of leadership and management in embedding ambition and driving improvement*". (Paragraph 55)

5. We have not been convinced of the merits of an accredited course, which was advanced by Professor King of the Earth Science Teachers' Association but we do recommend that all trainee science teachers should be expected to prepare successfully and lead at least one fieldwork session themselves, and to take part in a field trip before acquiring qualified teacher status. (Paragraph 57)

6. The Government should require that, in order to advance over pay thresholds, a science teacher should demonstrate he or she has maintained the practical classroom skills, fieldwork and associated risk assessment skills necessary to be a good science teacher. (Paragraph 59)

The importance of technical support and quality facilities

7. A school providing science courses at GCSE and A level should be required to demonstrate, during Ofsted inspection, it has ready access to a basic suite of facilities such as fume cupboards to facilitate rigorous examination of science skills. It would be incumbent on the Government to identify what a basic suite of facilities would be for the benefit of both senior management teams and examination boards. (Paragraph 64)

8. We reiterate the recommendation of our predecessor committee for action to be taken to "address the appalling pay and conditions of science technicians and to create a career structure that will attract skilled and dedicated people to work as technicians". (Paragraph 69)

9. We recommend that, when carrying out a Schedule 5 inspection, Ofsted should explicitly report on the management of science laboratories and, during a specialist science visit, the relationship between teachers and technical staff in the planning and delivery of practical lessons should be a key part of that inspection. (Paragraph 71)

Using examinations to drive fieldwork

10. We recommend that Ofqual direct examination boards to require a fieldwork component to science courses in which students must collect data as part of fieldwork outside the classroom and prove a level of competence in its analysis and that the Government give clear guidance to schools on how the pupil premium might be used to meet this requirement. (Paragraph 76)

The use of exhortation and facilitation

11. We recommend that, in its response to this report, the Government set out in detail how its "exhortation and facilitation" policy will work and what ministers will do that is distinct from their predecessors. (Paragraph 81)

12. We conclude that the Government has to ensure that students appreciate that the practical side of the sciences, as well as the theoretical, can lead to employment opportunities and that the qualifications which are offered facilitate students from among a wider ability range to study triple science at school. (Paragraph 84)

13. We recommend that the Government seek to change this narrow perception of how schools should be measured against each other by promoting, for example in league tables, the various measures of science success such as the number of teachers in the school to achieve chartered status and participation by pupils in, for instance, the Crest awards. (Paragraph 85)

Using examinations to drive practical science skills

14. We welcome the Department's commitment to assessment of practical skills in and out of the laboratory within the formal examination system. We recommend that the Department implement this within a five year timescale. (Paragraph 87)

15. To ensure the best possible use of these facilities, we recommend that Ofqual direct examination boards, within five years, to require an examination that properly assesses both students' laboratory skills and their technique and understanding of the experimental process. (Paragraph 92)

Enhancing and enriching the science curriculum

16. We welcome the Government's intention to slim down the science curriculum. The Government should seek to ensure that the time gained through the slimming down of the curriculum is used to broaden the teaching of science and its practical aspects rather than more time to revise courses for examinations. (Paragraph 94)

17. The Government should seek to secure the long term future of the STEM Directories as a tool to encourage good quality enhancement and enrichment activity, reduce gaps in provision and facilitate more providers and schools to participate. The relatively small amount of money involved should be found directly by Government or by encouraging sponsorship within the science community and providers of enhancement and enrichment activities. (Paragraph 101)

18. We recommend that science organisations build on the STEM Directories and the similar Getting Practical website as useful starting points in providing gateways through which teachers might more easily engage with enrichment and enhancement activities. (Paragraph 102)

Annex: summary of the main points from the e-consultation

Background

We wanted to hear views from students at school. Rather than through formal evidence sessions we gathered views from an e-consultation exercise. This had the advantage that we could hear from much wider ranges of students than could be heard at an oral evidence session and it filled a gap in the written material evidence as we received no written submission from students at school. The Student Room[161] (TSR) was identified as an appropriate external partner.

The TSR site is open to people at any stage of education, although the majority of its users fall within the 14 to 24 years age range. TSR has in the past worked with a number of government departments on student online engagement projects. TSR has also recently undertaken some collaborative work with the House of Commons Education Committee to gather contributions for its inquiry into youth services.[162]

Details

The e-consultation started with three subjects or "threads" launched on the website on 7 June.[163] Each thread focused on one aspect of practical science in schools with the headline questions below used as starting points:

a) What motivated you to study science at GCSE or A-level?

b) In your experience, how often do/did your science lessons involve practical experiments or field trips?

c) What value do you think practicals bring to your science education?

The exercise ended on 8 July, by which time 179 contributors to the consultation had posted 277 entries across the three topics or "conversation threads". By 18 July, contributions to the discussion had been viewed 6,588 times, which—at just under 24 views per post—indicates a much larger audience than the contributions would suggest.

There were 24 contributors that posted three times or more. The thread that attracted most interest was the question on motivation (125 of the 277 posts were on this topic).

[161] The Student Room, www.thestudentroom.co.uk. TSR is a large online student community with more than 500,000 registered members, 2.8 million unique users per month and more than 16 million posts across 280+ forums. The site itself is a provider of peer support services to students with young people visiting to get homework help, inform education choices and get social and emotional support.

[162] www.thestudentroom.co.uk/youthservices

[163] www.thestudentroom.co.uk/practicalscience
All the quotes in this annex are taken from the three conversation threads associated with this page.

Conversation Threads

Motivation to study science (Question 1)

Of 95 contributors discussing motivation to study science just under half (44, that is 46%) indicated that it might to some degree be related to the opportunity to carry out practicals or go on field trips.

There were few contributors that indicated that the motivation to study science came to a large measure from practicals they had carried out or of those they hoped to do.

There was frequent reference to the need to study the subjects that related to future jobs or university courses. This was a by far the most common response in the thread. Indeed some of the contributors suggested that the courses were made worse by the practical elements and that the teachers should have dropped them and focussed instead on matters that would improve grades. One student wrote:

> I begged my teachers to stop doing practicals and teach on the syllabus. I wish they would stop trying to make it fun and just teach it because in the end all that matters is my grade. My grade depends upon my exams. My exams depend upon the syllabus. Anything else in my opinion is a complete waste of everyone's time.

Where students discussed inspiration it was often attributed to an inspiring teacher or a science event. One contributor explained what she thought would motivate people to choose science:

> there should be greater opportunities for interested students to do taster sessions in more 'exciting' areas of science. It's obviously very important for people to get a good grounding in the basics, or they'll never be prepared for higher studies, but the problem is that the things that sound really flash and tell you a lot about the nature of the universe—astrophysics, for example—aren't really introduced in any depth until GCSE/a-level, by which point you've lost a lot of students. As well as skills like writing down chemical formulae or whatever, I think you also need to show people what greater meaning scientific ideas can have, and how they can describe big things that people are often interested in.

There were also some comments about the courses arranged by the wider science community but many commented on how inaccessible they were rather than how good:

> I think that schemes such as the Nuffield Bursary should be more highly advertised in schools as well. I only found out about it the other week, and by then it was too late for me to apply;

and one who commented on content as well as access:

> I realise that schemes like this exist (I did a silver CREST award at the end of Y8, and I really enjoyed it) but they don't seem to be widely publicised or put into place, at least in my experience.

Frequency of practicals (Question 2)

There was a range of experiences among contributors. From regular science practical classes to hardly any experience of practicals, with the bulk of experience tending towards latter end of the spectrum. There were two patterns among responses. One was that the number of practicals appeared to decrease as students progressed through the school, for example:

> At KS3 we were doing practicals at least 1 once a week and we had 3 lessons per week. At GCSE we were promised at least 1 practical per week out of our 5 lessons. We are lucky to get 1 practical a month to be honest. It has made science for me really boring.

Alternatively, it was recorded that the practicals carried out were only those absolutely necessary "once this year—for the [Internal Assessment Activities] in all three topics".

In addition, there appeared to be a variation across the subjects. Biology was often quoted as the least likely science subject to provide practicals, physics being better and chemistry being the most likely to have practicals in class.

The second pattern was the almost complete absence of science field trip experiences among respondents. There were one or two respondents who cited a trip to an observatory and one to CERN but the vast majority told us there was a complete lack of field trips from within the science courses they experienced.

Value of practicals (Question 3)

When discussing the value of field trips and practicals 42 of the 59 (71%) contributors considered that practicals and field trips were of value. On the question of value contributors spoke of practicals as showing how theory worked in practice and did not appear to value them as deliverers of practical skills. Contributors were more inclined to explain the pedagogical use of practicals, for example:

> Practical experiments give meaning to theory. I'm not saying that all theory should be demonstrated and worked at hands on, but as someone mentioned before the use of videos is a good way of showing the outcome and elaborating on the theory, not old video tape cheesy science videos, but more modern real world videos, such as those on youtube. Science isn't purely about knowledge, it's about "what do I know, and How can I use it", and practical work can play a big part of that.

None of the contributors said that practical classes needed to deliver practical skills that would be of use in possible future careers. The one response that did mention the use of practical skills was more focussed on university than any future employment:

> The only use [practical classes] have is [to] develop practical skills for university science courses such as chemistry where you get proper lab time.

The contributors focussed mainly about how the practicals might improve their understanding of the theoretical knowledge of the subject; most did not mention that they might develop laboratory skills that would be of practical use in later life.

Formal Minutes

Wednesday 7 September 2011

Members present:

Andrew Miller, in the Chair

Gavin Barwell	Stephen Mosley
Stephen Metcalfe	Graham Stringer
David Morris	Roger Williams

Draft Report (*Practical experiments in school science lessons and science field trips*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 102 read and agreed to.

Annex and Summary agreed to.

Resolved, That the Report be the Ninth Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

Written evidence was ordered to be reported to the House for placing in the Library and Parliamentary Archives.

[Adjourned till Wednesday 14 September at 9.00 am

Witnesses

Wednesday 15 June 2011

Page

Wednesday 29 June 2011

Monday 4 July 2011

List of printed written evidence

(published in Volume II)

List of additional written evidence

(published in Volume III on the Committee's website www.parliament.uk/science)

List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2010–12

First Special Report	The Legacy Report: Government Response to the Committee's Ninth Report of Session 2009–10	HC 370
First Report	The Reviews into the University of East Anglia's Climatic Research Unit's E-mails	HC 444 (HC 496)
Second Report	Technology and Innovation Centres	HC 618 (HC 1041)
Third Report	Scientific advice and evidence in emergencies	HC 498 (HC 1042 and HC 1139)
Second Special Report	The Reviews into the University of East Anglia's Climatic Research Unit's E-mails: Government Response to the Committee's First Report of Session 2010–12	HC 496
Fourth Report	Astronomy and Particle Physics	HC 806 (HC 1425)
Fifth Report	Strategically important metals	HC 726
Third Special Report	Technology and Innovation Centres: Government Response to the Committee's Second Report of Session 2010–12	HC 1041
Fourth Special Report	Scientific advice and evidence in emergencies: Government Response to the Committee's Third Report of Session 2010–12	HC 1042
Sixth Report	UK Centre for Medical Research and Innovation (UKCMRI)	HC 727
Fifth Special Report	Bioengineering: Government Response to the Committee's Seventh Report of 2009–10	HC 1138
Sixth Special Report	Scientific advice and evidence in emergencies: Supplementary Government Response to the Committee's Third Report of Session 2010–12	HC 1139
Seventh Report	The Forensic Science Service	HC 855
Eighth Report	Peer review in scientific publications	HC 856