

Assessment of Practical Work in GCSE Science

Analysis of Consultation Responses



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Ofqual/15/5624

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Summary

We have consulted about GCSE science twice. In 2013, we suggested that students' practical science work should be assessed by non-exam assessment, counting for 10 per cent of the marks.¹ People who responded to our consultation had mixed views about that, and we have discussed fresh options with teachers, subject associations and others.

Our second consultations was held from December 2014 to February 2015. This document analyses the responses to that second consultation, in which we sought views on our proposals for students' knowledge, understanding and application of practical procedures and techniques in science to be assessed by exam and confirmed through a school and student record.

Responses received

We received 172 responses to our second consultation. Of those, 164 used the consultation document, answering the closed questions. The remaining 8 respondents submitted comments in a non-standard format. These submissions were manually inputted to the online database; they tend to be more detailed and therefore the responses were coded in accordance with the code frame for the open questions. A diverse range of stakeholders responded. These included teachers and schools, awarding organisations, subject associations and learned societies, teacher representative groups, unions and employer and business groups. Of the 172 responses, 134 (78 per cent) were a "Personal view" and 38 (22 per cent) were classed as an "Official response from an organisation".

Pie charts summarising the quantitative responses to our consultation are supplied in Appendix 2. For some of the questions the degree of agreement and disagreement summarised in the pie charts varies by stakeholder groups and this has been reported accordingly in Section 4 Key findings and themes.

The comments provided by the respondents:

- provided good justifications for agreement with the proposals;
- highlighted the core issues related to the proposals;
- were sometimes about issues that were not consulted on or related to details not covered in the consultation.

¹ <http://webarchive.nationalarchives.gov.uk/20140813095715/http://www.ofqual.gov.uk/files/2013-06-11-gcse-reform-consultation-june-2013.pdf>

In addition, analysis of the comments shows that there is not always a correlation between the answer to the closed question and the nature of the comment made. Details of the qualitative responses to the consultation are provided in Section 4 Key findings and themes.

Summary of results

The majority of the proposals outlined in the consultation were well received, with all receiving 50 per cent agreement or more, apart from one of the questions asked. (This was Question 1k which asked about the weighting of mathematical skills in the different science subjects.)

Overarching views

Over 60 per cent of responses (100 of 160 respondents who responded to this question) agreed that the proposals present the best balance to achieve the delivery of the curriculum aims, encourage a wide range of practical science teaching, provide valid and reliable assessments, be manageable for schools and withstand accountability pressures. The proposals were cited as an improvement over the current model. The most frequent reason given for support of the proposals (20 comments) related to the removal of assessment pressures from teachers. The key comments where respondents answered “Neither agree nor disagree” or “Disagree” referred to concerns about the record-keeping and monitoring arrangements becoming burdensome. Of the 51 respondents who believed that there was a better option than that presented in the proposals, 12 wanted the assessment of practical activities to contribute to the final qualification grade. Without this they believed there will be a decrease in the amount of practical work carried out in school.

Use of questions in the exam papers

There was strong agreement with the proposal to assess practical work via questions in the exam; 80 per cent (130) of the standard-format responses approved of the proposal. Most of the comments from respondents stated that the proposal will ensure teachers provide a range of opportunities to conduct practical work and will raise students’ motivation and interest in science. Overall, teachers were supportive, reiterating that these proposals would reduce the pressures they faced with controlled assessment, giving them independence to teach and offer a range of practicals. Other stakeholders felt this would ensure teachers will teach the practicals and that the 15 per cent would demonstrate the importance of these skills. Concerns were raised by some stakeholders that 15 per cent represented a reduction in emphasis on practical skills. The need for appropriate and valid questions was also highlighted as a concern by all the respondent groups.

Number of practical activities and list of apparatus and techniques

The requirement to undertake eight practical activities was positively met, with over 60 per cent (99 of 163 respondents) agreeing with the proposal; this was reasonably consistent across the respondent groups. A number of respondents highlighted the risk of teachers reducing the number from those completed at present and concentrating on the examinations only.²

Over 60 per cent (101 of 159 respondents) approved of the proposal to provide a list of apparatus and techniques. The majority of awarding organisations raised some general and specific issues with the apparatus and techniques listed but not the proposal for a list itself. They raised concerns about the availability of the apparatus listed and about the different ways in which the requirements were set out in physics in comparison with biology and chemistry. Responses from teachers focused almost exclusively on the availability and increased expense in providing some of the apparatus specified.

Impact on teaching and learning

There was agreement with the proposal that students will be more likely to be given opportunities to undertake a wide and varied range of practicals if such work itself is not assessed (59 per cent; 94 of 159 respondents). Respondents commented that this would allow more focus on a range of practicals and would encourage exploration and greater understanding of scientific matter. However, nearly 25 per cent (39 of 159 respondents) were unconvinced that this was a good idea. They believed it may result in the devaluing of practical skills and lead to less time spent on them.

School and student records

There was over 50 per cent support (86 of 161 respondents) for the proposal that students will be given opportunities to complete the practical work if schools are required to confirm this in writing to their exam board. These respondents felt this requirement would incentivise teachers and will highlight to school leaders and senior management teams the importance of the practical requirements and ensure they authorise the budget and time for them. A relatively high number of respondents (17 per cent; 28 respondents) were unsure about this question. Respondents who disagreed with the proposal (29 per cent, or 47 respondents) expressed concerns about this requirement that related to the monitoring becoming a bureaucratic burden. A few respondents also expressed a view that as the exam results provide a 'check' through the questions relating to practical activities, further confirmation from the school was unnecessary.

² The minimum number of practical activities proposed in the consultation is significantly higher than is required currently by controlled assessments.

Exactly 50 per cent of responses (81 of 162 respondents) supported the idea of a student record with, again, a high number unsure (20 per cent; 33 respondents). Comments from respondents were most divided on this proposal. Overall they valued the student record concept as it provided students with a developmental and revision tool. Concerns were raised, however, about how it would work in practice, the impact it would have on teacher and learner behaviour and manageability issues. A 'lab book' was the most frequently suggested form for a student record (24 mentions) but the need for simplicity was a key theme (21 mentions).

Direct assessment of practical skills

Responses from across the respondent groups were against the idea that teachers directly assess science practicals (67 per cent; 110 of 163 respondents) due to this being unmanageable for qualifications of this type. Respondents stated that direct assessment is impractical and that the time it takes to adequately assess makes it impossible for a qualification the size of a GCSE and given the student numbers involved. In addition, a number of responses stated that if teachers directly assessed the practicals there is potential for the pressures of the accountability system to place them in an unmanageable position (where they are acting as the assessor and being judged themselves through the outcomes of the assessments they make), as found currently in controlled assessments.

Assessment objectives and weightings

In all, 73 per cent (115 of 158 respondents) agreed with the assessment objectives and most were particularly pleased with the references to practical skills they included. In contrast, all the awarding organisations disagreed with the proposed set of weightings. They presented alternative proposals with a greater weighting on assessment objective 1 and a lower weighting on assessment objective 3, citing consistency with A level and the relative demand of the assessment objectives as the rationale. Other respondents also questioned the weighting of assessment objective 3 for students entered for the lower tier.

Teachers, awarding organisations and stakeholders agreed (68 per cent; 106 of 155 responses) that the weighting given to assessment objectives should be the same at each tier.

Assessment of mathematical skills

The proposal for no less than 15 per cent of the marks to be for the demonstration of mathematical skills in each of the sciences had fairly low agreement at 41 per cent (66 of 159 respondents). Similarly, the proposal that the weighting of mathematical skills should be the same in each subject had a low agreement rate at 31 per cent (50 of 159 respondents). Teachers, awarding organisations and stakeholders recommend that it should be 20 to 25 per cent for physics, 15 to 20 per cent for chemistry, 10 to 15 per cent for biology and 15 per cent for combined sciences.

1 Introduction

In February 2013, the Secretary of State for Education announced proposals for the comprehensive reform of GCSEs. The reform of GCSEs is intended to make them more challenging so pupils are better prepared for further academic or vocational study, or for work.³

We are responsible for ensuring that the reformed GCSE qualifications are of the right standard and in line with Government policy aims. The Department for Education (DfE) is leading on the development of subject content, and we are responsible for regulatory arrangements around the design of the qualifications, assessment structures and the reporting of outcomes of GCSEs.⁴

Our reform of GCSE science takes place in the context of the wider reform programme. The main features of new GCSEs are:

1. A new grading scale of 9 to 1 will be used, with 9 being the top grade. This will allow greater differentiation between students and will help distinguish the new GCSEs from previous versions.
2. Assessment will be mainly by exam, with other types of assessment used only where they are needed to test essential skills.
3. There will be new, more demanding content, which has been developed by government and the exam boards.
4. Courses will be designed for two years of study – they will no longer be divided into different modules and students will take all their exams in one period at the end of their course.
5. Exams can only be split into ‘foundation tier’ and ‘higher tier’ if one exam paper would not be able to give all students the opportunity to show their knowledge and abilities.
6. Resit opportunities will only be available each November in English language and mathematics.

GCSE science is being reformed for first teaching in September 2016, with the first results issued in August 2018.

³ www.gov.uk/government/policies/reforming-qualifications-and-the-curriculum-to-better-prepare-pupils-for-life-after-school/supporting-pages/gcse-reform

⁴ www.gov.uk/government/organisations/ofqual/about. See also Appendix 1 “Ofqual’s role, objectives and duties”.

2 Context

This is the second time we have consulted about GCSE science. In 2013 we suggested that students' practical science work should be assessed by non-exam assessment, counting for 10 per cent of the marks.⁵ People who responded to our consultation had mixed views about that, and we have discussed fresh options with teachers, subject associations and others, as well as undertaking a large amount of research.

We found that the current approach involving controlled assessments is failing in two main ways. First, it is not producing sufficiently valid and reliable assessments, since controlled assessments focus entirely on the indirect assessment of practical skills and are not effectively discriminating between students' performances. Secondly, the pressures of the system are having an adverse effect on teaching and learning. Teachers are focusing on a very small range of practical activities and students are not receiving the range of experience required for a rounded science education. These pressures in the system are also contributing to the issues with how effectively these teacher-marked assessments are discriminating.

Our findings, as well as work we did subsequently on A level science, meant that we needed to consult again on a new set of proposals. In this consultation, we laid out our reasons for proposing changes to how practical work in science GCSEs is assessed. We examined different models of assessment, and outlined the potential benefits and deficiencies of each one.

We looked for the approach that can best meet the aims to:

- deliver the curriculum aims and encourage a wide range of practical science teaching over the period of study;
- be manageable for schools – taking into account the numbers of students who take science GCSEs, the range of ability and the time typically allocated to each subject;
- provide valid and reliable assessments – testing the right things and doing this accurately and consistently, so as to differentiate effectively between students' performance;
- be able to withstand accountability pressures, that is, to avoid exerting unmanageable contradictions on teachers where they are acting as the

⁵ <http://webarchive.nationalarchives.gov.uk/20140813095715/http://www.ofqual.gov.uk/files/2013-06-11-gcse-reform-consultation-june-2013.pdf>

assessor and being judged themselves through the outcomes of the assessments they make – the results of their students.

The consultation sought views on our proposals for students' knowledge, understanding and application of practical procedures and techniques in science to be assessed by exam and confirmed through a school and student record. In summary, our main proposals were as follows.

- Written exams would include questions that draw on students' practical science experience. At least 15 per cent of marks for each GCSE would be allocated to these. The questions would be designed to give students with practical experience a real advantage over those without.
- GCSE specifications would set out the apparatus students should use and the techniques they should develop, together with a minimum of eight practical activities (16 for combined science) they should do during the course using the specified apparatus and techniques.
- Students would each keep a record of their practical work, to be made available to their exam board on request.
- Schools would then confirm to their exam board that each student has completed the practical activities and so has used the required apparatus and developed the required techniques. This submission of the school record would be a pre-requisite ahead of exams.

We believe this approach addresses many of the current problems. It should broaden the range of practical work undertaken by students in science GCSEs over that in the current qualifications and enable students to develop good hands-on skills.

Our consultation asked people to respond to a variety of questions about our proposals, and invited them to suggest alternative or additional options that might meet the same aims. We also proposed and asked questions about assessment objectives, the assessment of mathematical skills in science subjects, and the specific apparatus and techniques that might be used and demonstrated by students in the new GCSEs.

3 The consultation process

Consultation method

This consultation ran from December 2014 to February 2015 for an eight-week period. It was open to anyone to respond. Respondents were encouraged to submit their response to the consultation through an online survey or via hard copy or email.

The consultation asked about our proposals for the future assessment of practical work in GCSE science. It included closed questions and also provided the opportunity for respondents to make comments. This was in order to elicit both explicit levels of agreement, and more detailed views on the proposals. The list of consultation questions and the number of responses received for each question are presented in Appendix 2.

A series of “Your details” questions was included in the consultation in order to understand whether each response was an “Official response from an organisation” or a “Personal view”. Following this categorisation, respondents were further classified using several detailed questions on their personal or organisational characteristics. These categorisations provided the basis for sub-groups by which the responses to the consultation have been analysed.

Respondent profile

Respondents to this consultation maintained a high level of engagement. Of the 172 respondents, 164 used the consultation document, answering the closed questions. The remaining 8 respondents submitted comments in a non-standard format, and are therefore not represented in the quantitative data. Their views and comments have, however, been taken into account in this evaluation.

Of the respondents who answered the closed questions, response rates to individual questions ranged from 100 per cent to a low of 90 per cent. If the equality impact questions are excluded, the lowest rate of response was 94.5 per cent (to Question 1i, which asked about assessment objective weightings at different tiers).

Of the 172 responses, 134 (78 per cent) were a ‘Personal view’ and 38 (22 per cent) were classed as an “Official response from an organisation”. The majority of personal views were from teachers (89 per cent; 119 of 134 respondents) and those remaining were from “Educational specialists”, with a single person who classified themselves as “General public” also responding. A breakdown of responses received is provided in Figure 1. In terms of the official responses from organisations, the majority were from representative and interest groups followed by schools, awarding organisations, local authorities and a single employer. The category “Representative and interest groups” includes the following categories:

Figure 1

Type of respondent	Number
Union	3
Subject association or learned society	7
School, college or teacher representative group	4
Unspecified	2
Employer or business group	1

The single respondent who classified themselves as an employer was the Field Studies Council (FSC). From our point of view, the FSC more closely resembles an interest group, and we have therefore treated their comments as such. We have, however, included them as an “Employer” in the quantitative data.

A list of official respondents can be found in Appendix 3.

Figure 2

Type of respondent	Total	Per cent
Official response from an organisation/group	38	22.1%
Awarding organisation	4	2.3%
Employer	1	0.6%
Local authority	2	1.2%
Other representative or interest group	17	9.9%
School or college	14	8.1%
Personal views	134	77.9%
Educational specialist	14	8.1%
General public	1	0.6%
Teacher	119	69.2%
Total	172	100.0%

Analysis approach

The approach to the analysis was:

- Closed questions are presented in tables with the frequencies of responses against each answer.

- The opportunity for open-ended comments with each closed question promoted varied responses, ranging from generalised comments about the proposals, to comments about specific issues related to them. Using the responses received, a code frame was developed to group responses to each question into categories. This enabled a summary of the themes reflected in the responses to be quantified.
- Submissions received in other formats were manually inputted into the online database. These submissions tended to be more detailed and therefore the responses were coded in accordance with the code frame for the open questions described above. These responses were not coded to the closed questions as the coder would need to make a judgement about the respondent's view. By including them in the main database the responses were analysed and reported in the overall frequencies. In addition, these responses were also reviewed as a whole, in order to understand the strength of the key themes emerging from them.
- The analysis framework used for each question was: closed questions with open responses themes; differences in stakeholder responses; and key stakeholder and themes analysis.
- For the analysis and reporting of the responses, the respondents were categorised into three groups:
 - teachers (includes teachers and school responses)
 - awarding organisations
 - other organisations (includes local authorities, subject bodies and representative and interest groups)

Limitations of the consultation analysis

Limitations of the analysis are:

- Of the official responses, 37 per cent were views from schools and colleges. The similarity of views between these official responses and the personal views of teachers is such that they were reviewed together, and are included as a single group in the stakeholder analysis section of the report.
- In general the consultation did not ask explicitly about individual science subjects and therefore any analysis by subject can only be led by the contents of respondents' comments. We asked questions such as whether the weighting of mathematical skills should be consistent across the different subjects – these were the most likely to produce comments that specifically related to individual science subjects.

- The qualitative comments, where possible and appropriate, have been quantified in order to get a view of how widespread was an individual view or theme. In some cases, individual comments relating to the proposal were judged to be important – for example if they expressed a view held by a number of respondents – and are therefore quoted.
- There were 9 occasions where more than one person from an organisation submitted a response. Of these, 8 are schools and one is an interest group (Association for Science Education); they were all personal responses.

4 Key findings and themes

Practical work proposals: exams

Question 1a: GCSE science students will be given appropriate opportunities to complete a range of practical work if exam questions reward those who can draw on their practical experiences.

This statement had a very high level of agreement among those who responded to the closed question in the consultation. Approximately 80 per cent (132 of 164 respondents) agreed or strongly agreed. Of the 32 official responses, 25 per cent (8 respondents) disagreed or strongly disagreed. Among the 131 individual responses, only 11.5 per cent (15 respondents) disagreed or strongly disagreed with the statement.

Figure 3

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/group	11	12	1	4	4	32
Awarding organisation	3	1				4
Employer					1	1
Local authority	1	1				2
Other representative or interest group	1	6		2	2	11
School or college	6	4	1	2	1	14
Personal views	54	55	7	11	4	131
Educational specialist	2	7	1	2	1	13
General public				1		1
Teacher	52	48	6	8	3	117
Total	65	67	8	15	8	163
Total percentage	39.9%	41.1%	4.9%	9.2%	4.9%	

Most of the respondents offering comments on this statement were very positive in relation to the proposal. The main strengths outlined by respondents were that it will encourage a thorough understanding of scientific methodology and its application. Respondents mentioned the separate, but related, proposal for a minimum of eight practicals (which was not formally part of this question) as a much better concept than the current approach whereby students are often only assessed on only one.

The respondents stated that the proposal will ensure teachers provide a range of opportunities to conduct practical work and it will raise students' motivation and interest in science. The proposal was also commended (10 comments) for aligning with IGCSE approaches, which are considered effective assessment forms.

Although most respondents agreed with the proposal, some concerns were expressed regarding the availability of adequate resources in all schools. Some respondents felt that because the practical work itself is not assessed this may result in tactical strategies, such as assigning limited time and resources to practical science, and instead using the time to prepare for exams. In addition, there were concerns that some teachers may use videos and demonstrations and only explain to students how to conduct the practicals, rather than having students undertake the practicals themselves. Some respondents were concerned that the practicals may be too prescriptive and may result in questions in exams that are increasingly predictable.

In addition, respondents highlighted the importance of ensuring the exam questions are appropriate. They felt that these questions must differentiate in such a way as to enable candidates to demonstrate, and be credited for, their experience of practical work.

Finally, those that disagreed were not convinced that the proposal to assess students' knowledge, understanding and application of practical procedures and techniques in science through written examinations would test the experience of practical skills adequately or completely.

For example:

The usual types of exam questions on practical work that exam boards use in written papers cover a narrow range of skills – usually tabulation of data, graph drawing & interpretation. This is not valid coverage of the learning experiences that we want for practical science. We also know from APU research that performance on written questions about practical [sic] do not correlate with performance when observed doing practicals and so they may be measuring something else other than the direct process skill intended. This renders them unreliable.

Educational expert

This will depend on:

- whether exam questions can indeed distinguish those who have undertaken the practical work from those who have not
- the extent to which higher marks are accessed according to the level of skill the student gained in that practical work

- whether all teachers are equally convinced that there is no alternative teaching method other than undertaking the practical work
- whether in any single exam series it is possible to assess the full range of practical skills developed during the preceding years of learning

If these conditions are not fulfilled, and the exam questions do not properly assess the range of practical work, then there is a significant risk that some schools will reduce their funding for practical science and fewer practical experiences will be on offer.

Gatsby Charitable Foundation

Question 1b: At least 15 per cent of the marks in science GCSE exams should be allocated to questions drawing on students' practical science experiences.

This proposal received a similar response to question 1a. Of the 163 responses, there was a slight fall in the number of people agreeing with the statement (down to 75 per cent), which was compensated for by a larger proportion (9 per cent) answering "Neither agree nor disagree". The difference in the proportion of disagreement between personal and organisational responses was less apparent than in Question 1a, there being only a 4 per cent difference.

Figure 4

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	13	13		3	3	32
Awarding organisation	3	1				4
Employer					1	1
Local authority	1	1				2
Other representative or interest group	4	3		2	2	11
School or college	5	8		1		14
Personal views	45	52	15	15	4	131
Educational specialist	3	4	1	3	2	13
General public				1		1
Teacher	42	48	14	11	2	117
Total	58	65	15	18	7	163
Total percentage	35.6%	39.9%	9.2%	11%	4.3%	

Very few respondents suggested that the proportion of marks allocated to exam questions drawing on students' practical science experience should be less than 15 per cent. They argued that if it were, it would be meaningless and a token gesture, which might result in teachers allocating less teaching time to practical skills. The majority thought 15 per cent was sufficient to encourage practicals in the classroom and to ensure those students with strong practical and problem solving skills are rewarded accordingly.

Of the 163 respondents, 30 (18 per cent) suggested a higher percentage of 20 to 25 per cent, noting that this was closer to the current arrangements where controlled assessment accounts for 25 per cent of the qualification. These suggestions came from both those who agreed and those who disagreed with the proposal. Of these 30 responses, 5 were from a representative or interest group (Council for Learning Outside the Classroom, Field Studies Council, Association of School and College Leaders, Gatsby Charitable Foundation and SCORE).

The importance of valid questions was highlighted, again by both those that agreed and those that disagreed with the proposal. The comments included some repeated themes:

- quality and variation in questions is needed

- questions should be thought-out and consider the best way to assess a certain body of knowledge
- the right balance between theoretical knowledge and practical questions needs to be struck

Those that disagreed felt that this proposal is dependent on the quality of the questions and what is being assessed. Greater clarification and guidance on how it would work for combined science was recommended.

Question 1c: Science GCSE students will be more likely to be given opportunities to undertake a wide and varied range of practical work if such work is focused on teaching and learning and is not itself assessed.

There were 159 responses to this question. A quarter (39 of 159 respondents) of these disagreed or strongly disagreed with the statement, and about 60 per cent (94 of 159 respondents) agreed or strongly agreed. Responses from “Other representative or interest group” were the only category in which a higher proportion expressed disagreement than agreement – of the 11 responses from this group, 5 disagreed, while 4 agreed and 2 were unsure.

Figure 5

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	8	9	5	7	3	32
Awarding organisation	2	1	1			4
Employer					1	1
Local authority		1		1		2
Other representative or interest group	1	3	2	4	1	11
School or college	5	4	2	2	1	14
Personal views	48	29	21	18	11	127
Educational specialist	3	2	2	3	2	12
General public					1	1
Teacher	45	27	19	15	8	114
Total	56	38	26	25	14	159
Total percentage	35.2%	23.9%	16.4%	15.7%	8.8%	

The majority of the comments for this proposal were positive. Of the 94 respondents who agreed, 36 stated the proposal and the resulting removal of controlled assessment would free up teachers' and students' time to conduct practicals, would lead to a greater range of practicals and would encourage exploration and greater understanding of scientific matter. The respondents felt the proposal would promote students' interest and engagement while developing the necessary skills.

Respondents' comments included:

There is a danger that assessed practical work can lead to narrowing of opportunities to ensure the maximum marks are gained for a narrow range of experiences (as in the present system of assessment of practical work using a narrow range of Controlled Assessment tasks). The proposed arrangement significantly reduces this risk, and helps to shift the focus to practical work to support teaching and learning.

University of York Science Education Group

At the moment we spend half a term devoted to coursework, so 1/12th of the teaching time. Because of this we then rush teaching the theory which leads to less overall practical work. We still do lots of practicals at my school, but we could spend more time on them if coursework is abolished.

Teacher

There are two main reasons that respondents disagreed with this statement.

- If practicals are not 'formally assessed' (by which respondents mean marks contribute to the overall grade), teachers will not value them and will not spend sufficient time teaching them. This may manifest itself by teachers simply demonstrating practicals, or not engaging with practicals at all.
- For the same reasons, schools and colleges will not devote sufficient resources (laboratory space, equipment, timetabling and so on) to science departments, meaning that even teachers who want to complete practicals may not be able to do so.

If practical work is not assessed, the reality is that it will not happen in many schools. Firstly, because teachers may not give it the priority it deserves. Secondly, because, despite the good intentions of many science teachers, funding of science departments would diminish if practical work is not directly assessed.

Teacher

Some respondents noted that rather than abandoning practicals altogether, schools, colleges and teachers would focus on the specified practicals to the exclusion of all others.

Although far from ideal, this would in fact be an improvement on the current situation in many cases. It is likely that the schools and colleges who would cease to resource science adequately would be the same ones that are currently only doing the minimum number of practicals – which may be no more than one or two. To start doing eight (as the consultation proposes) would be a large improvement.

Of the 11 “representative or interest groups” who responded to this question, 9 stated this proposal would result in a ‘devaluation’ of science practicals and consequently a decrease in the amount of practical work done in schools.

Question 1d: Science GCSE students will be more likely to be given opportunities to complete the practical work included in an exam specification if schools are required to confirm this in writing to their exam board.

The 161 responses to this question were largely supportive of the statement, with over 50 per cent (86 of 161 respondents) expressing agreement, and nearly 30 per cent (47 of 161 respondents) expressing disagreement. The remainder were unsure. No single group of respondents disagreed more than they agreed. Awarding organisations were noticeably divided, with 2 agreeing, 1 disagreeing and 1 unsure. Schools and colleges, education specialists and teachers were the groups who expressed most disagreement – this is telling as it is schools, colleges and teachers who would most be impacted by this proposal.

Figure 6

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	7	11	5	7	2	32
Awarding organisation		2	1	1		4
Employer				1		1
Local authority	2					2
Other representative or interest group	3	4	2	2		11
School or college	2	5	2	3	2	14
Personal views	28	40	23	25	13	129

Educational specialist	2	6	1	2	2	13
General public					1	1
Teacher	26	34	22	23	10	115
Total	35	51	28	32	15	161
Total percentage	21.7%	31.7%	17.4%	19.9%	9.3%	

Respondents felt that the requirement for schools to confirm to exam boards in writing that practical work has been completed would incentivise teachers and would highlight to school leaders and senior management teams the importance of the practical requirements and ensure they authorise the budget and time for them.

Both those that agreed and those that disagreed had some concerns. These included:

- How will this activity be monitored by awarding organisations to check the confirmations are correct and what would be the consequences of them not being correct? Some respondents were in favour of having sanctions in place to deter a tick box exercise. In addition, a few were concerned that meaningful information is collected for awarding organisations to make judgements – these respondents however have misunderstood our proposals, as we do not suggest that judgements are made on the basis of the school record.
- Some respondents stated that awarding organisations need to put in place a system which avoids this confirmation becoming a burdensome and bureaucratic practice for schools.
- Some saw writing to exam boards to confirm that practical work has been completed as an administrative burden which is not needed since the teaching of other parts of the curriculum does not require similar confirmation.
- Some pointed out that the check is in the exam results themselves, as these will reflect whether practicals have been conducted, so that centre confirmation is therefore unnecessary.

Question 1e: Science GCSE students will be more likely to be given opportunities to undertake a wide and varied range of practical work if they are required to keep a record of such work (a student record).

Responses to this question were among the most divided in the consultation. Among the 32 organisational responses, 12 (38 per cent) disagree or strongly disagree and 16 (50 per cent) agree or strongly agree.

Among personal responses, 36 of 130 respondents (28 per cent) disagreed or strongly disagreed and 65 (50 per cent) agreed or strongly agreed.

The total proportion of responses indicating “Neither agree nor disagree” was also relatively high at 20 per cent (33 of 162 respondents).

In their comments, many respondents asked questions about the details of what the student record may look like. This suggests that some respondents might have found it hard to answer this question without knowing what the student record might consist of.

Figure 7

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	3	13	4	8	4	32
Awarding organisation	1	1		2		4
Employer		1				1
Local authority	1	1				2
Other representative or interest group	1	6	1	2	1	11
School or college		4	3	4	3	14
Personal views	30	35	29	22	14	130
Educational specialist	1	7	2	2	1	13
General public					1	1
Teacher	29	28	27	20	12	116
Total	33	48	33	30	18	162
Total percentage	20.4%	29.6%	20.4%	18.5%	11.1%	

Respondents who answered this question positively thought that the student record would help students to value their work, and would also be a good revision and development tool for students. A few noted that student records have been adopted at A level, and commented that having a similar approach at GCSE would benefit students who go on to higher levels of study.

A key issue among both those who agreed and disagreed with the statement was how the requirement for student records would be monitored and enforced. Some of those who commented that the record would ensure students undertake practical

work only did so with the caveat that it depends on these arrangements. Some warned that if there is no monitoring process then the record would become superfluous.

Another concern raised by respondents is the potential burden this requirement could put on students, teachers and awarding organisations, in producing, sorting, monitoring and evaluating student records. It was perceived to be time-consuming, unmanageable and would only work if a simple process is put in place – 33 of the comments (30 of which were from schools and teachers) specifically mentioned that the record could become a burden. However it was also suggested that an overly simple process will affect the validity of the records.

Respondents had a range of views about the form records should take, the chief concern being the degree to which awarding organisations should set out the requirements. Some felt that this would be too prescriptive, while others thought it would ease any administrative burden. Respondents were given an opportunity to discuss this matter specifically in their responses to Question 2.

Other comments regarding the student record included:

- Verification of the records may be difficult, and a lack of monitoring may result in the fabrication of results or turn it into a tick-box exercise.
- The workability of the record was questioned, with some arguing it is not clear what it should record and how this should be done.
- The need for trust and confidence in teachers was mentioned by those that disagreed with the proposal, stating that teachers already include practicals in their lessons and will include them if the specification requires it.
- The proposal could narrow the range of practicals completed by the students to only the eight required by the specification.

Many respondents made detailed comments about this proposal. The primary concerns are illustrated in the following quotations:

While keeping records of lab work can be valuable for many reasons (it is a skill in itself, it enables teacher–student discussion about practical work, it is revision material for the student) it only works as an incentive for teachers to offer a wide and varied range of practical work if the requirement is checked and there are repercussions if it is missing. There is also the possibility that using student records for monitoring/moderation purposes may undermine the other benefits such record-keeping can bring, and focus teaching time on producing high-quality records rather than doing practical work. The student record (coupled with the teacher

record) must also indicate where students lack competence, otherwise it cannot report a 'fail'.⁶

Gatsby Charitable Foundation

The student record is not the motivation for doing the practical work. A student record of all the practical activity that they do would be unmanageable for the full range of ability and actually discriminate against those students who complete really good practical work but fail to produce a detailed account. AQA suggests that the record of practical opportunities should be maintained by the teacher. Examples of student work could be copied and retained as part of a teacher portfolio of evidence that could be monitored by comparing a cross-section of student practical records.

AQA

This is far more likely to have the desired effect than just requiring teachers to sign a form to say they've done them. However, the way in which this is recorded must not be too prescriptive or onerous. One of the benefits of removing the ISA is more time released for teaching. If this then [sic] taken away again by onerous record keeping the object is partially defeated.

Teacher

Not sure this is necessary. If it's assessed by questions teachers will have to do the practicals. It is very difficult to get some students to write up experiments and would take away the 'joy' of practicals and distract from the main reason for the practical – engagement and learning.

Teacher

Question 1f: It would be unmanageable, in terms of time and cost, for teachers to assess directly each of their science GCSE students manipulating a range of equipment and conducting a range of experiments to confirm their competency in practical skills.

This question received the largest proportion of "Strongly agree" answers in the consultation. Teachers in particular felt strongly about this issue, with 72 per cent (84 of the 117 who responded) strongly agreeing or agreeing and only 18 per cent of them (21) either disagreeing or strongly disagreeing.

⁶ It is unclear whether this sentence demonstrates a misunderstanding (as there is no intention in our proposals to report separately on the practicals themselves, or on the student records) or a suggestion that separately reported practicals should be part of the qualification.

The 32 official responses received from organisations have a slightly more mixed view, with 21 (66 per cent) strongly agreeing or agreeing and 8 (25 per cent) disagreeing or strongly disagreeing. Awarding organisations agreed with the proposal.

Figure 8

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/group	13	8	3	5	3	32
Awarding organisation	2	2				4
Employer				1		1
Local authority		1		1		2
Other representative or interest group	2	3	2	2	2	11
School or college	9	2	1	1	1	14
Personal views	65	24	15	17	10	131
Educational specialist	4	1	2	5	1	13
General public			1			1
Teacher	61	23	12	12	9	117
Total	78	32	18	22	13	163
Total percentage	47.9%	19.6%	11%	13.5%	8%	

Respondents stated that direct assessment is impractical since the time it would take to adequately assess students makes it impossible for a qualification the size of a GCSE and given the student numbers involved. In addition, a number suggested that if teachers directly assessed the practicals there is potential for them to face impossible pressures, as found currently in controlled assessment.

We have 330 students per year group. Forget it. We would waste significant amounts of learning time, and the opportunity for much quality practical work if we had to stand over individual students with a tick list.

Teacher

Those who disagreed, and thought that direct assessment would be manageable, said that it can be done if tasks are simple and planned.

Again debateable – this is not in principle unmanageable – it depends on how it is constructed, what is to be assessed – how much – how detailed what records are required – not unmanageable to ask teachers to provide a judgement on each pupils practical competency – it could easily be made unmanageable by excessively rigorous requirements for evidence collection.

CLEAPSS

If there were a range/circus of simple practical exercises that could be objectively assessed such as setting up a circuit and making accurate measurements this could be manageable.

Teacher

Assessment objectives (includes mathematics skills)

Revised assessment objectives

Question 1g: The revised assessment objectives for science GCSEs are appropriate.

The three questions on assessment objectives (this question and the two following) received a lower rate of response than most of the other questions in the consultation, although only by a few respondents. Opinions were also less strongly held. For this question, only about 16 per cent (25 of the 158 responses) either strongly agreed or strongly disagreed.

About 73 per cent (116 of the 158 responses) across both individuals and organisations supported our proposed assessment objectives, with only 13 per cent (20) disagreeing or strongly disagreeing.

Figure 9

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	3	18	4	3	4	32
Awarding organisation		3			1	4
Employer					1	1
Local authority	1	1				2
Other representative or interest group		7	1	2	1	11
School or college	2	7	3	1	1	14

Personal views	16	78	19	11	2	126
Educational specialist	1	6	1	4		12
General public		1				1
Teacher	15	71	18	7	2	113
Total	19	96	23	14	6	158
Total percentage	12%	60.8%	14.6%	8.9%	3.8%	

The questions on assessment objectives elicited fewer comments from the respondents. Most teachers and stakeholders who commented felt that the objectives were adequate and most were particularly pleased with the references to practical skills they included. Several comments on this question addressed the weightings of the assessment objectives – these are more properly addressed in the following two questions, so we have considered these comments as part of the analysis for those questions.

Some stakeholders, however, disagreed with the assessment objectives. These included the Association of Colleges and School Leaders, Field Studies Council and The Gatsby Foundation. Their comments were:

Practical skills should not be assessed by exam. But we agree that a percentage of the marks should credit mathematical skills.

Association of School and College Leaders

Include AO4 assessment objective such as: adapt and use a variety of skills and techniques to plan, carry out and evaluate aspects of investigative, practical work and analyse the results. As well as the proposed weighting of 25% with 5% used to respond to fieldwork data and contexts. Additionally, FSC recommends that 10% of the AO3 weighting is applied to practical work.

Field Studies Council (FSC)

We are disappointed that AO4 with its 10% direct assessment of practical skills has been removed since the last consultation, meaning that the following set of important skills will no longer being [sic] assessed:

The ability to:

- follow instructions accurately,
- use scientific instrumentation, apparatus and materials appropriately,
- work with due regard for safety, managing risks,
- observe, measure and record accurately and systematically and

- carry out and report on investigations or parts of investigations.

Gatsby Charitable Foundation

Question 1h: The weightings proposed for the revised assessment objectives for science GCSEs are appropriate.

Responses to this question were broadly similar to those for Question 1f. The number of responses decreased by one, from 158 to 157. The proportion of respondents who neither agreed nor disagreed is higher going from 15 per cent to 23 per cent (23 to 36 responses) and there were slightly more responses that disagreed or strongly disagreed (an increase of about 2 per cent).

Figure 10

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	4	15	4	5	4	32
Awarding organisation				2	2	4
Employer					1	1
Local authority	1	1				2
Other representative or interest group		8	1	1	1	11
School or college	3	6	3	2		14
Personal views	12	66	32	15		125
Educational specialist	2	4	4	3		13
General public				1		1
Teacher	10	62	28	11		111
Total	16	81	36	20	4	157
Total percentage	10.2%	51.6%	22.9%	12.7%	2.5%	

The majority of those who responded positively either made no comment, or only commented briefly, for example “Statements and weightings seem fair” or “They seem sensible”.

Many of those who “Neither agree nor disagree” also often made no comment or only very brief comments (for example “Have not read this part” or “See answer to 1g”). The few longer comments made either referred to the perception that the AO3

weighting may be difficult for lower tier students, or suggested the weighting of the practical skills should be higher.

All the awarding organisations disagreed with the proposed weightings. They proposed that the AO1 weighting should be increased and the AO3 weighting reduced, by 5 per cent each. See Figure 11 for a breakdown of their proposals.

Figure 11

	AO1	AO2	AO3
Proposed weighting	35%	50%	25%
AQA proposal	–	–	20%
Edexcel proposal	40%	40%	20%
OCR proposal	40%	40%	20%
WJEC proposal	40%	40%	20%

Two principal reasons were given by the awarding organisations. First, that these weightings better align with the A level and secondly, that assessment under AO3 is regarded as the most demanding and therefore the weighting is too high. Specific comments were:

Evaluative skills require higher order thinking around decision making, justifying those decisions and weighing up data and evidence. Too high a weighting for AO3 would skew the challenge of papers and make them less accessible for the full range of student ability.

AQA

This provides a progression in demand to AS/A level and reflects better the starting point of GCSE (and the subject criteria) which emphasise a significant body of content which must be known.

OCR

This is incongruous, as AO3 is acknowledged as the most demanding AO; in the AS level from 2015 it will be apportioned 20–25% and in the full A level 25–30%. Therefore, we would recommend that this is lowered slightly to 20% in the GCSE.

Pearson Edexcel

These weightings will allow assessments that are more appropriate for GCSE and will allow appropriate progression to the assessment of AS.

WJEC

The Council for Learning Outside the Classroom (CLOtC) neither agreed nor disagreed (and made no comment), while ASCL, FSC and the Gatsby Charitable Foundation disagreed with the proposed weightings.

ASCL’s comment, however, did not refer to the assessment objectives. Their disagreement focused on their view that practical skills should not be assessed by exam.

The Gatsby Charitable Foundation and the FSC both suggested the addition of a fourth assessment objective focusing on the assessment of practical skills. The Gatsby Charitable Foundation were disappointed that it was removed since the last GCSE science consultation (where it comprised 10 per cent for “Experimental skills and methods requiring direct assessment”). The FSC response included:

FSC recommends the inclusion of an AO4 focused on skills and techniques and with a weighting of 25% (see question 1g). Additionally, 10% of the AO3 weighting should be applied to practical work. As such, Ofqual should use the geography assessment objectives weighting as guidance to ensure the science assessment objectives reflect the necessary rigour on application of knowledge.

Field Studies Council

Question 1i: The weightings proposed for the assessment objectives for science GCSEs should be the same at each tier.

The levels of disagreement to this question were very low, particularly among stakeholders. Teachers were the group that disagreed the most, with 16 per cent (17 of the 109 teacher responses) disagreeing or strongly disagreeing, whereas the awarding organisations were notable in all strongly agreeing – the only question where they did so.

Figure 12

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	12	15	2	3		32
Awarding organisation	4					4
Employer		1				1
Local authority	1	1				2

Other representative or interest group	1	6	2	2		11
School or college	6	7		1		14
Personal views	27	52	24	17	3	123
Educational specialist	2	9		2		13
General public				1		1
Teacher	25	43	24	14	3	109
Total	39	67	26	20	3	155
Total percentage	25.2%	43.2%	16.8%	12.9%	1.9%	

Less than half (70 of the 155 respondents) of those who answered the closed question went on to make a comment. Among the relatively few who disagreed (19 comments), the majority (12 comments) thought that AO1 should be higher at foundation tier and AO3 higher at higher tier. Of the other 7 disagreeing comments, 6 made a similar but less specific point, and the last did not think that the qualification should be tiered at all.

Almost all the official responses agreed with the proposal that assessment objectives for science GCSEs should be the same at each tier. Some of the comments received pointed out that it would maintain consistency, continuity and parity of qualifications and would enable movement between tiers. A number of respondents stated that differentiation should be at question level, not weighting of assessment objectives. Some specific comments were:

Otherwise you are turning the tiers into different qualifications rather than different tiers of the same qualifications.

Teacher

Different weightings on each tier could make it more difficult to compare outcomes on standard demand questions targeting the overlapping grades. If there were a difference between the tiers it might be to introduce more AO1 on the Foundation Tier papers, but as AO1 is often interpreted as easier from the specification this could lead to more predictability and consequently a less valid assessment.

University of York Science Education Group (UYSEG)

Mathematic skills

Question 1j: The proposal that no less than 15 per cent of the total marks available in a science GCSE must be used to credit the demonstration of mathematical skills is appropriate.

This question provoked the most division in responses, with just over 52 per cent (83 of the 158 responses) expressing agreement and 30 per cent (48 responses) disagreement. Every category of respondent was divided in its opinions to at least some extent. Awarding organisations, however, were the only group where the majority disagreed with the proposal – 3 answered “Strongly disagree” and only 1 (Pearson) agreed.

Figure 13

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/group	4	11	6	6	4	31
Awarding organisation		1			3	4
Employer				1		1
Local authority		1		1		2
Other representative or interest group	2	3	5	1		11
School or college	2	6	1	3	1	13
Personal views	14	54	21	27	11	127
Educational specialist		6		6	1	13
General public					1	1
Teacher	14	48	21	21	9	113
Total	18	65	27	33	15	158
Total percentage	11.4%	41.1%	17.1%	20.9%	9.5%	

Most of those who agreed with this statement did so on the basis that “mathematics skills are vital for science”, although many placed a caveat on this statement by noting that the exact way in which the questions function in the exam will need to be clarified (and appropriate). Several comments also related the GCSE to the A level, saying that it is good that they share common ground such as the testing of mathematics skills.

Those who disagreed did so for two main reasons. Firstly there was a view that “We should assess science, not mathematics” and respondents worried that candidates (particularly at the lower tier) may be put off by a significant mathematical element. This view was felt to be reinforced at GCSE by the fact that all students will be taking mathematics anyway (as opposed to A level, where mathematics is not mandatory).

Secondly, some respondents who disagreed did so because they felt that the weighting is wrong. Three reasons were given:

- The weighting is too low. Particularly in physics, higher proportions are suggested, ranging from 20 per cent to 50 per cent.
- The weighting is too high. The figure most commonly suggested is 10 per cent.
- The weightings need to vary between science subjects. This was strictly the focus of the following question, but many respondents addressed it here. While many comments did not specify suggested weightings, most of those that did so proposed a lower weighting for biology, about 15 per cent for chemistry, and a higher weighting for physics.

The three awarding organisations who disagreed with this proposal reflected the last point above. As their proposals were in some cases quite detailed, we have quoted them here in full:

The GCSE should give a true reflection, at the appropriate level, of the nature of the subject. Physics is more mathematical than chemistry and both are much more mathematical than biology. To allow learners to make genuine choices for future study, these differences in the nature of the subjects should be clear from the assessments they take. On that basis the weightings for maths in each subject should be differentiated with Physics > Chemistry > Biology following the approach adopted for A level. Given that learners will be taking GCSE maths in parallel with GCSE Sciences we would support an idea that Key Stage 3 maths content is used as a benchmark, in that case weightings could be: Biology, 10%; Chemistry, 20%; Physics, 40% as overall minima (reflecting A level).

However, the criteria clearly require some GCSE level Maths. On that basis we propose there should be a sub-weighting for GCSE Maths within each subject: Biology 5% (i.e. half of the maths assessed in Biology has to be at GCSE level maths for the appropriate tier, i.e. Foundation Biology would require a minimum of 5% Foundation tier GCSE Maths and 5% of ‘other’ maths benchmarked against the KS3 requirements), Chemistry 10% (i.e. half of the maths assessed is at GCSE level), Physics 20% (i.e. half of the maths assessed is at GCSE level. We

recognise that due to the mathematical nature of physics this could be higher, e.g. 25%).

The GCSE maths requirements should match the science tier, i.e. Foundation Biology requires Foundation GCSE Maths. There is a danger of making the Foundation paper have a maths demand which is too high to enable candidates to show the science they know.

Weightings in Combined Science should reflect the proportions for the constituent separate sciences.

It is vitally important it is clear for Exam Boards what the maths requirements will be; at GCSE we would support that the requirement is against Key Stage 3 with a sub-set requirement against Higher and Foundation GCSE Maths. The 'Level 2' requirement at A level then shows a definite progression in demand between the levels (GCSE and A level). We do not consider that the 'Level 2' A level definition is required for GCSE as it would distort other aspects of the assessment at this level especially given the restrictive nature of the defined content.

OCR

The figure of 15% is not appropriate to each of the qualifications due to their different natures. WJEC proposes the following weightings: GCSE Biology – 10% GCSE Chemistry – 15% GCSE Physics – 25% GCSE Combined science – 15% However, the same breakdown as proposed for the separate GCSE subjects should be applied to generate the overall figure of 15%.

WJEC

The mathematical weighting has to reflect the particular scientific discipline. Clearly the proportion of mathematics in Physics will be greater than that in the other two subjects. The weighting for the Biology would need to be about 10%, Chemistry about 15%, and Physics about 25%, which would be roughly in line with current papers. The combined science would then naturally be 15% but this figure would reflect the different sciences in the proportions described.

AQA

The awarding organisation who agreed with our proposal noted that in their current specifications they do have different weightings for different subjects, but felt that the proposal of 15 per cent for each would be appropriate.

We would agree that a 15% requirement of mathematical skills would be appropriate, on the assumption that all calculation questions would be included in this percentage. This would be our preferred option. The

proportions we currently have in our assessments include maths at all levels, and are wider than the skills listed in the DfE criteria; our assessments include approximately 10% calculation questions in biology, 10–15% in chemistry and 15–20% in physics.

However, clarification is needed on whether the 15% requirement would only include the maths skills covered in the DfE subject criteria and whether or not the requirements at each tier for the science subjects must be commensurate with the requirements at that tier for the new maths GCSEs. In this case, we would need to review the allocation of mathematical skills in our assessments as a 15% allocation to mathematical skills could lead to a disproportionately high percentage of maths assessment in the science qualifications.

Pearson Edexcel

Question 1k: The proposal that no less than 15 per cent of the total marks available in a science GCSE must be used to credit the demonstration of mathematical skills should apply to each of the science GCSE subjects.

This proposal received the highest level of disagreement among all the questions asked in the consultation, with 39 per cent (62 of the 159 respondents) disagreeing overall. There is no meaningful difference in responses from organisations or individuals. Awarding organisations all expressed disagreement. This statement also received the lowest proportion of strong agreement among all the questions.

A relatively large proportion of respondents, nearly 20 per cent, said that they neither agreed nor disagreed.

Figure 14

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	2	10	8	8	4	32
Awarding organisation				1	3	4
Employer				1		1
Local authority		1		1		2
Other representative or interest group	1	3	5	2		11
School or college	1	6	3	3	1	14
Personal views	14	40	23	39	11	127

Educational specialist	2	4	1	5	1	13
General public					1	1
Teacher	12	36	22	34	9	113
Total	16	50	31	47	15	159
Total percentage	10.1%	31.4%	19.5%	29.6%	9.4%	

Analysis of the comments highlighted that respondents agreed on the relevance and importance of incorporating mathematical skills in the sciences, and agreed with the inclusion of it in these qualifications. There were, however, some concerns and differences in opinion about how this applies to each science subject:

- **The weighting of 15 per cent is not appropriate.** The majority (75 comments) were about mathematical requirements being different for each of the sciences and therefore 15 per cent not being the right level for them all. It was argued that higher percentages are needed for physics and chemistry than for biology. Some alternative proportions were proposed, for example 20 to 25 per cent for physics, 15 to 20 per cent for chemistry and 10 to 15 per cent for biology. Some respondents suggested that they should match the A level percentages.
- **There is a need for additional details.** Respondents noted that further details are required on the nature of the mathematics requirement for different tiers. Some suggested a higher proportion of mathematics in the higher tier. Also, there were comments that the demand of the mathematics requirements should equal (or not exceed) those for GCSE mathematics, which would ensure that the level is not too high and is relevant to the sciences. Exam boards need to be clear what the mathematics requirements will be.
- **Science should not be a mathematics test.** A number of respondents argued that GCSE science is not a mathematics test and that the inclusion of mathematics should assist with the learning and not hinder it. It was felt that mathematics may just be included in order to meet the requirement of a 15 per cent weighting. Some teachers stated they do not want to be teaching mathematics.

Some of the comments encapsulated in the points above suggest that some respondents had not read the subject content that has been published by the DfE. The mathematical skills that will be assessed are described in relation to the subject content, placing them firmly in a scientific context.

Details of the mathematical skills that will be assessed are included in that document. For example:

The mathematics should be at levels up to, but not beyond, the requirements specified in GCSE mathematics for the appropriate tier.

Biology, Chemistry and Physics GCSE subject content⁷

Awarding organisations disagreed with the mathematics weightings proposed and suggested the following: biology 10 per cent, chemistry 15 per cent and physics 25 per cent, with 15 per cent for the combined science divided in the same proportions outlined for the separate subjects.

A “Strongly agree” response from an educational specialist pointed out, in the answer to this question and the preceding one, that each science has an equally wide range of mathematical skills specified in the subject content, and that 15 per cent may not be enough to assess any of them sufficiently.

Practical work proposals: non-exam requirements

Question 11: The lists of apparatus and techniques that all students taking science GCSEs will be expected to be able to use are appropriate.

Overall this statement received a high level of support, with about 63 per cent (101 of the 159 responses) agreeing or strongly agreeing. Awarding organisations were again the group of respondents that most clearly disagreed with the statement, with only a single response (OCR) expressing agreement. An analysis of the comments from the awarding organisations identified that they were not opposed to there being a list but have concerns over the details and consistency of the lists in the consultation. A relatively low proportion of respondents answered “Neither agree nor disagree”.

Figure 15

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/group	3	15	3	6	5	32
Awarding organisation		1		2	1	4
Employer					1	1
Local authority	1	1				2
Other representative or		6	1	2	2	11

⁷ www.gov.uk/government/publications/gcse-single-science, page 5

interest group						
School or college	2	7	2	2	1	14
Personal views	21	62	17	24	3	127
Educational specialist	1	4	2	5		12
General public				1		1
Teacher	20	58	15	18	3	114
Total	24	77	20	30	8	159
Total percentage	15.1%	48.4%	12.6%	18.9%	5%	

Analysis highlighted some general and subject-specific issues with the lists of apparatus and techniques (see Figure 16 below). The main concerns were:

- Further thought is required on the content of the lists. Some argued that the lists lack detail and suggested the need for further guidance.
- Purchasing additional and specified equipment will increase expense (mentioned by 30 respondents). Some argued that school budgets may constrain them in meeting the requirements.
- The prescriptive nature of the lists may lead to a minimum number of practicals being devised to meet the requirements of the specification.

Figure 16 shows items from the list of apparatus and techniques for each subject that attracted comments, with a summary of relevant comments in each case, as well as a summary of general comments (where applicable). Items from the published lists that do not appear below did not receive any relevant comments.

Figure 16

Science subject	Objective and key issues raised
Biology	<p>Use of appropriate apparatus to make and record a range of measurements</p> <ul style="list-style-type: none"> ■ Should include length as well and volume should not be limited to gases. <p>Use of a Bunsen burner and a water bath or electrical heater for heating</p> <ul style="list-style-type: none"> ■ Some questioned the inclusion of an electrical heater for heating for biology. Others suggest that it should be replaced with a heating device. <p>Measurement of pH and oxygen levels using a variety of techniques such as indicators, a pH/oxygen meter or a pH/oxygen probe and data logger</p> <ul style="list-style-type: none"> ■ The cost implications of stipulating the use of oxygen probes) and data logging software might result in considerable financial outlay for schools. The use of oxygen meters and pH charts would be sufficient. ■ Oxygen probes are very fragile, difficult piece of equipment to use and can be unreliable. ■ Data logging equipment varies in amount available and quality from school to school. <p>Use of sampling techniques in fieldwork to investigate the distribution and abundance of organisms in an ecosystem</p> <ul style="list-style-type: none"> ■ Access to ecological sampling will be an issue here, as schools will not all have the same access to suitable locations. <p>Use of the light microscope at lower and medium power</p> <ul style="list-style-type: none"> ■ Availability of equipment and cost issues here. <p>General comments</p> <p>I welcome the inclusion of biological drawing but not the use of Bunsen or water bath for example. Important pupils can</p>

	<p>interpret data collected, rather than simply collecting it without understanding.</p> <p style="text-align: right;">Educational specialist</p> <p>Suggestions were made to include using stains for cells and identifying cells under a microscope. Some respondents were concerned about the ethical use of organisms.</p>
Chemistry	<p>Measurement of pH using pH charts and digitally</p> <ul style="list-style-type: none"> ■ Use of pH meter may have significant cost implications. <p>Use of a range of equipment to separate chemical mixtures: to include evaporation, filtration, distillation, crystallisation, chromatography, electrolysis</p> <ul style="list-style-type: none"> ■ This will require investment in distillation equipment which may not be possible for all schools. <p>Collection and analysis of products from a simple electrochemical cell</p> <ul style="list-style-type: none"> ■ Clarification of whether electrochemical cell is referring to electrolytic. <p>Use of appropriate apparatus to determine relative concentrations of strong acids and strong alkalis</p> <ul style="list-style-type: none"> ■ Cost implications <p>General comments:</p> <ul style="list-style-type: none"> ■ No mention of thermochemistry, or fieldwork.
Physics	<p>Measure speeds of both sound and of waves on water, and the wavelengths and frequencies of waves on water.</p> <ul style="list-style-type: none"> ■ Measuring speed, frequency and wavelength of waves on water is not practically possible for GCSE. It is possible via demonstration using a ripple tank, but unmanageable and costly if every student was to do this practical. <p>Connection, or checking, of these three wires for an AC mains plug and checking of the way these wires are connected to a domestic</p>

	<p>device</p> <ul style="list-style-type: none">■ The requirement to rewire a plug was questioned as inappropriate, and some feel it is too time and resource intensive. <p>Safe and careful handling of electrical power supplies, experiments involving accelerated and uniform movement of objects, and effects of steady or oscillating light sources</p> <ul style="list-style-type: none">■ Some questioned the ‘fit’ and relevance of ‘oscillating light sources’. <p>General comments</p> <ul style="list-style-type: none">■ Some respondents would like more fieldwork included and measuring density.
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Question 1m: The proposal that exam boards must require each student taking science GCSEs to undertake at least eight practical activities (16 for combined science) is appropriate.

This statement received a very positive response and a high degree of engagement from over 60 per cent (99 of the 163 respondents). This level of support was reflected across all the stakeholder groups with the exception of the 13 respondents who identified themselves as educational specialists, and the awarding organisations. One of the awarding organisations that disagreed with the proposals did so because 16 practical activities in combined science could not be divided equally between the three science disciplines. The other awarding organisations proposed that the minimum number of practical activities should be increased to 12 for the separate sciences and 24 for combined science.

Figure 17

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	6	14	2	6	4	32
Awarding organisation	1	1		2		4
Employer		1				1
Local authority	1	1				2
Other representative or interest group	2	4	1	2	2	11
School or college	2	7	1	2	2	14
Personal views	27	52	18	23	11	131
Educational specialist	1	4	2	4	2	13
General public				1		1
Teacher	26	48	16	18	9	117
Total	33	66	20	29	15	163
Total percentage	20.2%	40.5%	12.3%	17.8%	9.2%	

Analysis of the comments showed that there was not always a correlation between the answer to the closed question and the nature of the comment made. For example, 8 respondents who agreed or strongly agreed also indicate that they thought that 8 is too few practicals.

Similarly, many respondents across the range of responses commented that “It depends” on a variety of factors. The most common factor mentioned was the precise nature of the practical activities required, and how these intersect with the subject content, the skills and apparatus required, and general teaching practice. Other factors included the way in which the practicals would vary through the lifetime of the qualification and the amount of detail required for the student record.

Other comments (mostly from those that agreed with the proposal) emphasised that 8 is only the minimum, and that in practice this would not be a problem as most teachers currently do more than this. A few respondents mentioned that this requirement matched the A level practicals model, and that the standardised approach would benefit students going on to A level as it would give them all the same starting point.

Some comments indicated that our proposal had been misunderstood. For example:

I think that 6 and 12 for combined is more appropriate, then you are aiming for one per half term that has to be written up. How does Ofqual see this beign [sic] marked?

Teacher

The references in this response to practicals being “written up” and “marked”, which we have not proposed, suggest that this misunderstanding may have affected some respondents’ answers to this question, as they may have suggested a lower figure than our proposal in order to avoid manageability issues.

A few of the respondents pointed out that the proposal can work effectively so long as it is managed effectively, sufficient time is given to piloting the approach and schools and departments are provided with resources.

Several respondents noted that the 16 practicals proposed for combined science could not be divided equally between the three disciplines:

16 doesn’t divide by three. Assuming that the practical tasks for combined science are drawn from each of the separate sciences that implies a 5/5/6/ split, or a 6/6/4 split. Which science(s) would have fewer practical activities in combined science?

Teacher

Some respondents who disagreed argued that 8 practicals would become the norm, with teachers only doing the set 8 and no more.

This will reduce practical [sic] to 8 hours per qualification out of a Guided learning hours of 140. Science will become less than 6% practical. Please don’t do this. My senior management will slash practical time down to this level and refuse all calls for equipment that are not on this list. They have already told me that they will!

Teacher

There were 5 respondents that commented that 8 (or 16) is too high a figure. All of these answered the closed question as “Disagree” or “Strongly disagree”. Where the comment also gave an explanation, it was that 8 practicals would be unmanageable, particularly when combined with a student record.

Proposed model and alternatives

Question 2: Do you have any views about what form the student record should take and the types of information it should contain? If 'yes', please give suggestions below.

The student record proposal elicited a strong response, as demonstrated by the responses to Question 1e. Given an opportunity to expand on their opinions, over 75 per cent (124 of 162) of respondents to this question did so.

Teachers and schools and colleges were the groups who were least likely to express a view on the form of the student record. These two groups were also among those who most strongly disagreed with Question 1e.

Figure 18

	Yes	No	Total
Official response from an organisation/ group	26	7	33
Awarding organisation	4		4
Employer	1		1
Local authority	2		2
Other representative or interest group	10	2	12
School or college	9	5	14
Personal views	98	31	129
Educational specialist	11	2	13
General public	1		1
Teacher	86	29	115
Total	124	38	162
Total percentage	76.5%	23.5%	

None of the respondents who said “No” to Question 2 submitted a comment. However, 17 of the respondents who said “Yes” used their comment as an opportunity to argue against the presence of a student record requirement in any form.

Those respondents who made suggestions about the nature of a student record discussed both its form and its content; in some cases, those were the same thing.

The use of a 'lab book' was the most frequent suggestion, with 24 mentions in comments. The proposed contents of the lab book varied, however. Some respondents said that a consistent format for all experiments was required, whereas others argued that freedom of choice was necessary. Many comments mentioned the standard practice of method, results, calculations, conclusions and evaluations, whereas others made less specific suggestions.

Simplicity was a key theme in the comments (21 mentions), respondents saying that whatever form the student record takes, it must be simple and not onerous. There were 17 suggestions that a pro forma of some kind would be appropriate, and 8 thought that a tick list would work.

Questions and concerns were raised about what awarding organisations might expect to see, and how and when they would request it.

Question 3: We are looking for the approach to the assessment of students' practical science experience that can achieve the best balance between the aims of:

- **delivering the curriculum aims and encourage a wide range of practical science teaching over the period of study**
- **being manageable for schools – taking into account the numbers of students who take science GCSEs, the range of ability and the time typically allocated to each subject**
- **providing valid and reliable assessments – test the right things and do this accurately and consistently, so as to differentiate effectively between students' performance**
- **being able to withstand accountability pressures, that is, to avoid exerting unmanageable contradictions on teachers where they are acting as the assessor and being judged themselves through the outcomes of the assessments they make – the results of their students.**

How far do you agree that our proposed model provides the best balance between these aims? Please give reasons for your answers.

The answers to this question reflected the fact that the responses to the majority of the other questions in this consultation were positive. Of the 160 responses, over 62 per cent (100 responses) agreed that the proposals represent the best balance across our aims. A relatively large proportion (nearly 19 per cent – 30 responses) were unsure.

Figure 19

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total
Official response from an organisation/ group	5	14	6	4	3	32
Awarding organisation	1	1	2			4
Employer				1		1
Local authority	1	1				2
Other representative or interest group		5	1	3	2	11
School or college	3	7	3		1	14
Personal views	23	58	24	19	4	128
Educational specialist	1	6	3	2	1	13
General public				1		1
Teacher	22	52	21	16	3	114
Total	28	72	30	23	7	160
Total percentage	17.5%	45%	18.8%	14.4%	4.4%	

Those who agreed or strongly agreed that our proposals represent the best balance provided a variety of reasons. The most frequent reason (20 comments) related to the removal of assessment pressures from teachers. The proposals were cited as an improvement over the current model – for many commentators that was reason enough to endorse them.

There was relatively little to distinguish comments made by respondents who “Strongly agree” from those who only “Agree”. The most common distinguishing feature was a concern among those who agreed that the student record and monitoring arrangements could become onerous.

Comments where the respondent answered “Neither agree nor disagree” presented a variety of points. There were 2 awarding organisations in this category. Concerns about the record-keeping and monitoring arrangements came up in 9 of the 16 comments. Others agreed in principle but had doubts in practice. Views of respondents in this category can be illustrated well by this comment from a teacher:

As all ways [sic] the proposals seem reasonable, but it is the implementation which will determine the success.

Those who disagreed or strongly disagreed raised issues in three main areas. In 8 comments, maintaining a student record was specifically mentioned as a reason for disagreeing with our proposal, while 7 comments said that limiting the assessment of practical experiences to written exams may result in limited practical science teaching in many schools, and to schools only resourcing the minimum 8 practical activities required. The validity of assessing practical experience via exam questions was explicitly questioned in 4 comments.

There were also a few comments which suggested that our proposals have not been fully understood by all respondents:

WHY can it not simply be the case that students are tested on their knowledge and skills by the exam? Any internal assessment is open to abuse AND takes time that could be better used in TEACHING!!!!

Teacher

This is precisely our proposal on the understanding that teaching involves practical activities.

Question 4: Do you believe that there is an alternative option that can provide a better balance between these aims?

Given the response to Question 3, it is unsurprising that the majority (68 per cent) of respondents to this question did not think there is an alternative that will better balance the aims than the approach we have proposed. Respondents were not able to comment on this question. Those who answered “Yes” were invited to respond to Question 5, where they had an opportunity to express their views on a better option.

There is, however, a small discrepancy between the responses to Questions 3 and 4. Of the 100 respondents who said that they think our balance is the best one (by answering agree or strongly agree to Question 3), 10 (10 per cent) went on to say in Question 4 that they could propose a better option.

“Other representative or interest group” was the only category of respondent where more than half the responses (8 out of 11) were that there was a better alternative.

Figure 20

	Yes	No	Total
Official response from an organisation/ group	11	21	32
Awarding organisation	1	3	4
Employer	1		1
Local authority		2	2
Other representative or interest group	8	3	11
School or college	1	13	14
Personal views	40	85	125
Educational specialist	5	6	11
General public	1		1
Teacher	34	79	113
Total	51	106	157
Total percentage	32.5%	67.5%	

Question 5: If you responded ‘yes’ to question 4, which of the options below do you believe provides a better balance between these aims when used in addition to some science GCSE exam questions drawing on students’ practical science experience? Please give reasons for your answer.

- **Option (i) science GCSE students’ practical skills are directly assessed and marked and that mark contributes to the overall grade. The practical skills are assessed by:**
 - () teachers observing students during the course;
 - () a practical exam testing students’ technical and manipulative skills
 - () an extended investigation including direct assessment of practical skills
 - () a portfolio of experiments, detailing methodologies, results and conclusions and including direct assessment of practical skills.
- **Option (ii) science GCSE students’ practical skills are assessed on a pass/fail basis related to competency with that outcome reported alongside the grade derived from their performance in the exams.**
- **A different option that has not been covered in our consultation (please give full details of your proposed option).**

Of the 51 respondents who answered “Yes” to Question 4, 50 went on to respond to Question 5.

Over 50 per cent of the responses to this question (27 responses) chose “A different option” rather than one of the two the question provides. The remaining responses were split relatively equally between the other two options.

Figure 21

	Option (i)	Option (ii)	A different option	Total
Official response from an organisation/group	3	1	6	10
Awarding organisation				
Employer			1	1
Local authority				
Other representative or interest group	3	1	4	8
School or college			1	1
Personal views	9	10	21	40
Educational specialist	1		4	5
General public			1	1
Teacher	8	10	16	34
Total	12	11	27	50
Total percentage	24%	22%	54%	

Respondents who supported option (i) did not make many substantive comments. The main reason they gave was that this option would encourage practical experience because it would be part of a ‘high stakes assessment’.

There were two more detailed comments about option (i):

We recommend a terminal practical exam for the assessment of technical and manipulative skills across science GCSEs.

The examination would comprise a series of short experimental tasks, each focussed on a specific practical skill. It would be set up as a carousel of stations, performed under exam conditions, with individuals moving between stations after a set period of time. Groups of candidates would

take the examination sequentially; stations would be refreshed and tasks changed between groups.

The examination could take place over several days using a number of different tasks, drawn from a bank provided by the exam boards to prevent candidates from sharing the contents. The examination would be independently invigilated, perhaps by a teacher from a neighbouring cluster school. Tasks could have simple and advanced versions, providing differentiation. Evidence of performance would combine results recorded by the student and witness statements from the teacher. Written or photographic evidence could be taken and samples sent for moderation by the exam board. The examinations would be monitored by the exam board through visits to schools, with serious consequences where malpractice is discovered.

We outlined this model in our response to Ofqual's 2013 consultation on GCSE reform and indicated our willingness to work with Ofqual and the exam boards to further develop the model.

Gatsby Charitable Foundation

Option (i) will ensure that practical skills are assessed effectively and that recognition is given to students who excel in practical situations, rather than only giving recognition to students who excel at writing about an experience and interpreting data after the event. Of the above options, a portfolio of experiments when used in conjunction with teachers' observations and direct assessment of practical skills will be an effective and manageable way of encouraging schools to build a number of high quality, progressive practical experiences into GCSE science courses.

Council for Learning Outside the Classroom

Respondents who chose option (ii) did so for two reasons. First, they argued it would reduce the workload on teachers and free them up to teach (mentioned in 6 comments). Secondly, respondents noted that a separate pass/fail result had good links to A level.

Pure and simply, it would be a lighter work load for teachers. Let's be honest, departments are going to choose the exam board with the easiest model to administer and run.

Teacher

Those respondents who proposed "A different option" provided a wide variety of reasons and suggestions.

Some of them had not understood our proposals, and thus made suggestions that replicated what we have proposed:

| There should be no direct assessment required by teachers.

Teacher

Of the 24 comments made, 7 suggested a modified form of our proposals, in that they proposed we keep the assessment of practical skills in the exam, but remove or modify the requirement for a student record.

| As your proposed description, but change the individual student portfolio with a teacher's folder showing what was done with a marking grid.

Teacher

The approach in the Australian state of Queensland was mentioned twice, and that in Scotland mentioned once, as potential role models. These comments were similar to others calling for further research and trialling to be carried out before any decision is taken. This was a view held particularly by some of the subject associations and learned societies who responded:

| There is currently very limited evidence to support the proposal or alternatives presented in the consultation document. There is also little detail on how the proposal will be implemented. Such details will have a significant impact on the success of any reforms. The uncertainties resulting from this lack of evidence and detail make it difficult to accurately assess the merits of the different options presented in the consultation. Nor does it give confidence that the right solution has been identified in the proposal. We therefore believe that Ofqual should not go ahead with the proposal without further development, consultation, and evidence gathering beyond this consultation. This should include further dialogue with the science, engineering and education communities.

Campaign for Science and Engineering

| As first teaching of the new GCSE sciences will take place in September 2016 this leaves sufficient time to trial different approaches, particularly in developing a suite of practicals and fieldwork activities for all three sciences, and creating student portfolios which provide evidence of practical work. FSC would support both areas. An option to support this work could be developed by Ofqual.

Field Studies Council

| While we agree that indirect methods of assessment may be valid, we have yet to see the evidence Ofqual employs to support their use in the

GCSE sciences. This reflects a broader issue, namely the dearth of research evidence on the assessment of practical work for public examinations. We understand that the Wellcome Trust, Nuffield Foundation and Gatsby Foundation are embarking on a research programme designed to investigate this issue, and we hope the findings will be taken into account in considering future reforms.

SCORE

Other responses suggested modified forms of option (i) and (ii). There were 2 suggestions about an “externally assessed practical paper”, but no details about what this would entail; and just 1 respondent expressed a view that the current system is working well and saw no reason to change anything.

Stakeholder analysis

Although views varied widely, it is possible to analyse each group of respondents as a whole. We have identified three main groups.

- Teachers, schools and colleges were generally in favour of the proposals. They had questions regarding specifics, but overall this is the group which most consistently agreed with our proposals.
- Awarding organisations were in favour of the proposals in principle, but were concerned about the practicalities of implementing them and did not entirely agree with all we had suggested.
- Subject bodies, interest groups and learned societies were the groups which agreed least, though there was a degree of variation among them. All agreed that the current system is not functioning adequately. Some saw the value in the ideas behind our proposals, but had concerns about how they will function in practice. Others are opposed to our proposals in principle.

Content analysis of the responses from the stakeholders to the overall and closed questions (note that only official responses are included) showed that the level of agreement was divided. The content analysis outcomes are illustrated in Figure 22. The ratings and the resulting numbers are based on the coders’ judgement.

Figure 22

Stakeholder type	Overall agreement	Neither agree or disagree	Mostly disagree
Awarding organisation	1	3	0
Local authority	2	0	0
Other representatives or interest groups	6	3	8
Total	9	6	8

Schools, colleges and teachers

Teachers comprised the majority of responses received (119 of 172, or 69 per cent). When the official responses from schools and colleges are added to the teacher responses, they account for 77 per cent. As a group, these respondents had many questions, but they were overwhelmingly in favour of the main points in our proposals.

Their main reasons for agreeing were related to the pressures they face with assessment, both from the current accountability arrangements and from a manageability point of view. They thought that the new approach will give them more freedom to teach. They differed widely when it came to specifics such as the necessity or nature of student records, and the specific apparatus and techniques that students should be able to use and demonstrate.

The area in which this group disagreed most with our proposals was in regard to the equal assessment of mathematical skills between the three sciences (Question 1k), where 47 of the 127 (37 per cent) teachers, schools and colleges who responded disagreed or strongly disagreed. They felt that science is “not a mathematics test” and that if a proportion of mathematics is going to be specified, it needs to be lower for biology and higher for physics.

Teachers, schools and colleges responded extremely positively to the first three questions in the consultation, with only 11 per cent, 11 per cent and 20 per cent respectively disagreeing. They expressed dissatisfaction with the current controlled assessments, and saw many benefits in the proposals, primarily increased teaching time and freedom to do practicals unhindered by assessment concerns.

Answers to questions about school and student records were more ambivalent, with 30 per cent of teachers and 32 per cent of schools and colleges disagreeing. They were concerned about the administrative burden these requirements might impose, and many felt they were unnecessary, since the 15 per cent weighting for practical questions in the exam should be incentive enough to deliver practicals in class.

Suggestions as to the nature of the student record varied widely, from simple checklists of skills to detailed write-ups of each experiment. The most common suggestion was for a lab book, although there was not agreement about the form this would take. Teachers who supported the idea thought that it would make a good teaching and learning tool. There were many questions as to what processes would exist for checking and monitoring these requirements.

Engagement with the consultation from these respondents declined somewhat when asked about assessment objectives, but the responses that were received were largely positive. Comments focused more on weightings than the assessment objectives themselves.

Awarding organisations

The awarding organisations largely agreed with our approach. They were concerned, however, about the workability of some key components of the proposal. They all agreed that:

- exam questions should reward those who can draw on their practical experience;
- 15 per cent of the marks in science GCSE exams should be allocated to these questions;
- practical work should not be assessed;
- It would be unmanageable for teachers to directly assess all the students in their practical work.

Their views were split on the proposals that:

- required schools to confirm to the exam boards in writing that the practical work has been completed;
- a student record of practical work should be kept;
- detailed the lists of apparatus and techniques;
- students must undertake at least 8 practical activities – 2 of the awarding organisations would like the minimum number of core practicals to be higher; 3 awarding organisations suggested for combined science that the number should be 15, 18 or 24 (in order that it would be divisible by 3).

Because the practicals will feature in exam papers, the awarding organisations firmly believed it will mean teachers will teach the practical activities. They also noted, however, that the current proposal for a student record may result in manageability

issues. These points are illustrated by awarding organisations' comments, for example:

In general, the Assessment Objectives (with small alterations) will allow us to test aspects of practical work so that students who have engaged in a wide variety of practical activities will be at an advantage. We will be able to test both knowledge and understanding of the core practicals, but also students' ability to understand and apply the scientific method. We believe that this will result in valid assessments that genuinely do reward students who have engaged well with practical work. Removing controlled assessment will address many of these issues. These proposals should allow teachers to offer as broad a practical experience as possible. Better teaching of practical science, rather than narrow teaching of practicals will be rewarded in the outcomes of the assessments

Pearson Edexcel

Awarding organisations raised significant concerns about the availability of the apparatus listed in the proposals, as well as the way some of these requirements are worded and specified in the consultation.

Examples for biology include: “ ‘use of a Bunsen burner and a water bath or electric heater for heating’ does not actually involve any particular skill, but the requirement to use these pieces of equipment has the potential to cause problems with availability of apparatus” (WJEC). With regard to the requirement for pH and oxygen meters or probes, one of the awarding organisations stated that rather than very specific types of equipment, the requirement should involve just “indicators and/or data loggers” (OCR).

Awarding organisations believed that the student record is a good concept, but emphasised its success is dependent on how it is used. They highlighted the risk of using it to ensure the completion of practicals, arguing that this will dictate the direction of the records and will lead to them being constrained to tick-box exercises. They suggested that the student record should be a formative tool where students record and process results, draw conclusions about the practicals, and use it to aid revision. As a result, they proposed that the record should be light touch, non-formal documentation, driven by the activity and student requirements. One awarding organisation recommended a summary sheet to record completed practicals with written evidence.

Awarding organisations disagreed with some of the proposals. These included the assessment objective weightings, though they strongly agreed that these weightings should be the same at each tier. In addition, most of the awarding organisations disagreed with the proposal for equal mathematics weightings across the sciences.

There was agreement among them on the counter-recommendations they made, as detailed on page 29 of this analysis.

Other representative and interest groups

As illustrated in Figure 22, the views of the representative and interest groups was divided. In summary most of these groups agreed with the following two proposals:

- exam questions should reward those who can draw on their practical experience;
- 15 per cent of the marks in science GCSE exams should be allocated to these questions.

However, four stakeholders (including teaching unions and subject associations) disagreed with these proposals. They argued that these proposals depend entirely on what and how questions in exams are devised to enable students to apply practical skills. They contended that they need to be designed in such a way as to avoid teachers making use of teacher or video demonstration and referring students to text books for an explanation of the experiment. These stakeholders said that they need convincing this will be done and at present there is very little evidence to support this.

Six of the interest groups also criticised the 15 per cent figure for the proportion of marks in the exam which will assess practical experiences. As controlled assessment is currently worth 25 per cent of the qualification marks, they said 15 per cent cannot be perceived as anything other than a devaluation of practical science.

Some of the representative and interest groups were worried that not assessing practical work will result in narrowing of learning, as teachers will only concentrate on the components of the qualification that are assessed. They argued that schools will not allocate the resources, time and budget to practicals if they are not assessed. Their positive responses to the proposal for schools to confirm completion of the practicals in writing to their awarding organisation, and for a student record, went some way toward mitigating this concern. They expressed additional concerns, however, regarding the manageability, reliability and validity of the records, stating that they need further details of how the checks, monitoring and validation by awarding organisations would be arranged. They recommended that awarding organisations must have a common approach and that external moderation should be part of the process.

These stakeholders were keen to have a formal student record, but appreciated there are a number of potential weaknesses such as the authenticity (and therefore value) of the record. They liked the idea of a lab book, as these are used in the professional world and in further learning, but were aware that this may become burdensome.

Representative and interest groups tended to agree with the proposals for the revised assessment objectives, their proposed weightings, and for the weightings to be the same for each tier. However, they were less sure about awarding 15 per cent of the marks to mathematics skills.

The majority agreed with the proposed lists of apparatus and techniques. They highlighted however that further scrutiny of the list is required as some apparatus, which should be required, is missing and some of the techniques have not been expressed correctly. Some suggested specifically that the physics list confuses apparatus with techniques.

Agreement was divided over the requirement for a minimum of 8 practicals. Those who disagreed feared that this will become the *de facto* maximum that a school or college will undertake. Others who agreed with the requirement stated the minimum will ensure all schools offer the full range.

Overall, arguments from these stakeholders centred on their view that the proposals will devalue practical science skills and experience, leading to a decrease in the amount of practical work carried out in school. Primarily, they thought that practical skills should be assessed more directly, and should contribute more directly to the qualification grade than they do under our proposals. They did, however, acknowledge that the current system is inadequate. They called for more research and piloting to be carried out before these reforms take effect.

5 Equality analysis

Our December 2014 consultation on the assessment of practical work in GCSE science⁸ included proposed key design features for the qualifications and proposals for regulating the new qualifications. We included in the consultation our initial analysis of the potential positive and negative impacts the proposals could have on students who share different protected characteristics.

We have considered our initial analysis in light of the responses to our consultation. This section sets out our current analysis of the potential impact of the proposed reforms on different groups of students. Our roles, objectives and duties are laid out in Appendix 1.

This consultation

Gathering evidence

We asked three specific questions in our consultation specifically targeting the equality impacts of our proposals:

Question 6: We have identified some ways in which our proposals for science GCSEs would impact (positively or negatively) on persons who share a protected characteristic. Are there any potential impacts we have not identified? If so, what are they?

Question 7: Are there any additional steps we could take to mitigate any negative impact from resulting from these proposals on persons who share a protected characteristic? If so, please comment on the additional steps we could take to mitigate negative impacts.

Question 8: Have you any other comments on the impacts of the proposals on persons who share a protected characteristic?

The quantitative responses to these questions (Appendix 2) and the comments made have informed our understanding of the potential impact of our proposals on students who share protected characteristics.

We received one response to our consultation from an equalities organisation, which was a joint response from the Royal National Institute of Blind People and VIEW. This response had a specific focus on equality. We also received a response from a

⁸ www.gov.uk/government/consultations/assessing-practical-work-in-gcse-science

special school, which answered more broadly but also indicated through their comments that they answered in light of the nature of their students.

Structure of this equality analysis

In this report we have considered, for the points on which we have consulted, the potential impact of the proposals on students who share protected characteristics and whether, and if so how, potential negative impacts could be mitigated.

We have also considered the potential positive and negative impact our proposals may have in relation to socio-economic status, in addition to protected characteristics, where concerns have been identified. There is evidence that social class intersects with certain protected characteristics such as racial group.⁹ However, socio-economic status is not, in itself, a protected characteristic, and therefore students who are disadvantaged by their socio-economic status are not protected by the Equality Act 2010 simply by virtue of possessing that status. Where, however, a student possesses a protected characteristic as defined by the Equality Act 2010 that student will, of course, be afforded protection in respect of that characteristic.

Summary of the key impacts identified

The main impact identified was a concern among respondents about what effect there would be on students who were not able, because of a protected characteristic, to complete the practical activities specified in the consultation. The specific characteristic(s) that might result in absence was not routinely identified by respondents, but is most likely to be disability, gender reassignment or pregnancy and maternity.

As our proposal is that 15 per cent of the written exam will comprise questions that reward students who have had practical experience, there is the potential that students with a protected characteristic will be disadvantaged if they are not able to complete the practicals.

⁹ Croxford, L (2000) *Inequality in attainment at age 16: A 'home international' comparison*, Centre for Educational Sociology, University of Edinburgh; Cassen, R. and Kingdon, G. (2007) *Tackling low educational achievement – The Joseph Rowntree Foundation* in Caplan, A. and Jackson, J. (2013) *GCSE Reform Equality Analysis: Literature Review*. Available from: <http://webarchive.nationalarchives.gov.uk/20141031163546/http://www.ofqual.gov.uk/files/2013-06-11-annex-2-gcse-reform-equality-analysis-literature-review.pdf>

Our findings

We did not, in our consultation, identify any of the options as having an impact, positive or negative, on students because of their age, racial group, their religion or belief, their sex or their sexual orientation.

We acknowledged that arrangements will have to be made for students who are absent when the practical activities take place to do them at another time, which may incur some inconvenience for centres that are thus affected. Such absence may occur because of disability, pregnancy and maternity or gender reassignment. However, exams may also be missed for the same reasons. As the practical activities are not, in themselves, assessed it may be more straightforward for schools and colleges to reschedule any missed opportunities.

We also acknowledged that some disabled students will not be able to use some of the specified scientific apparatus owing to the nature of their disability. Currently some disabled students use a practical assistant to support their learning. They are also permitted to use a practical assistant to help them complete their controlled assessment. This is permissible as a reasonable adjustment because practical skills are not currently directly assessed, but are inferred through the results produced. Centres must, however, provide detailed information listing the tasks which the practical assistant would perform.¹⁰

In the future, as now, practical assistants will be allowed to support students' learning. There will be no restrictions on the use of a practical assistant, as neither the practicals carried out nor the results produced will be assessed. Centres will no longer have to provide information about how practical assistants are used. There is no need for a formal exception to any part of the qualification.

¹⁰ Joint Council for Qualifications, *Access Arrangement and Reasonable Adjustments 2014–2015*, page 66. www.jcq.org.uk/Download/exams-office/access-arrangements-and-special-consideration/regulations-and-guidance/access-arrangements-and-reasonable-adjustments-2014-2015-interactive-version

Responses to our consultation

Question 6: We have identified some ways in which our proposals for science GCSEs would impact (positively or negatively) on persons who share a protected characteristic. Are there any potential impacts we have not identified? If so, what are they?

Figure 23

	Yes	No	Total
Official response from an organisation/group	6	23	29
Awarding organisation		4	4
Employer			
Local authority		2	2
Other representative or interest group	4	5	9
School or college	2	11	13
Personal views	18	103	121
Educational specialist	6	6	12
General public		1	1
Teacher	12	96	108
Total	24	125	149
Total percentage	16.1%	83.9%	

In the consultation survey response, 24 of the 149 respondents (16 per cent) said that they had identified an impact which we had missed. The comments on 3 of these responses, however, indicated that the question had been misunderstood.

Of the comments that remained, 8 related to students who have poor attendance for some reason, or have had to move school during the course of study. The former of these issues was identified specifically in our initial equality analysis. The latter presents many of the same issues, with the added complication that a student will need to also arrange the transfer of any student record they have produced.

Two teachers told us that the requirements for biology may disadvantage some students on the ground of religion or belief. Specifically, the following points from the *list of apparatus and techniques* were mentioned:

- safe and ethical use of living organisms to measure physiological functions and responses to the environment;

- production of labelled scientific drawings from direct observation of biological specimens.

As mentioned in the consultation document, these lists are compiled by the Department for Education, who will have undertaken their own equality impact assessment. We will share the outcomes of this consultation with the DfE for them to consider in the light of the curriculum intentions of the published content.

Two other teachers (one from a special school) specifically mentioned students with visual impairments. One said that the proposals are a good move for blind students, as they will be able to access more practical work with assistance or adapted equipment. The other suggested that a modified range of practicals may be needed for people with visual impairment.

The RNIB and VIEW response suggested that most of the apparatus and techniques listed can be accessed by blind and partially sighted students, “with the obvious exception of a light microscope for blind students.”

They also highlighted a concern that schools may “duck their responsibilities in this area by taking advantage of these new rules to limit disabled students’ access to practical science.”

Two teachers expressed concern for science in “non mainstream schools” such as Pupil Referral Units and special schools, where there may be less easy access to science equipment.

One teacher voiced a concern that a stressful situation is likely to impact on the mental health of students. Our findings, however, suggest that by removing the formal assessment of practicals we are reducing the amount of stress that students face.

One teacher suggested that students should be able to record their practical work in a way that suits them, for example through photographs. This would help students who were unable to record their work through writing because of a protected characteristic.

One response from a subject association argued that a more differentiated approach is needed “for all students so that they can show the practical skills they are able to achieve.” The comment did not make clear, however, how the proposals disadvantage students with a protected characteristic.

Question 7: Are there any additional steps we could take to mitigate any negative impact resulting from these proposals on persons who share a protected characteristic? If so, please comment on the additional steps we could take to mitigate negative impacts.

Figure 24

	Yes	No	Total
Official response from an organisation/group	6	24	30
Awarding organisation		4	4
Employer			
Local authority		2	2
Other representative or interest group	5	5	10
School or college	1	12	13
Personal views	17	105	122
Educational specialist	4	7	11
General public		1	1
Teacher	13	97	110
Total	23	128	151
Total percentage	15.2%	84.8%	

Of the 151 respondents, 23 (15 per cent) said that there are additional steps we could take to mitigate any negative impact resulting from our proposals on persons who share a protected characteristic

Of these, 21 made a comment, but 8 of these indicated that the question had been misunderstood, or referred to a previous answer. Of the remaining 13, 6 referred to the nature of the student record. The suggestions were:

- that the requirement should be removed completely
- that the requirement should be removed only for students who have a protected characteristic
- that a standardised record would make it easier to provide versions adapted for students with a protected characteristic, for example copies in large print or in

Braille that a teacher portfolio would allow teachers to record students' achievements, taking into account any protected characteristics

- that the record take a broader, 'portfolio' nature to avoid disadvantaging those who might find a strictly written record difficult to complete.
- that the record should focus on the skills experienced rather than the specific practicals undertaken, on the grounds that the skills are common between exam boards. This approach would make it easier for students to move between schools.

There were 4 comments on steps that could be taken to mitigate poor attendance. The first of these made no suggestions, but pointed out that a process needs to be in place whereby these students can complete their record. Another comment suggested that the number of practicals in the content be higher (for example 25) and that pupils 'shortlist' a subset of their or their teachers' choice. A different comment made a similar point in less detail.

One comment said that options should be provided in the list of skills and apparatus for biology so that students will not be affected by reasons of religion and belief already mentioned in the previous section. As already explained, this is a content issue for the Department for Education to consider.

Question 8: Have you any other comments on the impacts of the proposals on persons who share a protected characteristic?

Figure 25

	Yes	No	Total
Official response from an organisation/group	2	28	30
Awarding organisation		4	4
Employer			
Local authority		2	2
Other representative or interest group	2	8	10
School or college		13	13
Personal views	2	121	123
Educational specialist		11	11
General public		1	1
Teacher	2	109	111
Total	4	148	152
Total percentage	2.6%	97.4%	

Of the 152 respondents, 4 (3 per cent) said that they had an additional comment. Only one of these comments actually addressed equality issues – the others made general points about the consultation document.

The single pertinent comment regarded potential problems with students who are absent for long periods of time. It suggests that to mitigate these circumstances, “all practicals should be able to be watched on YouTube (or similar).”

Appendix 1 – Ofqual’s role, objectives and duties

Ofqual is a statutory body, established by the Apprenticeships, Skills, Children and Learning Act 2009. The Act sets out our objectives (Apprenticeships, Skills, Children and Learning Act, 2009).

Our statutory objectives include the qualifications standards objective, which is to secure that the qualifications we regulate:

- (a) give a reliable indication of knowledge, skills and understanding; and
- (b) indicate
 - i. a consistent level of attainment (including over time) between comparable regulated qualifications; and
 - ii. a consistent level of attainment (but not over time) between qualifications we regulate and comparable qualifications (including those awarded outside of the UK) which we do not regulate.

We must, therefore, regulate so that qualifications properly differentiate between students who have demonstrated they have the knowledge, skills and understanding required to attain the qualification and those who have not.

- We also have duties under the Apprenticeship, Skills, Children and Learning Act 2009 to have regard to the reasonable requirements of relevant students, including those with special educational needs and disabilities, of employers and of the higher education sector,¹¹ and to aspects of government policy when so directed by the Secretary of State.¹²

The exam boards that design, deliver and award GCSE, A level and AS qualifications are required by the Equality Act, among other things, to make reasonable adjustments for disabled people taking their qualifications, except where we have specified that such adjustments should not be made.

Legislation therefore sets out a framework within which we must operate. We are subject to a number of duties and we must aim to achieve a number of objectives. These different duties and objectives can, from time to time, conflict with each other. For example, if we regulate to secure that a qualification gives a reliable indication of a student’s knowledge, skills and understanding, a student who has not been able to demonstrate the required knowledge, skills and/or understanding will not be awarded

¹¹ Apprenticeships, Skills, Children and Learning Act 2009, section 129(2).

¹² Ibid. section 129(6).

the qualification. A person may find it more difficult, or impossible, to demonstrate the required knowledge, skills and/or understanding because they have a protected characteristic. This could put them at a disadvantage relative to others who have been awarded the qualification.

It is not always possible for us to regulate so that we can both secure that qualifications give a reliable indication of knowledge, skills and understanding and advance equality between people who share a protected characteristic and those who do not. We must review all the available evidence and actively consider all the available options before coming to a final, rational decision.

The bodies we regulate have an obligation to comply with the *General Conditions of Recognition*.¹³ We require the exam boards to design qualifications to give a reliable indication of the knowledge, skills and understanding of those on whom they are conferred. We also require the exam boards to avoid, where possible, features of a qualification that could, without justification, make a qualification more difficult for a student to achieve because they have a particular protected characteristic. We require exam boards to monitor whether any features of their qualifications have this effect.

Qualifications cannot be used to mitigate inequalities or unfairness in the education system or in society more widely which might affect, for example, students' readiness to take the qualification and the assessments within it. Whilst a wide range of factors can have an impact on a student's ability to achieve a particular mark in an assessment, our influence is limited to the way the qualification is designed and assessed.

In setting the overall framework within which exam boards will design, assess and award the reformed GCSEs, A levels and AS qualifications we want to understand the possible impacts of the proposals on people who share a protected characteristic.

Public sector equality duty¹⁴

We have the following duties under section 149 of the Equality Act 2010:

- To have due regard to the need to –
 - eliminate discrimination, harassment, victimisation and any other conduct that is prohibited by or under the Equality Act;

¹³ *General Conditions of Recognition*, www.ofqual.gov.uk/documents/general-conditions-of-recognition

¹⁴ Equality Act 2010, section 149.

- advance equality of opportunity between people who share a relevant protected characteristic and people who do not share it;
- foster good relations between persons who share a relevant protected characteristic and people who do not share it.
- In having due regard to the need to advance equality of opportunity between persons who share a relevant protected characteristic and who do not share it, we must have due regard, in particular, to the need to:
 - remove or minimise disadvantages suffered by people who share a relevant protected characteristic that are connected with that characteristic;
 - take steps to meet the needs of people who share a relevant protected characteristic where their needs are different from the needs of people who do not share it;
 - encourage people who share a relevant protected characteristic to participate in public life or in any other activity in which participation by such people is disproportionately low.
- In having due regard to the need to foster good relations between people who share a relevant protected characteristic and people who do not share it we must have due regard, in particular, to the need to tackle prejudice and promote understanding.

The protected characteristics for the purposes of section 149 are:

- age;
- disability;
- gender reassignment;
- pregnancy and maternity;
- race;
- religion or belief;
- sex;
- sexual orientation.

It should be noted that with respect to the public sector equality duty under section 149 of the 2010 Act, we are not required to have due regard to impacts on those who are married or in a civil partnership.¹⁵

Additional equality duties

As the qualifications regulator for England, we have further duties under the provisions of Sections 96(7) and 96(8) of the Equality Act 2010 for “relevant qualifications” (which includes GCSEs and A levels). We must:

- determine any limitations on the use of reasonable adjustments for disabled students;
- when determining any such limitations we must have regard to:
 - the need to minimise the extent to which disabled people are disadvantaged in attaining the qualification because of their disabilities;
 - the need to make sure that the qualification gives a reliable indication of the knowledge, skills and understanding of a person upon whom it is conferred;
 - the need to maintain public confidence in the qualification.¹⁶

We also have a duty under section 129(2)(b) of Apprenticeships, Skills, Children and Learning Act 2009 to consider the reasonable requirements of students, including those with learning difficulties. Under section 129(9) a ‘person with learning difficulties’ means:

- children with special educational needs;
- other people who have a significantly greater difficulty in learning than the majority of people of their age;
- other people who have a disability, which either prevents them from or hinders them in making use of educational facilities of a kind generally provided for people of their age.

¹⁵ Equality Act 2010, section 149

¹⁶ Using our powers under Section 96, we have published our *Specifications in Relation to the Reasonable Adjustment of General Qualifications*, available at www.gov.uk/government/uploads/system/uploads/attachment_data/file/371296/2011-12-15-specifications-in-relation-to-the-reasonable-adjustment-of-general-qualifications.pdf

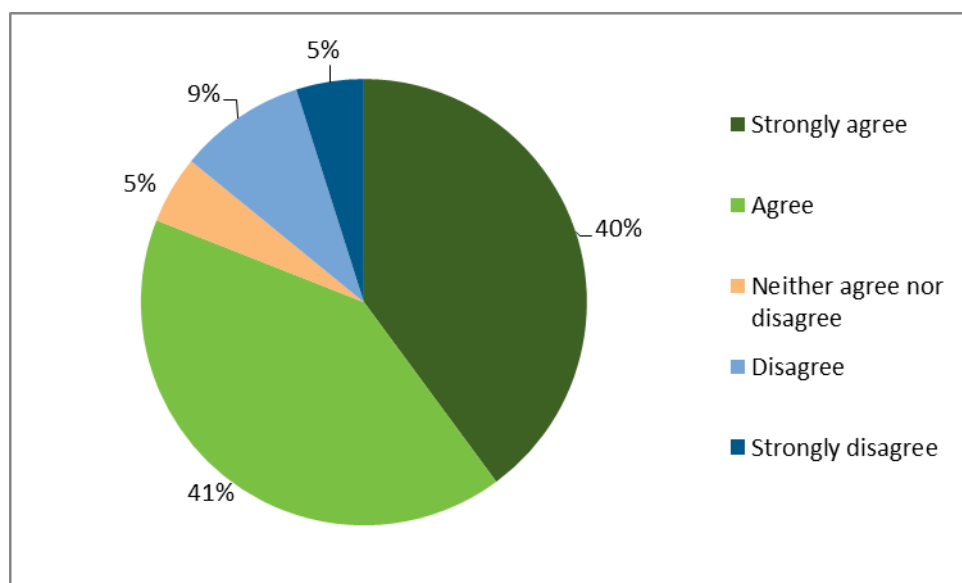
The awarding organisations we regulate are subject to equality duties in their own right, including making reasonable adjustments where appropriate in both general and vocational qualifications.

Appendix 2 – Pie charts to show breakdown of quantitative responses to consultation questions

The figures in these pie charts have been rounded, so they may not match exactly the figures in the grids in the document proper, which are displayed to 1 decimal place.

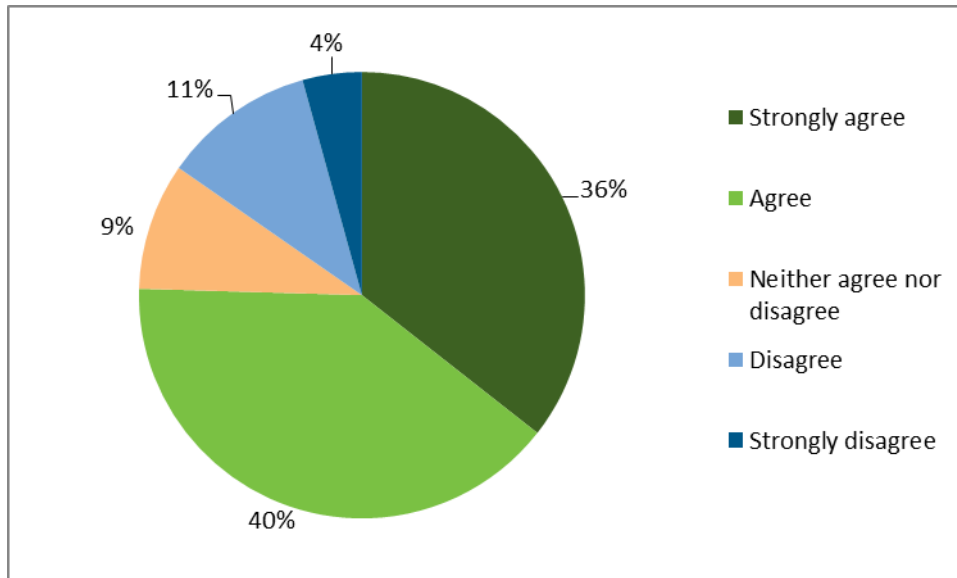
Question 1a: GCSE science students will be given appropriate opportunities to complete a range of practical work if exam questions reward those who can draw on their practical experiences.

163 responses:



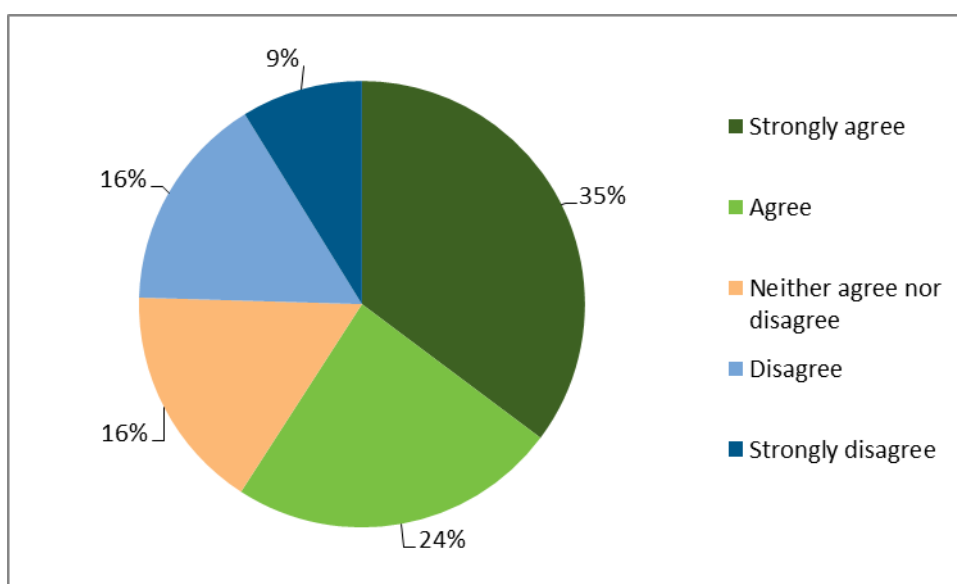
Question 1b: At least 15 per cent of the marks in science GCSE exams should be allocated to questions drawing on students' practical science experiences.

163 responses:



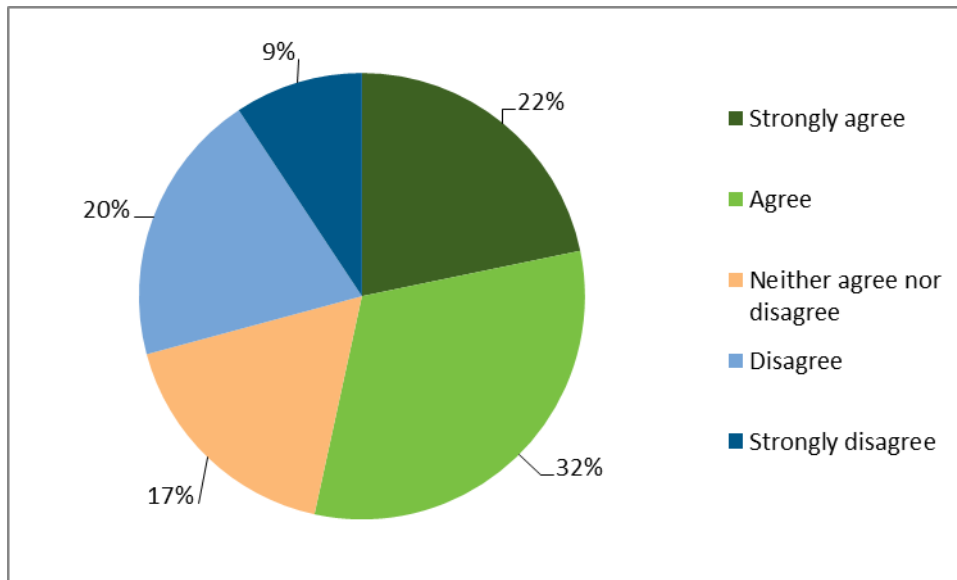
Question 1c: Science GCSE students will be more likely to be given opportunities to undertake a wide and varied range of practical work if such work is focused on teaching and learning and is not itself assessed.

159 responses:



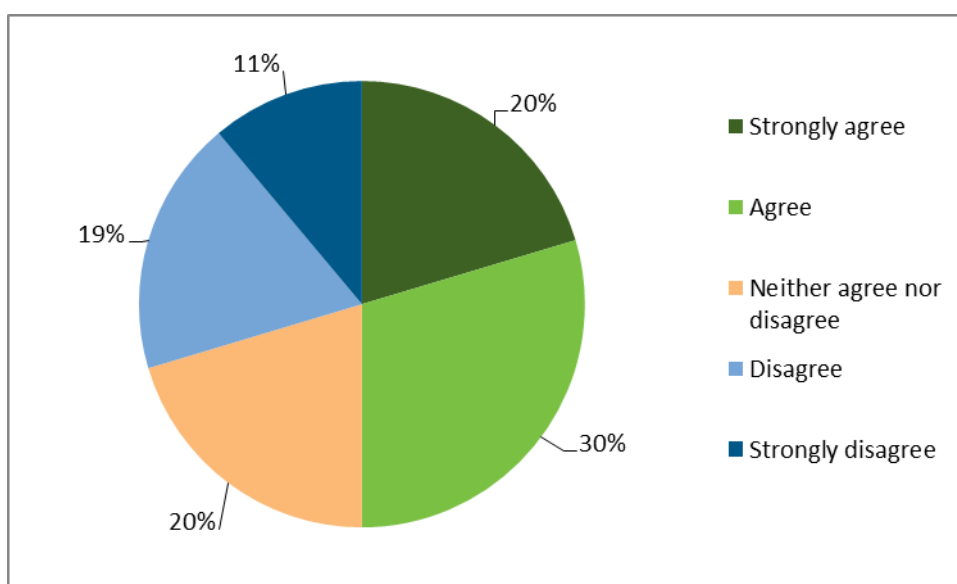
Question 1d: Science GCSE students will be more likely to be given opportunities to complete the practical work included in an exam specification if schools are required to confirm this in writing to their exam board.

161 responses:



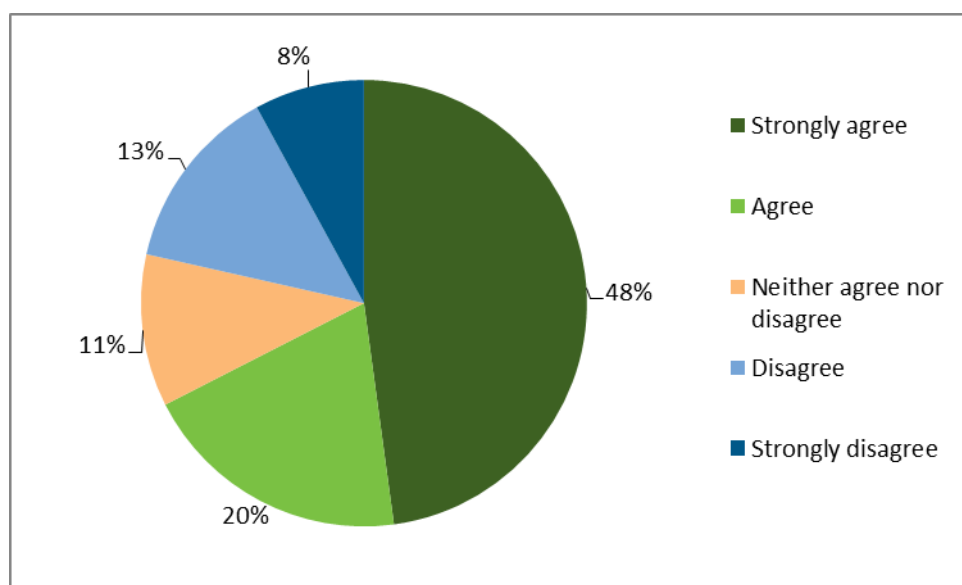
Question 1e: Science GCSE students will be more likely to be given opportunities to undertake a wide and varied range of practical work if they are required to keep a record of such work (a student record).

162 responses:



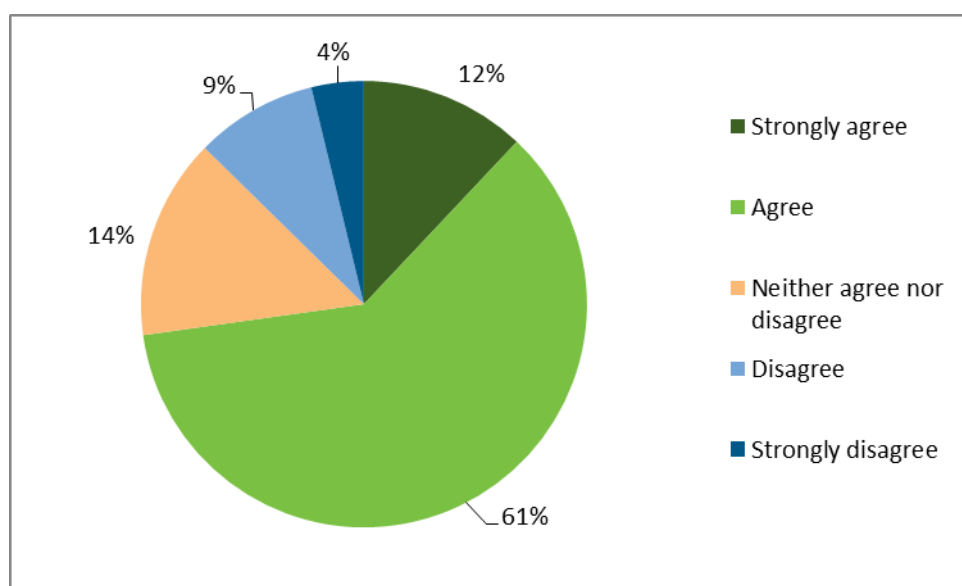
Question 1f: It would be unmanageable, in terms of time and cost, for teachers to assess directly each of their science GCSE students manipulating a range of equipment and conducting a range of experiments to confirm their competency in practical skills.

163 responses:



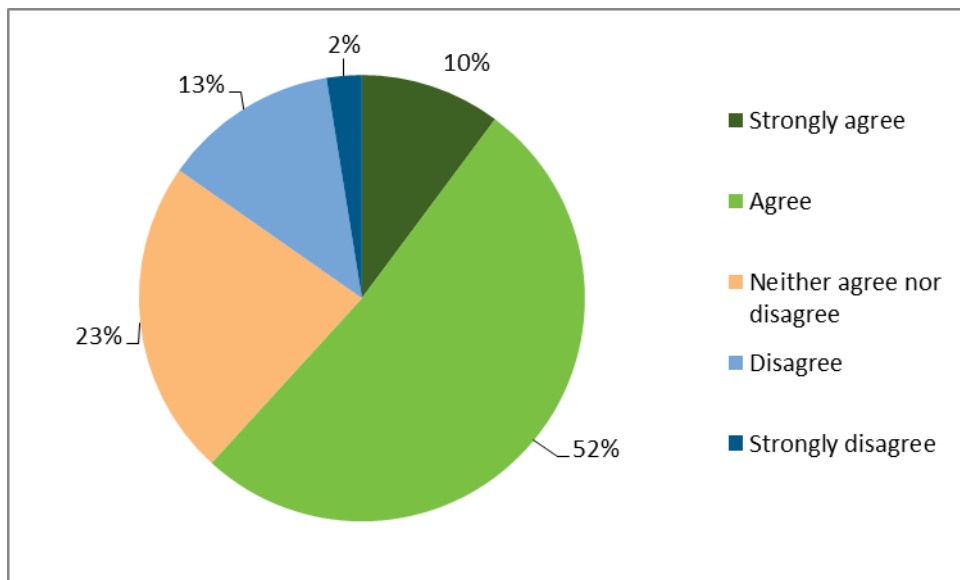
Question 1g: The revised assessment objectives for science GCSEs are appropriate.

158 responses:



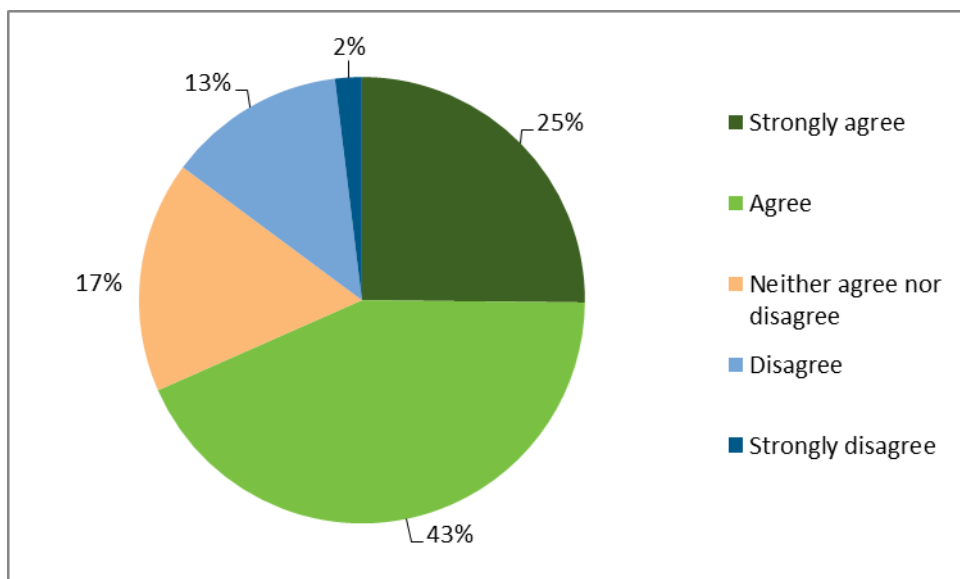
Question 1h: The weightings proposed for the revised assessment objectives for science GCSEs are appropriate.

157 responses:



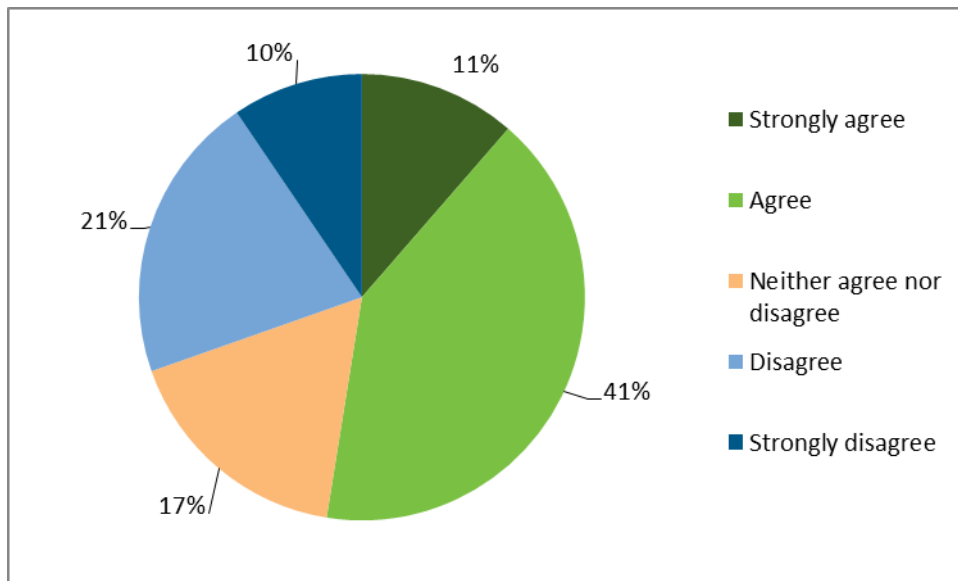
Question 1i: The weightings proposed for the assessment objectives for science GCSEs should be the same at each tier.

155 responses:



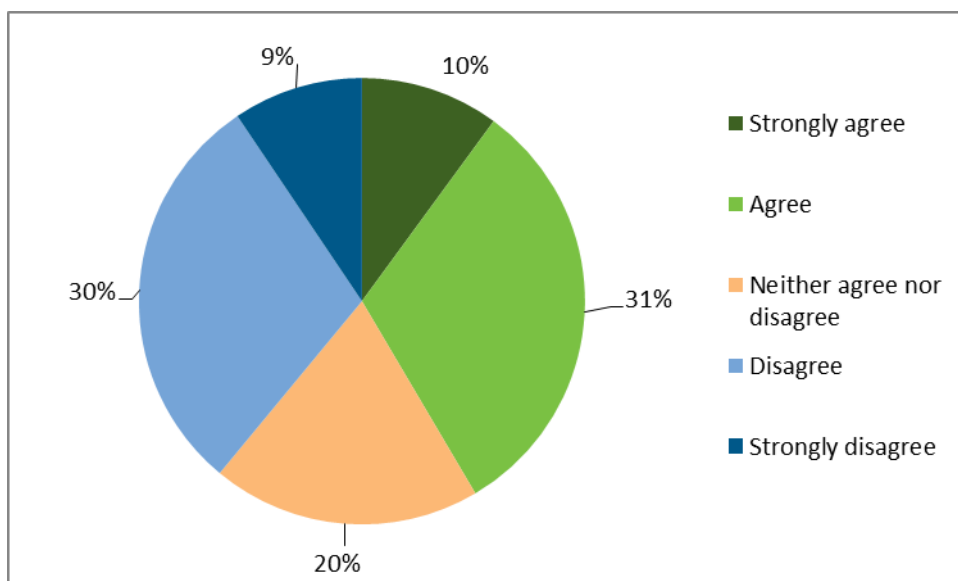
Question 1j: The proposal that no less than 15 per cent of the total marks available in a science GCSE must be used to credit the demonstration of mathematical skills is appropriate.

158 responses:



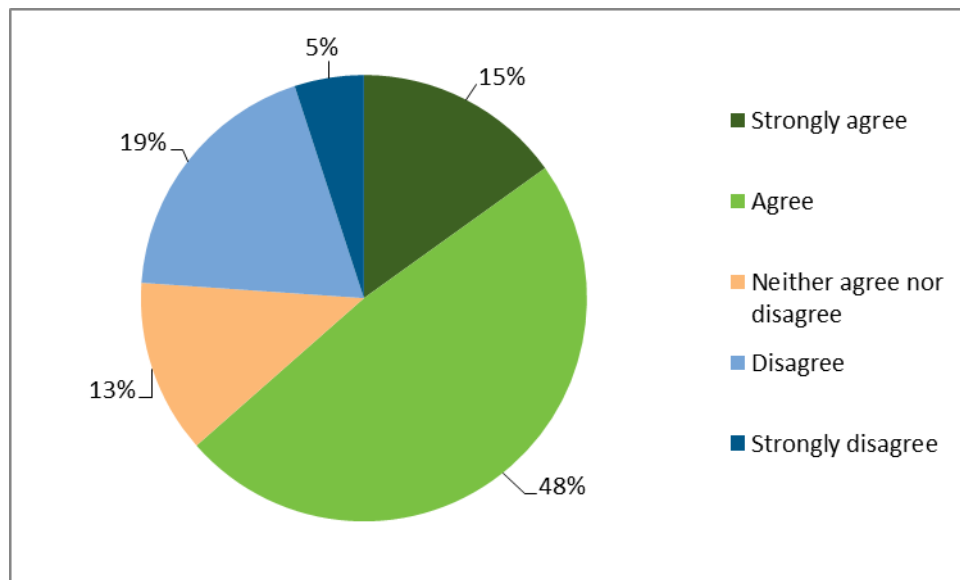
Question 1k: The proposal that no less than 15 per cent of the total marks available in a science GCSE must be used to credit the demonstration of mathematical skills should apply to each of the science GCSE subjects.

159 responses:



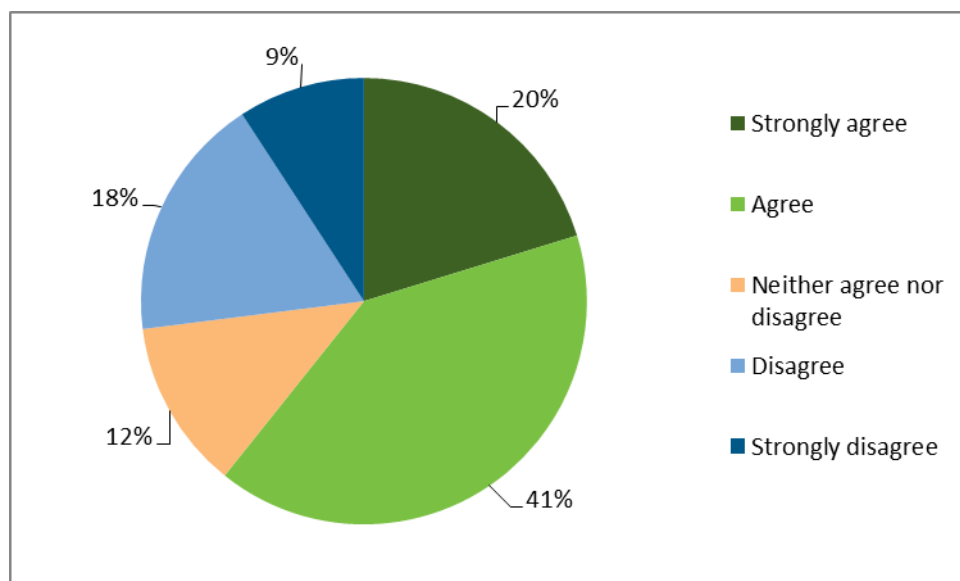
Question 1l: The lists of apparatus and techniques that all students taking science GCSEs will be expected to be able to use are appropriate.

159 responses:



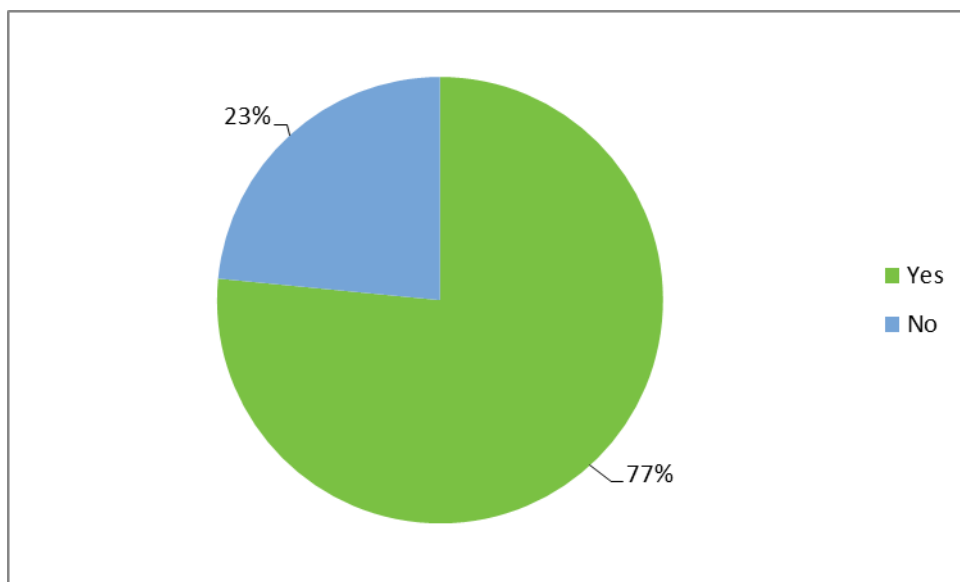
Question 1m: The proposal that exam boards must require each student taking science GCSEs to undertake at least eight practical activities (16 for combined science) is appropriate.

163 responses:



Question 2: Do you have any views about what form the student record should take and the types of information it should contain? If 'yes', please give suggestions below.

162 responses:

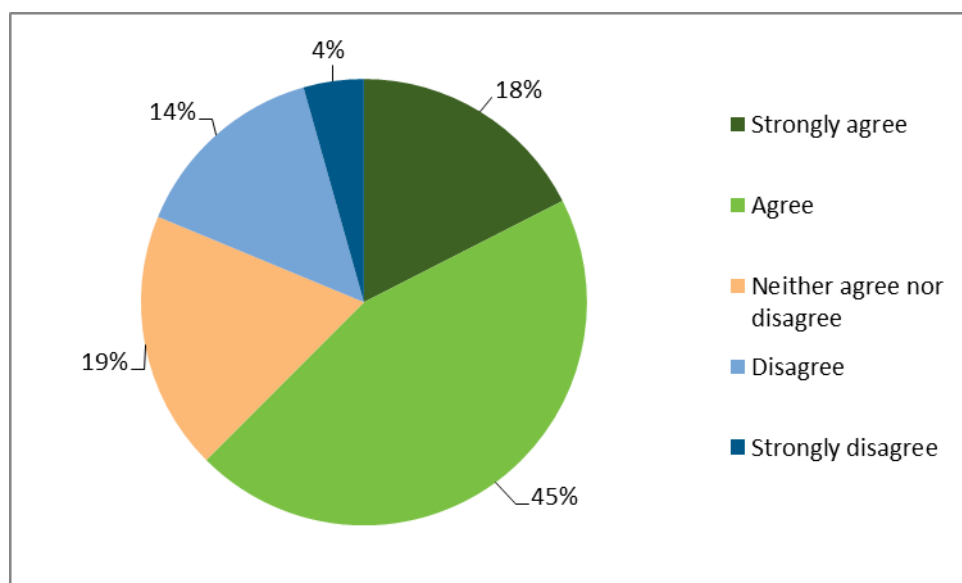


Question 3: We are looking for the approach to the assessment of students' practical science experience that can achieve the best balance between the aims of:

- **delivering the curriculum aims and encourage a wide range of practical science teaching over the period of study**
- **being manageable for schools – taking into account the numbers of students who take science GCSEs, the range of ability and the time typically allocated to each subject**
- **providing valid and reliable assessments – test the right things and do this accurately and consistently, so as to differentiate effectively between students' performance**
- **being able to withstand accountability pressures, that is, to avoid exerting unmanageable contradictions on teachers where they are acting as the assessor and being judged themselves through the outcomes of the assessments they make – the results of their students.**

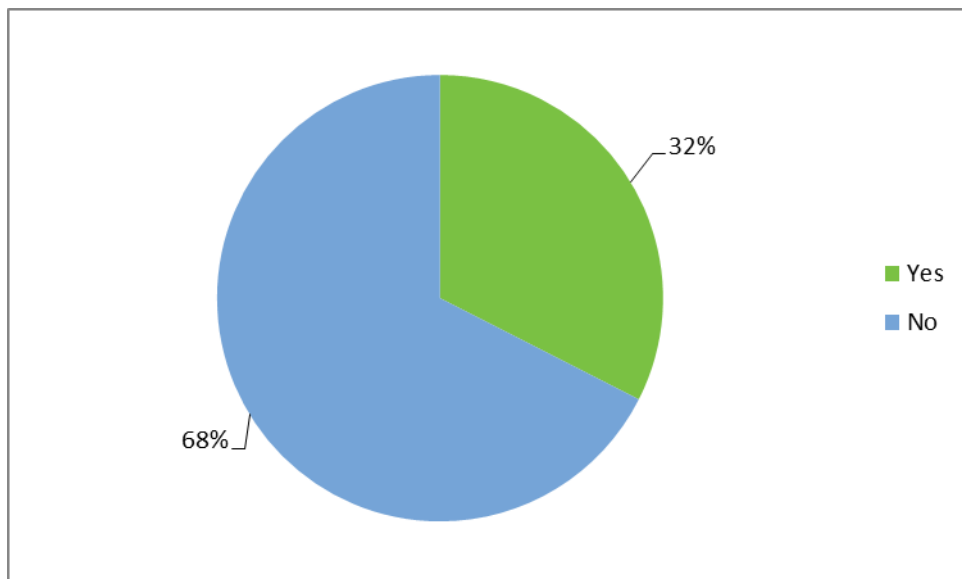
How far do you agree that our proposed model provides the best balance between these aims? Please give reasons for your answers.

160 responses:



Question 4: Do you believe that there is an alternative option that can provide a better balance between these aims?

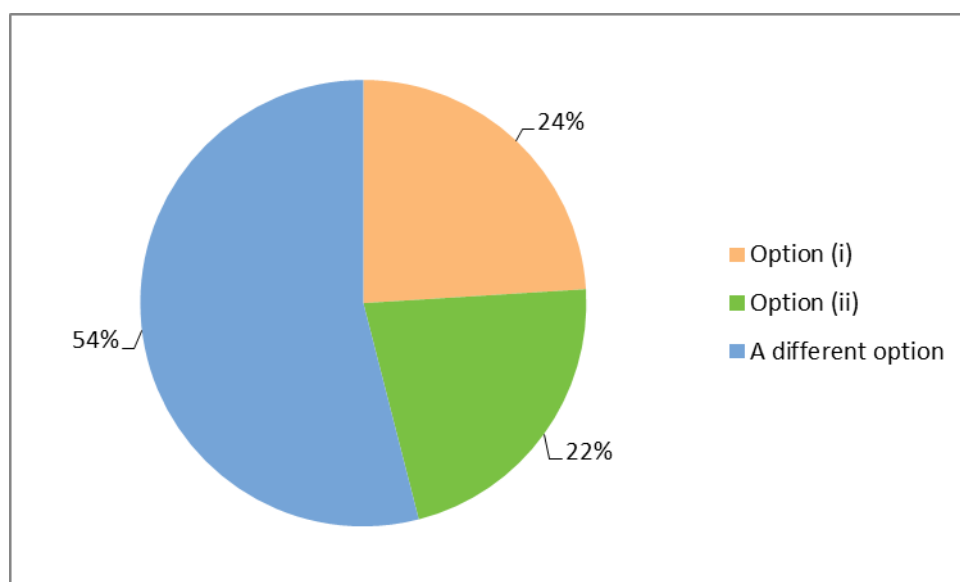
157 responses:



Question 5: If you responded ‘yes’ to question 4, which of the options below do you believe provides a better balance between these aims when used in addition to some science GCSE exam questions drawing on students’ practical science experience? Please give reasons for your answer.

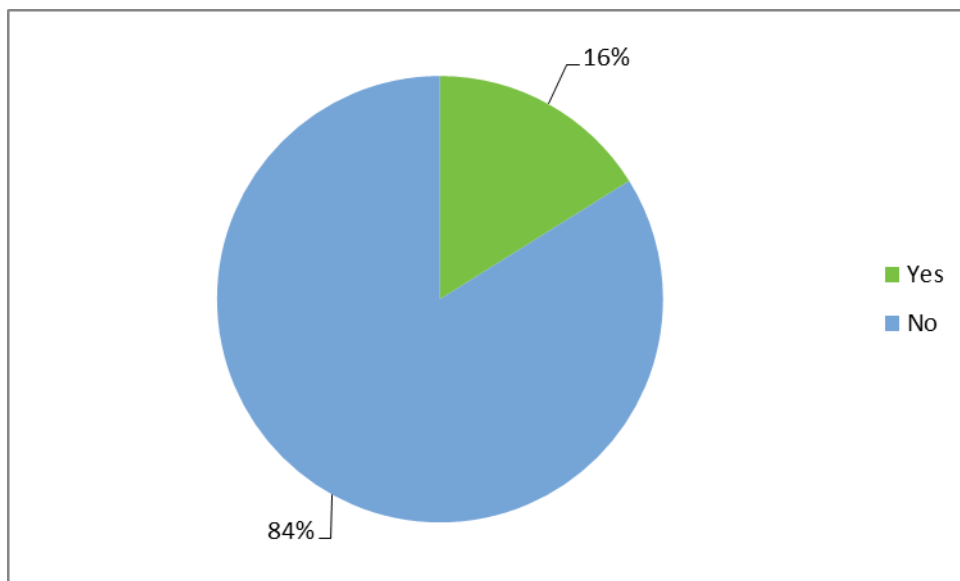
- **Option (i) science GCSE students’ practical skills are directly assessed and marked and that mark contributes to the overall grade. The practical skills are assessed by:**
 - () teachers observing students during the course**
 - () a practical exam testing students’ technical and manipulative skills**
 - () an extended investigation including direct assessment of practical skills**
 - () a portfolio of experiments, detailing methodologies, results and conclusions and including direct assessment of practical skills.**
- **Option (ii) science GCSE students’ practical skills are assessed on a pass/fail basis related to competency with that outcome reported alongside the grade derived from their performance in the exams.**
- **A different option that has not been covered in our consultation (please give full details of your proposed option).**

50 responses:



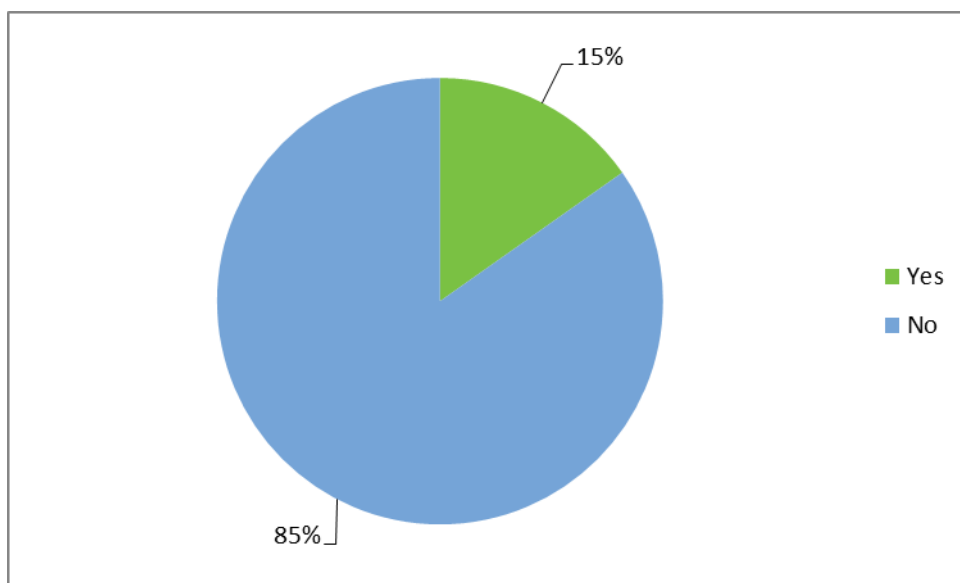
Question 6: We have identified some ways in which our proposals for science GCSEs would impact (positively or negatively) on persons who share a protected characteristic. Are there any potential impacts we have not identified? If so, what are they?

149 responses:



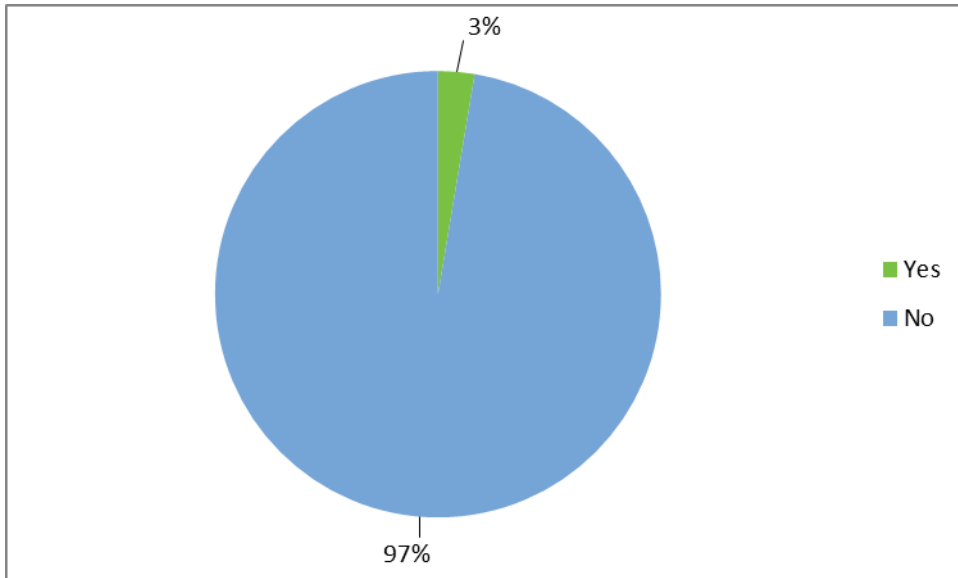
Question 7: Are there any additional steps we could take to mitigate any negative impact resulting from these proposals on persons who share a protected characteristic? If so, please comment on the additional steps we could take to mitigate negative impacts.

151 responses:



Question 8: Have you any other comments on the impacts of the proposals on persons who share a protected characteristic?

152 responses:



Appendix 3 – Organisations that submitted official responses

Name of organisation or group
AQA
Association of School and College Leaders
Association of Teachers and Lecturers
Aylestone Business and Enterprise College
British Science Association
Buckinghamshire County Council
CLEAPSS
Confederation of British Industry
Council for Learning Outside the Classroom (CLOtC)
Education for Engineering
Engineering Professors' Council
Field Studies Council (FSC)
Gatsby Charitable Foundation
Headmasters' and Headmistresses' Conference (HMC)
Independent Schools Association (ISA)
Independent Schools Council
Lancaster Royal Grammar School
Moor End Academy
MyScience: on behalf of National Science Learning Centre and Network and the National STEM Centre
NASUWT
New College Worcester
OCR
Oxfordshire County Council
Pearson Edexcel
Queen Elizabeth School, Lonsdale

Saint George Catholic College
SCORE
Studley High School
Tadcaster Grammar School
University of York Science Education Group (UYSEG)
Withernsea High School
WJEC-CBAC

A further six organisations submitted an official response but requested that their identity be kept anonymous.

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