AQA response to Ofqual GCSE consultation on the Assessment of Practical Work in GCSE Science

04 February 2015

Your details

To evaluate responses properly, we need to know who is responding to the consultation and in what capacity. We will therefore only consider your response if you complete the following information section.

We will publish our evaluation of responses. Please note that we may publish all or part of your response unless you tell us (in your answer to the confidentiality question) that you want us to treat your response as confidential. If you tell us you wish your response to be treated as confidential, we will not include your details in any published list of respondents, although we may quote from your response anonymously.

Please answer all questions marked with a star*

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Would you like us to treat your response as confidential?*

If you answer yes, we will not include your details in any list of people or organisations that responded to the consultation.

( ) Yes (X) No

Is this a personal response or an official response on behalf of your organisation?*

( ) Personal response (Please answer the question 'If you ticked 'personal views'…')

(X) Official response (Please answer the question 'Type of responding organisation')

If you ticked 'Personal views' which of the following are you?

( ) Student

( ) Parent or carer

( ) Teacher (but responding in a personal capacity)

( ) Other, including general public (Please state below)

If you ticked "Official response from an organisation/group", please respond accordingly:

Type of responding organisation*

(X) Awarding organisation
( ) Local authority
( ) School or college (please answer the question below)
( ) Academy chain
( ) Private training provider
( ) University or other higher education institution
( ) Employer
( ) Other representative or interest group (please answer the question below)

School or college type
( ) Comprehensive or non-selective academy
( ) State selective or selective academy
( ) Independent
( ) Special school
( ) Further education college
( ) Sixth form college
( ) Other (please state below)

_____

Type of representative group or interest group
( ) Group of awarding organisations
( ) Union
( ) Employer or business representative group
( ) Subject association or learned society
( ) Equality organisation or group
( ) School, college or teacher representative group
( ) Other (please state below)

_____

Nation*
(X) England
( ) Wales
( ) Northern Ireland
( ) Scotland
( ) Other EU country: _____
( ) Non-EU country: _____ *Consultation on the Assessment of Practical Work in GCSE Science*
Ofqual 2014 34

How did you find out about this consultation?
( ) Our newsletter or another one of our communications
(X) Our website
( ) Internet search
( ) Other

_____

May we contact you for further information?
(X) Yes ( ) No

Questions

Question 1: In relation to our proposed model (page 5 and pages 23 to 29 of the consultation) how far do you agree with each of the following statements? Please give reasons for your answers.

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.

(X) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree
Please give reasons for your answer

We have received overwhelmingly positive feedback from A-level teachers across the country at a wide range of face-to-face events who state that they will do more practical work if the required practicals are specified in the syllabus and rewarded in the question papers. We strongly believe the proposals for GCSE will have a similar response.

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

(X) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree
Please give reasons for your answer

This is in line with current A-level reform development and is well received as being sufficient to assure practical work is adequately rewarded whilst at the same time allowing the rest of the content in the specification to be assessed. This 15% represents assessment of the required practical activities, but it is worth noting that the assessment objectives as proposed also reward the practical skills associated with working scientifically in the context of enquiry, so the percentage of practical and enquiry skills assessed in GCSE papers is likely to be closer to 30% if we factor in planning, recording, analysing and evaluating data.

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.

(X) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree
Please give reasons for your answer (please see below)

The narrow controlled assessment focus distorts the nature of the practical activity and it often becomes more of a hoop-jumping exercise than a rewarding, authentic learning experience. Removing the constraint of the controlled assessments such as ISAs will free up time that can be better used in purposeful practical activity that is in the context of day to day teaching and learning and not a bolt-on event. This will be a more engaging experience for students too and remove some of the unnecessary pressure on both teachers and pupils.

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.

( ) Strongly agree
(X) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree
Please give reasons for your answer

Compliance is very important; however, we strongly believe that there is a need to have a manageable system allowing exam boards to meet the regulatory requirement of ensuring the practical science work is taking place. It is not possible for exam boards to enforce the curriculum, and the delivery of teaching and learning, in schools.

The Head of centre should be accountable for ensuring that students have had the opportunity to develop the skills and procedures as set out in the specification for the science GCSE. This will also ensure that adequate provision in terms of specialist accommodation and equipment is provided.

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).

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
(X) Disagree
( ) Strongly disagree
Please give reasons for your answer

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.

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.

(X) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree

This would deteriorate rapidly into a box-ticking exercise that would do nothing to improve the quality of science teaching and learning, but it would increase the administrative burden on teachers and create huge pressures in large classes.

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

( ) Strongly agree
(X) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree
Please give reasons for your answer

They are broadly in line with A-level assessment objectives, which improves continuity. There are some small improvements that would make them more effective but this has been discussed as part of technical guidance discussions as a part of consultation events beyond this current consultation.

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

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
(X) Disagree
( ) Strongly disagree
Please give reasons for your answer

AQA is concerned that AO3 may be too high to ensure the correct spread of demand across the papers. We would suggest 20% as being closer to what would reflect a good balance at GCSE. 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.

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

(X) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree

( ) Strongly disagree

We would prefer weightings to be the same at each tier in science as this would support the maintenance of standards where there are overlapping tiers. Although the assessment objectives follow a broad Bloom progression, accessible questions can be written for AO2 and 3. Writing papers of comparable standard would be possible if the weightings remain the same.

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.

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
(X) Strongly disagree
Please give reasons for your answer

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.

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.

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
(X) Strongly disagree

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.

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

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
(X) Strongly disagree
Please give reasons for your answer (please see below)

General comments about the apparatus and techniques requirements

There is the potential for repetition and confusion here as the vast majority of the skills and techniques listed are common to Combined Science. It would be more appropriate for common techniques in the different disciplines to be given then separate subject-specific examples if necessary, ideally with a common core for the combined science.

There is a distinct mismatch in the criteria for the three subjects. In Biology and Chemistry the criteria are clearly apparatus and the use thereof, but in Physics they are clearly a list of practical activities to be undertaken.

The criteria in Biology and Chemistry resemble those for the A-levels, giving a (fairly) clear progression, but those for Physics bear no relation to the A-level criteria, so progression from GCSE to A-level in these techniques is not clear.

In Physics, there is an expectation in these criteria that GCSE students (even at Grades 1 and 2) must memorise and recall equations that students at A-level do not need to do.

Some of the apparatus and techniques listed are not covered in the subject criteria for the GCSE Science concerned, meaning we are unable to assess them. Examples include wiring of a 3-pin plug in Physics, food tests in Biology, simple distillation in Chemistry.

The paragraph for GCSE Combined Science states: '… there should be no requirement for the same technique to be exercised in all three of the disciplines.' However, as presently worded, no two techniques listed are the same. It is thus unclear as to how these should be approached in Combined Science, as presently there are 29 criteria listed in total.

Examples include:

Biology bullet point 3 (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) and Chemistry bullet point 3 (measurement of pH using pH charts and digitally)

Biology bullet point 1 (use of appropriate apparatus to make and record a range of measurements (to include mass, time, temperature, volume of gas produced, distribution of organisms) and Chemistry bullet point 1 (use of appropriate apparatus to record a range of measurements (to include mass, time, volume of liquids and gases, and temperature).

Common wording for common techniques would be appropriate.

Some of the criteria (e.g. food tests; use of iron filings and magnetic compasses; simple distillation) are at the level of KS3, not GCSE.

Some of the criteria are too specific, meaning that some more extended practical work (eg factors affecting photosynthesis) could get edged out simply to cover them. Making the points more generic will allow greater flexibility when choosing relevant and engaging practicals for students, solving many of the problems listed above.

Here are some examples of generic points, using those from Biology:

- Use of appropriate apparatus to make and record a range of measurements such as mass, time, temperature and volumes.
- Use of temperature control techniques, such as use of a Bunsen burner or water bath or electric heater.
- Use of methods or digital apparatus such as meters, probes or data loggers to measure factors such as pH, oxygen or light.
- Use of qualitative reagents to identify substances.
- Choice and use of appropriate apparatus for a variety of experimental investigations.
- Use of sampling techniques in fieldwork to investigate the distribution and/or abundance of organisms in an ecosystem.
- Safe and ethical use of living organisms to measure physiological functions and/or responses to the environment.

Subject-specific comments:

Biology

- Distribution of organisms is extremely difficult for many schools to manage – especially inner-city schools that have no access to green areas.
- Point 3 requires expensive equipment, which many schools will not be able to afford.
- Measurement of physiological functions is quite limited (heart rate and respiration).

Chemistry

- Point 4: 'rates of production' should be 'rates of reaction'
- Point 7: Electrolysis is not used to separate mixtures
- Point 8: 'electrochemical cell' should read 'electrolytic cell'
- Point 9 is relates to Chemistry only in the DfE criteria (and Higher Tier). This means we are unable to cover it in Combined Sciences and at Foundation level.
- Eight practicals are needed to cover all the criteria in separate Chemistry, which can be done, but five for Combined Science would not cover all of the criteria.
- Because of the subject criteria, distillation as a practical can only be done as simple distillation – which is KS3 – or as a demonstration using a Leibig condenser or fractional distillation column. All schools have at least one of these.

Physics

- Criteria given for Physics are a list of specific methods or practicals to undertake, which is different from the criteria listed for Biology and Chemistry. There is a real mismatch with the criteria listed for A-level Physics, which is likely to limit and confuse teachers as the language of progression is absent in Physics but clear in Chemistry and Biology.
- The criteria listed give very little scope for meaningful extended investigations, with no explicit underlying skills included (eg wiring of a 3-pin plug, iron filings experiment). The criteria listed mean that 9 or 10 practicals are needed just to cover them all.
- There are no Physics-only criteria listed. All are expected to be completed for Combined Science.
- The criteria listed are not skills: they are just methods.

Suggested possible skills for Physics:

Skill	Apparatus + Technique
A	use appropriate instruments to obtain measurements such as length/distance, temperature, force, angle, volume
B	use appropriate instruments to obtain measurements such as time, current, voltage, resistance, mass
C	use apparatus carefully and safely
D	use a stopwatch or light gates for timing
E	use circuit diagrams to construct a circuit using apparatus such as DC power supply, cells, LDR, diode, lamp, switch, resistor, variable resistor, LED, fuse, thermistor
F	use appropriate apparatus to generate and measure waves (in terms of frequency and wavelength)
G	select and use apparatus appropriately for a range of practical investigations

Combined Science

- There is very limited cross-over between Biology, Physics and Chemistry (see General comments, above).
- Where common techniques appear in different subjects the wording should be the same so that in setting out the practicals for Combined Science we can avoid duplication, as stipulated in the criteria.

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.

(X) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree
Please give reasons for your answer (please see below)

This is broadly in line with A-level where we have consulted widely and received positive feedback on this proposal. Each A-level has a minimum of 12 required practicals so 8 over 2 years for GCSE should be feasible. We would suggest that 15 practicals for double award science would make sense as this would mean 5 in Biology, 5 in Chemistry and 5 in Physics.

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.
(X) Yes
( ) No

It should be the decision of each school as to how they require their students to record appropriate practical work. Slavish use of lab books would consign many students to wasted hours writing up laborious accounts of what they did, how they did it, what they found out, and any conclusions. Many students would spend more time writing than carrying out practical work and this would drive poor teaching and learning behaviours. The lab book is entirely appropriate at A-level but should be optional at GCSE. The type of record will depend upon the type of practical activity carried out.

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 (page 5 and pages 23 to 29 of the consultation) provides the best balance between these aims? Please give reasons for your answers.
(X) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree

This was always going to be a difficult problem but the solution proposed is likely to have the most positive backwash on teaching and learning while achieving manageability and reliability.

Question 4

Do you believe that there is an alternative option that can provide a better balance between these aims?
( ) Yes
(X) No

In the wider science community there is in general a poor understanding of assessment issues around discrimination between hands-on skills and the skewing effect this has on other assessments. Extensive research and experience of a range of models as well as wide-ranging consultation with experts has not yielded a single manageable alternative.

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).
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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?
( ) Yes
(X) No
If yes, please provide them here:

AQA is not aware of any potential impacts, but we believe other stakeholders are best placed to identify these
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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.

( ) Yes
(X) No
If yes, please provide them here:

We are not aware of any additional steps, but AQA believes that other stakeholders are best placed to identify such steps

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Question 8

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

( ) Yes
(X) No
If yes, please provide them here:

No, but AQA believes that other stakeholders would be best placed to identify such impacts

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Accessibility of our consultations

We are looking at how we provide accessible versions of our consultations and would appreciate it if you could spare a few moments to answer the following questions. Your answers to these questions will not be considered as part of the consultation and will not be released to any third-parties.

We want to write clearly, directly and put the reader first. Overall, do you think we have got this right in this consultation?
(X) Yes ( ) No
Do you have any comments or suggestions about the style of writing?
……
……

Do you have any special requirements to enable you to read our consultations? (For example screen reader, large text, and so on)*
( ) Yes ( ) No

Which of the following do you currently use to access our consultation documents? (Select all that apply)*
( ) Screen reader / text-to-speech software
( ) Braille reader
( ) Screen magnifier
( ) Speech to text software
( ) Motor assistance (blow-suck tube, mouth stick, etc.)
( ) Other: