Course report 2019

Subject	Biology
Level	Advanced Higher

This report provides information on candidates' performance. Teachers, lecturers and assessors may find it useful when preparing candidates for future assessment. The report is intended to be constructive and informative and to promote better understanding. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

The statistics used in this report have been compiled before the completion of any post-results services.

Section 1: comments on the assessment

Question paper

The question paper was designed to have the appropriate balance of questions testing demonstrating knowledge, applying knowledge, and skills. All questions were answered, so all were accessible. Most candidates attempted all, or most, of the questions. There was no evidence that candidates had difficulty completing the question paper in the time available. Markers commented that the course coverage was good, the balance of the paper appropriate, and the level of demand fair. There were straightforward questions balanced by those designed to be more challenging.

There was, as in previous years, a very wide range of marks achieved. While many candidates coped well with the question paper, a large number did not appear to be well prepared for the scale and demand of the assessment. Candidates displayed competency in a wide range of problem-solving skills, and coped particularly well with calculations and selecting information. Markers commented that some candidates' literacy skills were affecting their ability to express ideas clearly and accurately. The legibility of some candidates' handwriting continues to be an issue for markers.

Overall, the question paper proved more challenging than predicted, and this was taken into consideration when setting the grade boundaries.

Section 1

Most candidates coped well with Section 1 of the question paper. The ability to recall knowledge in this section was generally very good. Many candidates also successfully applied their knowledge and demonstrated the ability to use a variety of problem-solving skills when responding to multiple-choice questions.

Section 2

A number of candidates demonstrated sound knowledge across the curriculum as well as the ability to apply this knowledge at the right depth in novel contexts. There were however, candidates who seemed to have limited knowledge of the course content or a generally weak grasp of biology at this level. It remains the case that some candidates with a reasonably good grasp of the content from the *Cells and Proteins* and *Organisms and Evolution* units, had a much poorer understanding of the theory covered in the *Investigative Biology* unit. Candidates did very well in questions that required them to give terms, or make relatively simple statements. However, they found questions that required them to show a greater degree of reasoning and understanding, and apply knowledge in unfamiliar contexts, more difficult.

Project

A small increase in the average score indicates that attainment in the project continues to improve. Although markers noted that some candidates carried out work that was rather simplistic for this level, the majority of reports demonstrated suitable challenge. The large variety of topics investigated is testament to the support given by centres to candidates to allow them to carry out novel and interesting work. As in previous years, candidates scored well in the 'Procedures' and 'Results' sections, with the 'Discussion' section proving more challenging, as expected.

A small number of projects exceeded the word count and incurred a penalty for doing so.

It remains a concern that some very poorly performing candidates appeared to have had little engagement with laboratory work when completing their report.

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper

Section 1

Candidates performed well in this section of the question paper. Candidates answered questions 8, 13, 14, 15, 18, 21 and 25, which assessed knowledge and understanding, particularly well. Candidates coped particularly well with many of the questions that assessed problem-solving skills: questions 3, 7, 19 and 23.

Section 2

Question 1	Most candidates coped well with selecting information and describing relatively straightforward trends.
Question 1(c)(ii)	More than half of candidates were able to describe a cost of external fertilisation.
Question 1(d)(i)	This question was answered correctly by a majority of candidates.
Question 1(e)(i)	This question was answered correctly by a majority of candidates.
Question 3(a)(i)	A very high proportion of candidates were able to name retinal.
Question 3(a)(ii)	Over half of candidates were able to explain the functioning of rods in low light intensity in terms of the degree of amplification.
Question 4	Candidates coped well with the complex context of this question.
Question 4(a)	Most candidates gave the correct terms.
Question 4(b)(i)	Most candidates gave the correct terms.
Question 4(b)(ii)	A large number of candidates were able to link ligand binding to conformational change.
Question 4(c)(i)	Many candidates were able to describe the reaction catalysed by a kinase.
Question 4(c)(ii)	Candidates responded well to this question, which required them to link information about the cholera toxin to that given about the CFTR protein.

Question 5(b)	Most candidates gave good suggestions why data from a questionnaire might be inaccurate.
Question 5(e)	Successful candidates identified that causation cannot be assumed from observational studies.
Question 6	Most well-prepared candidates scored two or more marks for describing how animal behaviour can be measured and recorded. Many candidates were able to describe latency, frequency, and duration and knew the importance of avoiding anthropomorphism. Many referred to ethograms; although some did not seem to be aware that these are lists of species-specific behaviours used when observing animals. Although a number knew time budgets were constructed using data obtained from observation, some seemed to confuse time budget with ethogram.
Question 7(a)(ii)	Many candidates were able to use the information about the life cycle of the parasite to explain why the cricket is the definitive host.
Question 7(b)(ii)	Most candidates described a behaviour, other than movement, that can be altered as part of the extended phenotype of a parasite. Some chose to give specific examples, which was acceptable as long as the example was clearly linked to an appropriate behaviour, such as feeding.
Question 7(d)	Most candidates recognised the correct phylum.
Question 8(a)(i)	Most candidates were able to give a non-specific immune response.
Question 8(a)(ii)	Candidates responded well to this relatively challenging question, with most scoring at least 1 mark. 1 mark was often gained by recognising the importance of antigen change. In stronger responses, candidates linked this with the immune system to explain why new vaccines are developed annually.
Question 8(b)(i)	A high proportion of candidates gave the term ‘virulence’.
Question 8(b)(ii)	Many candidates were able to carry out this calculation.
Question 9(a)	Most candidates were able to describe the meaning of the term ‘hermaphrodite’.
Question 9(b)	A very high proportion of candidates gave the term ‘sexual dimorphism’.

Question 9(d)(iii)	Many candidates were able to suggest a suitable advantage of greater size.
Question 10A	Candidates gave very good accounts of insulin signalling and diabetes. Many also gave detailed and accurate descriptions of the binding of signalling molecules to their receptors. It was, however, notable that the idea of specificity was missing from some accounts. Many described examples of intracellular responses.
Question 10B	Candidates gave good accounts of the phases of the cell cycle and its control by checkpoints. Candidates found part (ii) more challenging, but many still gave good responses. Although most were aware of cyclins and cyclin-dependent kinases (CDKs), some seemed to think cyclins combine with kinases to form CDKs.

Project

It was clear that the majority of candidates had invested appropriate time and effort in planning and carrying out laboratory work at an appropriate level of demand for Advanced Higher. It was also apparent that most had read the instructions for candidates and had tried to follow its guidance.

Abstract

A very high proportion of candidates provided a suitable aim, together with the main findings of their investigation. Where this mark was not awarded, it was usually because the stated aim lacked reference to both the independent and the dependent variables, or the findings stated were not consistent with the data presented.

Introduction

A large majority of candidates gave an acceptable aim and hypothesis. Failure to clearly state both the independent and the dependent variables or hypotheses, lacking appropriate directionality were common reasons why this mark was not awarded. Although the quality was very variable, as in previous years, the vast majority of candidates made a reasonable attempt to describe underlying biology, with most achieving two or more marks for their accounts.

Procedures

Most candidates used methods that were broadly appropriate to their aim(s). The majority also gave clear and sufficiently detailed descriptions of their procedures; almost all candidates were awarded at least one mark for description of procedures. Very few candidates lost a mark by not writing in the past tense and impersonal voice (usually for providing a list of instructions). Most candidates described appropriate controls or explained why they were not required. Candidates were aware of the need for repeats and replicates, with most gaining the mark for having an adequate sample size. A very high proportion of candidates carried out work that was sufficiently complex in terms of technical difficulty

and/or experimental design. Most candidates now seem aware of the benefits of carrying out pilot studies, and many candidates described pilots that had an impact on the final procedures used.

Results

Most candidates demonstrated good presentation skills and, therefore, did well in this section. Very few candidates did not present results that were relevant to their aim(s). The majority of candidates included their raw data in the body of the report or an appendix, but some claimed an inappropriate degree of accuracy in the raw data or derived mean values. Although the quality of presentation was sometimes disappointing for candidates at this level, most chose appropriate formats to present data. A variety of graphical methods were used effectively. However, some candidates inappropriately chose to use a bar chart when the independent variable was continuous Most candidates described the trend(s) in their data satisfactorily.

Discussion

Although the discussion section was, overall, a very challenging part of the report, most candidates gave conclusions that were relevant to their aim(s).

Presentation

A very high proportion of candidates had clearly followed the guidance given and produced a project report with an appropriate structure. Many reports were easy to follow, with each individual section under clear a heading.

Areas that candidates found demanding

Question paper

Section 1

Candidates found questions 5, 6, 11, 16, and 24 particularly demanding. In question 11, candidates confused the whiskers on the box plots with error bars. In question 24, some candidates appear to have missed the ‘least’ in the stem of the question.

Section 2

Question 1	Many candidates found the data-handling question challenging. While the data-handling is intended to be demanding, some candidates did not seem prepared to cope with complex data in an unfamiliar context.
Question 1(a)	Many candidates simply noted that the points on the graph were scattered. Only a small number used the data to describe the lack of correlation between age and size.
Question 1(b)	Few candidates recalled this knowledge from the *Investigative Biology* unit. Some candidates confused review articles with abstracts.
Question 1(c)(i)	The relatively simple answer required was not obvious to most candidates.

Question 1(d)(ii)	Candidates did not seem to appreciate that the positive correlation in Figure 3b was much weaker than that in Figure 3a.
Question 1(e)(ii)	Although a large proportion of candidates answered correctly, many missed the connection between March and April.
Question 1(e)(iii)	Many candidates missed the importance of the decrease being unexpected and therefore gave incorrect responses around the normal lifecycle of the squid.
Question 2	Candidates found this description of an immunoassay a challenging context.
Question 2(a)(i)	Few candidates could state what is meant by a monoclonal antibody.
Question 2(a)(ii)	Several candidates omitted this question.
Question 2(b)	Candidates did not refer back to the procedure described in the question and instead gave generalised responses about cross-contamination or lack of antibody specificity. A few referred to washing, but at the wrong stage.
Question 2(c)	Many candidates failed to link a change in pH to the mandatory knowledge of protein structure.
Question 2(d)	Although candidates recognised that the parasite would be using energy, many did not go on to link that to the energy available for milk production. Some poor understanding was also evident with candidates suggesting the parasite was drinking the milk.
Question 3(a)(iii)	Candidates' knowledge of bacteriorhodopsin was generally poor. Some candidates focused their response on ATP synthase, and some others confused bacteriorhodopsin with photosynthetic pigments.
Question 3(b)	Many candidates described the information in the figure and did not refer to the photoreceptor proteins.
Question 3(c)	Many candidates found it difficult to link the information from the two figures. Some were unable to express their ideas clearly.
Question 5	As in previous years, candidates demonstrated a relatively weak grasp of the mandatory knowledge from the *Investigative Biology* unit.
Question 5(a)	Few candidates were able to state what is meant by the term 'epidemiology'. Many gave only partial statements.
Question 5(c)(i)	Candidates tended to give vague responses that were not related to the specific context of the question.
Question 5(c)(ii)	Few candidates were able to link selection bias with an unrepresentative sample.
Question 5(d)	Few candidates appreciated that wider confidence intervals are associated with data that is more variable.
Question 7(a)(i)	The term 'symbiont' is poorly understood, candidates need to understand that it is not restricted to parasites.
Question 7(b)(i)	Many candidates simply restated information from the diagram and missed the link with transmission of the parasite.
Question 7(c)	Few candidates recognised the reproductive strategy described as monogamy.
Question 9(c)	Some candidates confused sex change with sex determination.

Question 9(d)(i)	Some candidates gave a general description of the purpose of a control, rather than a response that related to the specific context of the question. Of the candidates who referred to the different numbers in each group, few went on to link that to different increases in size.
Question 9(d)(ii)	Some candidates simply restated results, rather than drawing a conclusion for the given data.

Project

Introduction

Relatively few candidates achieved more than two marks for underlying biology. This is because accounts lacked the necessary breadth and depth. It remains an issue that candidates often fail to address biology that is fundamental to the topic being studied, while presenting large amounts of information that is not clearly linked to the aim(s).

In addition to some accounts of underlying biology being superficial for this level, it was also reasonably common to see significant errors and inaccuracies in the biology presented. These issues may be, at least in part, a consequence of candidates obtaining information from poor-quality sources. Although most candidates tried to provide justification for the work carried out, some justifications were only tenuously linked to the actual investigation.

Procedures

There has been an increase in the number of candidates being awarded both marks for the description of procedures. However, for most candidates two marks were not awarded, because some key information required to repeat the procedure was missing. Most candidates seemed aware of the need to control confounding variables, yet relatively few did this satisfactorily. It was common for candidates to acknowledge, and attempt to justify, a failure to control or monitor, key confounding variables. Although many candidates referred to independent replication, fewer gained credit, because a description of how independent replication was achieved was absent or insufficient.

Results

Overall, the quality of data presentation remains disappointing. As in previous years, basic errors with headings, scales, labels, units, and plots meant candidates were not awarded the mark available for the quality of tables and graphs. Since the criteria for gaining this mark are similar to those at lower levels, most Advanced Higher candidates should be capable of producing tables and graphs of acceptable quality. Although more candidates summarised data by combining data sets, many failed to do so. In some cases, candidates presented summarised data in a graph, but the graph was not supported by an appropriate table.

Discussion

This is a demanding section of the report, which requires candidates to have a detailed understanding of both their particular project and the theory within the Investigative Biology unit. Many candidates found this part of the report particularly challenging. Candidates often took an overly simplistic approach and failed to show depth of understanding of the key issues affecting the validity and reliability of conclusions.

Although most candidates included a conclusion that was relevant to their aim, only a small proportion of conclusions were valid. In some cases, this was because the stated conclusion did not accurately reflect the data presented. As in previous years, the majority of invalid conclusions were the result of factors, such as the failure of candidates to adequately control or monitor key confounding variables; the absence of appropriate controls; and inadequate repeat or replicate measurements.

When evaluating procedures, some candidates provided little more than a description of equipment and the possible errors associated with their use. While some discussion of this nature may be relevant and appropriate, in many cases the accounts demonstrated little awareness of the bearing on validity and reliability. When evaluating procedures, candidates often mentioned controls, but few explained their importance. Discussion of reliability was commonly restricted to simple statements that the inclusion of repeats and replicates increased reliability. Candidates continue to identify flaws, such as a failure to control key confounding variables, which should be addressed at the planning stage of the investigation. Many candidates included a discussion of pilot studies, but they often failed to adequately address how these had affected the final experimental design. These issues were very similar to those encountered in previous years with, again, a very small proportion of candidates scoring both the marks available for the evaluation of procedures.

The evaluation of results proved to be, as expected, the most challenging part of the report. Many candidates were not awarded any marks for evaluating results, and very few achieved all three marks. Although these are demanding marks, many candidates showed little understanding of the need to make sense of their results. Investigations that were too simplistic offered limited scope for meaningful discussion. It was rare for candidates to discuss the variation in results between repeats and replicates. A large number of candidates attempted to use statistical analysis and, while this is welcome, some candidates seemed to have a weak understanding of the statistical tools they used. Some candidates calculated values, such as standard deviation and standard error, but made no reference to them in their discussion. Candidates frequently plotted range bars and then used them inappropriately to conclude that differences between values were not significant. Few candidates attempted to relate their findings to relevant biology. This was, for some, the result of a failure to include appropriate background information, including information from previous studies, in the underlying biology section.

Presentation

Few candidates gained the mark for citing and listing a minimum of three references using either the Vancouver or Harvard system of referencing. This remains an issue. Many of the difficulties arose from candidates using websites as sources but commonly failing to identify required information, such as the organisation responsible for the material. Many candidates listed only the URL and date accessed. Identifying journal articles when they were accessed online also seemed to cause candidates difficulty. Some candidates listed a URL instead of the correct journal reference. Many candidates did not follow the guidance about referencing carefully enough.

Section 3: preparing candidates for future assessment

The mandatory course content for Advanced Higher Biology has been reviewed and some areas of content have been removed. Teachers and lecturers must ensure that they are using the revised Advanced Higher Biology Course Specification from session 2019–20.

Question paper

From session 2019-20, the question paper will total 100 marks. Section 1 will contain multiple-choice questions worth 20 marks. Section 2 will consist of structured items worth 80 marks. The duration of the question paper will increase by 30 minutes because of these changes.

Candidates should be prepared to answer questions that ask them to demonstrate and apply the mandatory knowledge from the course. This mandatory knowledge is outlined in the course specification. The course support notes (appendix of the course specification) provides further detail on the depth of knowledge required for each key area of the course. The key areas **and** the depth of knowledge **can be assessed in the question paper**.

Markers observed that, as in previous years, many candidates struggled to cope with detailed descriptions or the application of knowledge in unfamiliar contexts. These are assessed in the Advanced Higher question paper, and candidates should be given opportunities to become familiar with the standard required at this level.

Candidates should be encouraged to read questions carefully, perhaps underlining key information to help ensure they are focusing on the question asked. They should pay close attention to information given in question stems and be prepared to apply knowledge to novel contexts when required. Candidates also need to be aware that, when directed to relate an answer to specific data or a particular context, they cannot gain credit for generalised responses.

Project

Candidates completed a diverse range of projects this session. Centres should continue to provide these opportunities.

Teachers and lecturers must ensure that they are using the revised *Advanced Higher Biology Project Assessment Task* from session 2019–20. The revisions to the Advanced Higher Biology Course have resulted in some changes to the marking instructions for the project. Teachers and lecturers should familiarise themselves with the updated marking instructions at an early stage in the course.

The instructions for candidates has also been revised. Candidates must make use of the updated instructions throughout the entire process of planning, executing and reporting their investigations. Candidates could also use other publications to support them with the project, such as the guides produced by SSERC: *Advanced Higher Biology Project Investigations*, and *Statistics for School Biology Experiments and Advanced Higher Projects*. These are available on the SSERC website.

Although candidates can modify their aims as their investigations progress, it is essential that they formulate a clearly stated aim at a very early stage in the planning process. Candidates should be encouraged to apply their knowledge of investigative biology to develop sound protocols with appropriate controls, procedures that allow key variables to be controlled, a reasonable sample size and independent replication. The degree of challenge should be appropriate for work at this level. Pilot studies to develop procedures, assess validity, and refine techniques should be included. Descriptions of procedures should make clear the controls that were used, how confounding variables were controlled, the sample size used and how independent replication was achieved.

When considering what to include in the account of underlying biology, candidates should try to ensure they have focused on information that is most relevant to their investigation's aim(s). The account needs to have sufficient depth to support later discussion of the results obtained. Candidates must be aware that they should not limit themselves to theory covered within the Advanced Higher Biology Course because reading beyond the scope of the mandatory knowledge is anticipated at this level. To help avoid using incorrect or unscientific information, candidates should be encouraged to consider the quality of the sources they are using during their research

Candidates should be encouraged to continue to use a variety of graphical presentations to display data in interesting and informative ways. They should consider what they have learnt from previous levels to ensure the quality of presentation is appropriate. Candidates should combine data from replicates to present summarised data; this does not stop them also presenting data in other ways.

When evaluating procedures, candidates must go beyond a description of procedures and explain how aspects of their experimental design were required to allow valid conclusions to be drawn. The use of statistical analysis by candidates in the evaluation of results is encouraged. Candidates using statistical analysis need to understand the statistics they are using to prevent errors in interpretation. All candidates would benefit from using an analysis of the variation between repeats and replicates to support discussion about whether variability is due to error in laboratory practice, intrinsic variation in the biological samples studied, or the treatments that have been planned. Candidates often find it particularly difficult to interpret results that do not match their hypothesis and/or previous findings. In these instances, they should try to distinguish between the effects of methodological weaknesses and treatments that have no effect.

Candidates must present all references using Harvard or Vancouver referencing. It is essential that they follow closely the guidance given in the instructions to candidates.

Markers raised a number of concerns about the safety of some of the procedures candidates seemed to have undertaken. Many of these concerned projects using microbiological techniques. Ethical concerns arising from the use of living organisms (including human volunteers) were also raised. The safety and wellbeing of those carrying out, or participating as volunteers in, Advanced Higher Biology investigations is paramount, and staff supervising projects need to be aware of the need to comply with all relevant safety and ethical regulations and codes of practice.

When submitting their report, candidates should ensure the stated word count is accurate and within the limit.

Grade boundary and statistical information:

Statistical information: update on courses

Number of resulted entries in 2018	2319

Number of resulted entries in 2019	2314

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

Distribution of course awards	Percentage	Cumulative %	Number of candidates	Lowest mark
Maximum mark				
A	24.6%	24.6%	569	75
B	24.7%	49.3%	571	64
C	24.8%	74.1%	575	53
D	12.3%	86.4%	285	47
No award	13.6%	-	314	-

General commentary on grade boundaries

SQA's main aim is to be fair to candidates across all subjects and all levels and maintain comparable standards across the years, even as arrangements evolve and change.

SQA aims to set examinations and create marking instructions that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional C boundary)
- a well-prepared, very competent candidate to score at least 70% of the available marks (the notional A boundary)

It is very challenging to get the standard on target every year, in every subject at every level.

Therefore, SQA holds a grade boundary meeting every year for each subject at each level to bring together all the information available (statistical and judgemental). The principal assessor and SQA qualifications manager meet with the relevant SQA head of service and statistician to discuss the evidence and make decisions. Members of the SQA management team chair these meetings. SQA can adjust the grade boundaries as a result of the meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper has been more, or less, challenging than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper is more challenging than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual.
- Where standards are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from question papers in the same subject at the same level tend to be marginally different year to year. This is because the particular questions, and the mix of questions, are different. This is also the case for question papers set by centres. If SQA alters a boundary, this does not mean that centres should necessarily alter their boundary in the question papers that they set themselves.