



Course Report 2016

Subject	Biology
Level	Advanced Higher

The statistics used in this report have been compiled before the completion of any Post Results Services.

This report provides information on the performance of candidates which it is hoped will be useful to teachers, lecturers and assessors in their preparation of candidates for future assessment. It 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.

Section 1: Comments on the Assessment

Summary of the Course assessment

Component 1: Question paper

This was the first year of the new course which brought significant changes to the question paper: a reduced total number of marks (100 reduced to 90), the removal of the optional units, and a move to a structured question paper.

Markers commented that candidates coped well. The inclusion of support lines helped candidates judge the length of answer required. Markers reported that there was no evidence that candidates struggled to complete the assessment in the time available, and that the majority of candidates attempted all questions.

The assessment was designed to have the appropriate balance of demonstrating knowledge and understanding, applying knowledge and understanding and skills questions. Markers commented that there was a good balance of knowledge and problem solving questions, and that the coverage of the course was balanced and fair.

This component generally performed as expected although, inevitably, some questions proved more or less challenging than anticipated. All questions were answered correctly by some candidates so all were accessible. Overall the assessment proved slightly more challenging than predicted. This was taken into account when setting grade boundaries.

Component 2: Project

Although many aspects of the project remained familiar, there were some significant changes. The total marks were increased from 25 to 30, and a word count penalty was applied for the first time. The additional marks are intended to allow candidates to access more marks for carefully planned and executed scientific investigations. This component is now supported by an Investigative Biology Unit with which all candidates should be thoroughly familiar.

Markers reported a wide variety of topics had been investigated and attainment varied considerably. Although the vast majority of candidates had been well-prepared, and provided with the most up-to-date information for candidates, some markers did note concern that this did not always appear to be the case. It was disappointing that, despite the support of the Investigative Biology Unit, and the opportunity to access more straightforward marks with the new marking instructions, the overall proportion of marks gained in this component has not improved on that achieved in previous years.

It is hoped that, as centres become more familiar with the changes, attainment in this component will improve.

Section 2: Comments on candidate performance

Areas in which candidates performed well

Component 1: Question paper

Candidates performed very well in Section 1, with a similar level of attainment to previous years. When responding to objective items candidates demonstrated the ability to both recall and apply knowledge and to use a variety of problem solving skills. It is very good that candidates performed better than expected in questions requiring processing skills, as this was felt to be an area of difficulty.

In Section 2 markers commented that, although specific difficulties were encountered, most candidates appeared well prepared to answer questions relating to the Cells and Proteins and Organisms and Evolution Units. Knowledge of the content of the Investigative Biology Unit was less consistent. A good proportion of candidates showed a wide range and depth of knowledge as well as excellent problem solving skills. Candidates performed particularly well in questions requiring terms or definitions.

Section 2

- 1(a)(i)(ii)(iii): Most candidates showed a good understanding of box plots, which they were dealing with in an Advanced Higher Biology question paper for the first time. Although most made good sense of the box plots, some candidates went wrong as they saw the 'whiskers' as error bars.
- 1(b)(i): Most candidates were aware of the importance of the error bars not overlapping when determining significance.
- 1(c)(i): Most candidates were able to describe the relationship between longevity and fecundity, even if they found interpreting the difference between infected and uninfected difficult.
- 3(a): Most candidates were able to identify the independent variable.
- 3(d): Although some candidates gave an answer that was too generalised, many candidates were able to identify an issue of reliability relating to the study in question.
- 3(e): Most candidates were able to describe an ethical consideration relating to studies involving human subjects.
- 4(a): Many candidates successfully recognised the correct class of amino acid.
- 4(b): Most candidates correctly identified a type of secondary structure from the figure (α -helix was far more common than turn).
- 4(c): Many candidates gave good, concise explanations of cooperativity.
- 5: Many candidates gave very thorough and accurate accounts of spindle fibres and their role in cell division.

- 6(a): Many candidates correctly identified maintaining osmotic balance as a function of sodium potassium pumps. Alternative answers were less common and correctly described less often.
- 7(a)(i): Most candidates knew the water channels are called aquaporins.
- 7(a)(ii): Many candidates correctly named the process as signal transduction.
- 7(b)(i)(ii): Many candidates understood the data well and used correct calculations in their responses.
- 7(b)(iii): Many candidates correctly recognised that a lack of ADH must be the cause of recruitment failure in this case. Candidates offering additional possible causes relating to receptor function did not demonstrate the correct understanding.
- 9(b)(ii): Most candidates could state a factor that can increase the rate of evolution.
- 10(a): Most candidates were able to give the term sexual dimorphism.
- 11A(i): Many candidates were able to describe costs of sexual reproduction in terms of only half of the population being able to produce offspring and the disruption of successful genomes due to only half of each parent's genome being passed on (points 1, 2, and 3). A number of candidates were able to relate sexual reproduction with increased genetic variation (point 4).
- 11B(i): Many candidates discussed the difficulties associated with rapid antigenic change, vaccine design and the culturing of parasites (points 2, 3, and 4).

Component 2: Project

The majority of candidates had clearly invested appropriate time and effort in planning and carrying out their laboratory work and producing the report for this demanding and rewarding component of the course.

- Section 1: Most candidates provided a suitable abstract under a separate heading as required. Some included hypotheses which are unnecessary.
- Section 2: Most candidates included appropriate aims/hypotheses in this section. Most candidates made a reasonable attempt to present relevant underlying biology with some ideas presented to an appropriate depth, and explained clearly and accurately.
- Section 3: Most candidates used procedures that were appropriate to their aims and gave good descriptions of the methods used. Very few candidates failed to describe procedures in the past tense and impersonal voice. Most candidates included appropriate controls; the impact of the Investigative Biology Unit was evident here, with many candidates referring to both positive and negative controls. Whilst issues remain around independent replication, a large

proportion of candidates had carried out appropriate repeats. Most candidates made reference to pilot studies.

- Section 4: Most candidates presented results that were relevant to the aims of their investigation. Most presented all the raw data, with many opting to put large quantities of raw data into an appendix to improve the clarity of the results presentation. When this mark was not awarded the inclusion of an inappropriate number of decimal places in average values (claiming a degree of accuracy not justified by the measurements) was often the problem. A variety of presentation formats was used with candidates making good use of graphs and charts, including the appropriate use of box plots and scatter graphs. Most candidates gave statements of trends following each table/graph.
- Section 5: This was the weakest section of the project reports. Most candidates were able to draw conclusions that were relevant to the aims of their project even if they found other aspects of this section challenging. A significant number of candidates attempted statistical analysis.
- Section 6: Most candidates produced project reports that were appropriately structured, and the majority were within the word limit. The majority of titles were acceptable, with most indicating the dependent and independent variable as well as the organism/context being investigated.

Areas which candidates found demanding

Component 1: Question paper

Section 2

- 1(c)(i): Although, as described above, most candidates were able to successfully describe the relationship between longevity and fecundity, very few used the term negative correlation. Many candidates were unable to compare the two lines of best fit to conclude that the relationship was more negatively correlated in uninfected mosquitoes. Some candidates thought that, despite the lines of best fit being presented, no relationship existed between longevity and fecundity.
- 2: This question proved challenging for the majority of candidates. Markers commented that performance in this question was disappointing as it appeared to be quite straightforward.
- 2(a): Most candidates were unable to state that serum provides growth factors. Some referred to growth factors but seemed to think they acted as nutrients.
- 2(b)(i): Candidates found difficulty with this calculation. Examples of similar calculations can be found in the Advanced Higher Biology Specimen Question Paper and the Advanced Higher Biology (Revised) question papers.

- 2(b)(ii): Most candidates were unable to describe a disadvantage of using a haemocytometer to perform cell counts. Those who had the opportunity to use a haemocytometer may have benefitted from this practical experience.
- 2(c): Most candidates made reference to the Course Assessment Specification (CAS) entry (tissue sections, whole organisms or parts of organisms) in their responses.
- 2(d): Candidates familiar with the 3Rs of replacement, reduction, refinement did not experience difficulty with this question. However, a significant number of candidates seemed unaware of this concept.
- 3(b): Most candidates did not appear to be familiar with the term '*in vivo*' and gave responses relating to the fact the patients were being treated at home or in familiar surroundings.
- 3(f): Many candidates gave responses that were descriptions of trends rather than conclusions based on the trends. A number of candidates did not appreciate there was insufficient data to give a conclusion based on a dose-related trend from Table 2.
- 4(d): Many candidates appeared to miss the importance of the difference in gradients of the two lines after 20 units of pressure so didn't clearly describe that beyond this pressure the increase for normal is greater.
- 4(e): Only a small number of candidates correctly applied their knowledge of amino acid and protein structure to give a suggestion based on the effect of charge/hydrophobicity on the interactions between protein molecules. Most candidates gave descriptions based on hydrophobic interactions within rather than between haemoglobin molecules.
- 6(c): Many candidates failed to state that digoxin would prevent potassium ions from binding.
- 8(a): Many candidates did not name gamete mother cells as the type of cell that undergoes meiosis. A number of candidates gave 'gametes' as their response, which may have arisen from careless reading of the question.
- 9(a): Many candidates didn't focus on the most significant change.
- 9(c): Most candidates did not give an appropriate answer for this level and state representative samples should have the same mean, or degree of variation from the mean, as the population as a whole.
- 10(b)(i): Most candidates had difficulty explaining what is meant by a lekking species. Some candidates thought a lek is the group of males. The importance of males gathering or competing was often missed.

- 10(b)(ii): Most candidates had difficulty explaining why the capercaillie's display is given as an example of sexual selection. Candidates seemed unclear about the idea that traits subject to sexual selection increase an individual's chance of reproductive success, and therefore failed to relate the display to an increase in the male's chance of mating. Some candidates focused solely on female choice (one mechanism of sexual selection), without reference to this leading to increased reproductive success of the chosen male.
- 10(b)(iii): Many candidates had difficulty stating the benefit to the female of receiving honest signals. Many answers simply stated that females would be able to choose the 'best mates' without reference to the increased fitness of offspring.
- 10(c)(ii): Many candidates had difficulty applying their knowledge of honest signalling to explain why the peacock 'solo' hoots could be regarded as a dishonest signal.
- 11A(i) Few candidates made reference to the red queen hypothesis (point 6).
- 11A(ii): Relatively few candidates made reference to asexual reproduction as a successful strategy in narrow, stable niches or when recolonising disturbed habitats (points b and c). Some candidates appeared to be confused and stated that hermaphrodites used asexual reproduction.
- 11B(i): Many candidates discussed sanitation and parasite transmission, but few referred to the difficulty/expense of making improvements (point 10).
- 11B(ii): Although many candidates made reference to increased survival or improved development/intelligence, this was not always linked to children (points a and b).

Component 2: Project

- Section 2: A relatively small number of candidates scored full marks in this section. The reasons for this were varied, but often related to a failure to include important information and/or a depth of discussion that showed poor understanding at this level. Whilst most candidates attempted to justify the work being carried out, the justifications given were sometimes not clearly related to the actual work being undertaken.
- Section 3: Although most candidates gave coherent descriptions of the procedures used, many failed to score full marks for 3(b) as some details were omitted that meant two marks could not be awarded. While many candidates correctly identified and included appropriate controls, some did not seem to be aware that if no controls are used (eg if the relative effects of two treatments are being compared), justification should be given as to why controls are not included. Although many candidates seemed familiar with the term 'confounding variable' only approximately one third adequately controlled the key variables that could impact on validity.

Fewer than half of the candidates achieved the mark for evidence of independent replication. Some were clearly confused about the distinction between repeats and independent replicates. As described in the marking instructions, independent replicates represent an entirely separate data set. Relatively few candidates scored full marks for 3(g); some candidates did pilot experiments but did not capitalise on this work in their report by making clear the modifications/improvements they made as a result of these preliminary findings.

Section 4: Markers reported disappointment in the quality of the tables, graphs, and charts presented. There was evidence of carelessness with table headings and graph scales and labels that prevented 4(d) being awarded. When candidates failed to achieve 4(e), which relates to the summarising of data, this was often because, rather than plotting average values, candidates plotted the results of repeated experiments separately. It was also fairly common to see summary graphs not supported by an appropriate table.

Section 5: A small number of candidates gave a conclusion that could be regarded as valid. Centres and candidates should be aware that a conclusion cannot be judged to be valid if there is no independent replication if confounding variables have not been controlled.

The evaluation of procedures and results continues to prove challenging to candidates. The evaluation of procedures was often a rather low level discussion of possible errors arising from instruments. Candidates continue to give reasons why key confounding variables were not controlled or independent replicates were omitted because of lack of time, which cannot gain credit.

When evaluating results few candidates managed to give an adequate discussion of how much repeat/replicate values varied by, or an explanation of how this might have happened.

It was also rare to see candidates making effective use of the information presented in the introduction to discuss their findings. Although a number of candidates tried to use statistical analysis, candidates seemed unsure how to interpret this information or failed to attempt to discuss this in the evaluation.

Section 6: Some candidates put important information that should have been in the main body of the report into appendices. The marking instructions allowed for any standard referencing system to be used but a number of candidates used an inconsistent approach.

Section 3: Advice for the preparation of future candidates

Component 1: Question paper

Markers commented that whilst the knowledge of the content from the Cells and Proteins and Organisms and Evolution Units was good overall, learning of the mandatory knowledge from the Investigative Biology Unit was less than expected. Candidates need to be clear that mandatory knowledge from all three units will be assessed in the question paper. In addition to the 2016 question paper, the specimen question paper, exemplar question paper and revised question papers provide suitable examples of how this knowledge may be assessed.

Candidates should be encouraged to read questions carefully, underlining key information to help ensure they are focusing on the question being asked. Candidates should also be encouraged to provide a sufficiently focused response. Whilst including additional information in a response will not necessarily result in any loss of marks, candidates who continually stray from the main points are using up time and may come under time pressure.

Most candidates used the space available to show working, and this is to be encouraged as it makes it easier for them to check their work. Candidates should be reminded that units will usually be required in numerical answers.

Markers commented that the handwriting of some candidates was difficult to read. Candidates should be reminded that markers need to be able to read their work, and centres should provide appropriate support if they identify candidates who struggle to write legibly.

Component 2: Project

Most candidates produced reports with an appropriate structure, which suggests candidates had access to the *Instructions for Candidates*. Candidates should be advised to refer to this document throughout the process of completing their project and the associated report to ensure that all sections are addressed thoroughly. The guides recently produced by Scottish Schools Education Research Centre (SSERC), 'Advanced Higher Biology Project Investigations' and 'Statistics for School Biology Experiments and Advanced Higher Biology Projects', are extremely useful and can be downloaded from the SSERC website.

As in the past, the completion of a successful project requires careful planning. Candidates often try to increase the complexity of their work by attempting to address many different aims. Candidates need to be wary of this as it can result in an overwhelming amount of data, which they find difficult to present and interpret coherently. At the other extreme, some candidates carry out work that is so straightforward that the results generated offer little scope for discussion; this should also be avoided.

During the planning stage, candidates should focus on having a sound protocol with appropriate controls, control of confounding variables, a reasonable sample size and independent replication. The use of pilot studies to develop procedures, assess validity and refine techniques is to be encouraged. If candidates have a valid design with reliable data, this will provide a solid basis for discussion later in the report.

Markers expressed concern about potential safety issues relating to the practical work being carried out by some candidates. These concerns included the use of very toxic chemicals in large quantities and the culturing of microbiological materials that could contain pathogens, sometimes at 37°C. Concerns about ethical issues relating to some studies involving a variety of species including humans were also raised. Centre staff supervising projects need to be aware of the need to comply with safety regulations, and due consideration must be given to the ethics of the experiments being carried out.

Candidates should be reminded that when presenting their data in tables, graphs and charts they should consider what they have learned from previous levels to ensure the quality of presentation is adequate.

It is encouraging that a significant number of candidates this year attempted some statistical analysis of their data. Candidates will benefit more from including statistics if they have an understanding of their use in assessing variance. Candidates should be encouraged to consider which statistical tests would be most appropriate for a given project at the planning stage.

Grade Boundary and Statistical information:

Statistical information: update on Courses

Number of resulted entries in 2015	0
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Number of resulted entries in 2016	2362
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Statistical information: Performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark -				
A	24.3%	24.3%	574	79
B	28.5%	52.8%	674	68
C	27.4%	80.3%	648	57
D	10.3%	90.6%	243	51
No award	9.4%	-	223	0

General commentary on grade boundaries

- ◆ While SQA aims to set examinations and create marking instructions which will allow a competent candidate to score a minimum of 50% of the available marks (the notional C boundary) and 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.
- ◆ Each year, SQA therefore holds a grade boundary meeting for each subject at each level where it brings 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. The meetings are chaired by members of the management team at SQA.
- ◆ The grade boundaries can be adjusted downwards if there is evidence that the exam is more challenging than usual, allowing the pass rate to be unaffected by this circumstance.
- ◆ The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual, allowing the pass rate to be unaffected by this circumstance.
- ◆ Where standards are comparable to previous years, similar grade boundaries are maintained.
- ◆ An exam paper at a particular level in a subject in one year tends to have a marginally different set of grade boundaries from exam papers in that subject at that level in other years. This is because the particular questions, and the mix of questions, are different. This is also the case for exams set in centres. If SQA has already altered a boundary in a particular year in, say, Advanced Higher Biology, this does not mean that centres should necessarily alter boundaries in their prelim exam in Advanced Higher Biology. The two are not that closely related, as they do not contain identical questions.
- ◆ 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.