External Assessment Report 2013

Subject(s)	Biology
Level(s)	Advanced Higher

The statistics used in this report are pre-appeal.

This report provides information on the performance of candidates which it is hoped will be useful to teachers/lecturers in their preparation of candidates for future examinations. 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 question papers and marking instructions for the examination.

Comments on candidate performance

General comments

Presentations for Advanced Higher Biology continue to increase. Prior attainment at Higher was better than last year, and the mean score for 2013 also improved against last year's by approximately 4%.

More markers noted how well prepared and better-coached candidates were; the examination component did indeed have a higher mean score (by about 5%).

The mean score for Section A was a little up (one mark) on the mean for the last ten years, and for the Investigation component, it was almost identical to all other years.

Improved knowledge and understanding was reflected most in questions relating to Unit 2, the environment topic (Section B, Q1-4). Performance in Unit 1 (molecular biology) was on a par with previous years. Approximately only 20% of candidates opted for essay A on transgenic plants; many wrote knowledgeably. The other essay option on cell proteins scored only a half mark more.

There appears to have been a further increase in uptake of the Option Physiology, Health and Exercise (to approximately 92%), and a corresponding decrease in the Option Topics, Biotechnology (to approximately 1%) and Animal Behaviour (to approximately 7%). Mark distributions were comparable between the latter two options (mean 9.5 and 9.7). Performance in Physiology was slightly higher.

Given the breadth of knowledge and insight required at this level of Biology, candidates face a major challenge putting together good performances in all three components. The number of candidates who achieved that this year was impressive. Unfortunately, there were also many centres where the entire presentation performed poorly; concepts were undeveloped or poorly expressed in the exam, and Investigations were trivial and perfunctory.

Candidates can reach the highest standards if they spend time in the lab developing practical skills and a good Investigation, and have spent time in tutorials clarifying concepts with experienced and knowledgeable teachers.

Areas in which candidates performed well

Numerical questions were generally done very well in all sections of the examination. Both essays were done very well by large numbers of candidates. Understanding of Unit 2 items was good and many more candidates scored highly in the physiology option than previously.

Section B

- Question 1: Many candidates had good knowledge of the expected impact of exotic species and were quick to see from the data that the alien *Daphnia* had a greater adaptive response to the presence of chemical markers released by predators.

- Question 3a), b) and c): Most candidates recognised *climax* community and how an ecosystem may change during succession.
- Question 4c): Most candidates knew that physiological conformers have a restricted habitat range.
- Question 5a)c): Good knowledge of steroid role in membranes, and data was well handled.
- Question 6a): The majority of candidates knew the role of MPF; the context provided was careful to stress the dynamic, active nature of its control.
- Question 8 A and B: Both were done well by many candidates.

Section C

The following items were done well by most candidates:

- Biotechnology: 1b), c)i), 4b)i), ii).
- Animal Behaviour: 1b)i+ii), c), 4b), d)
- Physiology, Health and Exercise: 1b), c), 3a), b) and c), 4b).

Areas which candidates found demanding

Extended response items (essays and mini essays) have high discrimination values; candidates who do well in these also do well in the other questions in the examination. These candidates are well prepared, have good recall, and they are able to express ideas correctly and clearly. Approximately 25% of the examination uses this style of question: Q8 (15), Q2 (5) and Options (5). The Investigation Report imposes a similar demand on extended writing, but the groundwork for it lies in sound experimentation and little on recall.

Candidates can lose marks in any item because clarity is missing, either in basic understanding of the biology or in expressing thoughts as text. They can also lose marks by not reading correctly; questions are worded very precisely and they need to be read carefully. Candidates need to recognise what is given; assume all information provided has a purpose. Terms or descriptions used in the stem of a question are not normally going to be part of the answer; stress that, quite commonly, content in the stem will have been given to push for a more thoughtful answer, not to make it easier.

The most common errors are outlined below.

Section B

Question 1b)i):	Not using data from the graph, as instructed; using data for day 45 rather than day 41.
Question 1c)i), ii):	Lack of understanding that control data in graph 3 show head spines are already present in the native species; not seeing that the measure eliminates body size as a variable by making it the reference point.
Question 2:	Many candidates wrote too much and strayed from the theme. There were also misconceptions. The title is about energy flow; energy enters ecosystems as light and ultimately leaves as heat. Misconceptions: plants make their own *energy*; heat *and* respiration are separate losses, rather than respiration producing the heat; ecological efficiency not defined and taken to be always

10%; energy is *used for* respiration.

Question 3c)ii), iii): These were poorly done. The text provided clues to the answers: cutting and rolling will leave the rhizomes underground to *regrow*. Many did not see herbicides as lethally toxic to bracken or make the link to syllabus concepts of specificity, persistence and magnification. Again this year, it was not uncommon to read that pesticides cause eutrophication and algal bloom.

Question 4a),b): Many candidates did not understand that the graphs combined to show a change in energy demand when the *Gammarus* switched from being an osmoregulator to an osmoconformer as sea water salinity increased. Many thought the question was about *Gammarus* being able to regulate its oxygen uptake in changing salinities.

Question 5b)i), ii): Part i) is asking for generic information about regulatory enzymes in pathways and how they are modulated. Many candidates scored only one of the two marks available. Part ii) is specifically about how cholesterol formation can be limited by the interaction of statins with the reductase enzyme and it required a more thoughtful answer than many set out. There were many weak answers, for example 'statins are competitive inhibitors and compete for the active site of the reductase'. Too many candidates thought the substrate has the active site and not the enzyme.

Question 6b), c): Many candidates took part b) to be asking what is *monitored* at checkpoint 3; for part c), most did not use the information provided about enzymes in the second sentence, and did not follow carefully how M-cyclin changes in relation to checkpoints.

Question 7 This question revealed several issues relating to DNA profiling. Many candidates recited the characteristics of probes but missed the point that the *role* of the probe was to reveal the location of DNA fragments of different length in the gel, and hence 'genotypes'. Many thought that child D had only one parent or had only one chromosome fragment rather than two fragments of the same length.

Question 8A: Many answers simply had poor knowledge of the processes involved in plant transgenics. Part c) has some complex detail, and candidates were often unclear about what was being cultured.

Question 8B: Many candidates had little accurate knowledge of the cytoskeleton and failed to mention microtubules. Some misconceptions arose quite frequently in relation to membrane bound receptors. The idea of signal transduction was confused and not seen to be an effect of the receptor being a transmembrane protein. Hydrophilic and hydrophobic processes were conflated. For example, receptors for hydrophilic signals were described as carriers for transferring hydrophilic signalling molecules into the cell to bind to gene regulatory proteins. Some went to considerable effort to explain how hydrophobic signals/steroids enter cells by diffusion through channels. Many thought the receptors were glycoproteins for

cell-cell recognition.

Section C

Biotechnology

Markers did not highlight any specific issues, but the following items did not score well in the small number of candidates sampled:

- Question 1b): In previous papers, the formula for growth rate constant (k) was provided; in this examination, candidates were expected to know that k=ln2/g and collect the value of *g* from the table. This proved difficult for some candidates.
- Question 3a)i): The role of error bars has been tested regularly in recent exams. The error bars show that the conclusion is valid for soya and wheat but not cottonseed.

Animal Behaviour

Question 1a), d): It was anticipated that this question would be straightforward. However, candidates of all abilities did not score well. Part a): in dung beetles, at low frequency of courtship, females choose large males but increasingly prefer small males as courtship frequency increases. Part d): rather than seeing the obvious point that nesting females would be camouflaged to avoid predators, many candidates guessed the dimorphism was allowing females to assess potential mates without being spotted.

Question 2b): Many candidates had not heard of the *per* gene protein controlling circadian rhythms; even fewer knew that different alleles generate other versions of the protein, which produce altered daily rhythms.

Question 4e): Most candidates find questions about experiment protocols quite difficult. Here the item was looking for any confounding variable that would invalidate the data, eg. the method eliminates habituation or other learning.

Physiology, Health and Exercise

Question 1a): This question was poorly done. In the Introduction to this Option topic in the Arrangements document (p46), the main focus of paragraph two is coronary heart disease (CHD). The question here is very clear that heart disease is the focus. Many candidates gave well-rehearsed descriptions of plaque formation but omitted to mention it is atherosclerosis in *coronary* arteries that leads to difficulties: blockage, angina, clots, and MI.

Question 2: Many candidates wrote large amounts on this theme but without mentioning that osteoporosis is associated with loss of bone (mineral) density. It was necessary to recognise osteoporosis in this way in order to elaborate on the effects of exercise. Expression and/or understanding were often poor, eg where candidates believed the condition could be *prevented* by exercise.

Investigations

Marking instructions for this component are available on SQA's website, and staff in centres can mentor candidates and initially supervise the experimental design aspects (Outcome 1) of the work via the 'daybook'. Despite this however, many Investigations score badly.

Some Investigations are too simple and are little more than a practical from a lower level. Some have inappropriate methods for the idea being tested; some have uncontrolled variables or lack a valid control. Others can be attempting too much, having several inputs and several outcomes to monitor. The former have too little of value to discuss; the latter have overwhelming amounts of data that can't be processed sensibly. Many are designed badly.

It is important to keep focused on what the investigation is — an early attempt by candidates to follow the 'scientific method'. They are attempting to design an experiment that will be an honest attempt to refute a hypothesis. If they have a valid design and reliable data, candidates will have a good deal of information to discuss at the end of the Report (Section 5 of the marking instructions).

In the examination, data-handling items are normally based on published scientific papers. Candidates recognise that, in these items, error bars show there was measurement variance between samples used in the study and that these reliability measures for the data underpin the validity of conclusions. Markers look for this same insight when marking Investigations.

Candidates could possibly attain better scores by setting up two or more independent runs of the whole plan. Sub-samples from within each run will usually vary and, with biological material, there will be variation between independent runs. All this measurement variance has to be documented and explained, and its impact on conclusions weighed up. It can be more valuable and more economical to have more repeats than more variables.

Advice to centres for preparation of future candidates

There is Investigation guidance on SQA’s website for candidates and teachers; this is an essential read. Centres are also advised to read the annual External Assessment Reports, which are published on SQA’s website, as well as the examination paper and the marking instructions, to pick up on common errors and misconceptions.

As an aid to improving Investigation scores in the current syllabus, centres are advised to study the content of the *Investigative Biology* Unit in the Revised Advanced Higher Biology course, which deals with scientific method and Investigation planning. SSERC will be publishing a resource to support this new topic, elaborating on the content of the Unit and linking it to the slightly revised marking instructions.

Statistical information: update on Courses

Number of resulted entries in 2012	2417

Number of resulted entries in 2013	2458

Statistical information: Performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark 125				
A	26.4%	26.4%	648	85
B	29.7%	56.1%	730	73
C	22.9%	78.9%	562	62
D	9.2%	88.1%	225	56
No award	11.9%	100.0%	293	-

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 Business Manager 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, Higher Chemistry, this does not mean that centres should necessarily alter boundaries in their prelim exam in Higher Chemistry. 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.