



## External Assessment Report 2011

Subject	<b>Biology</b>
Level	<b>Advanced Higher</b>

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

Although the average performance in AH Biology this year almost exactly matched that of previous years (the mean score out of 125 was 68.4 in 2009, 67.4 in 2010, and 68 in 2011), there was evidence of improving quality at the top end of the mark range being balanced by worsening performance at the bottom end.

Every year the best candidates show remarkable competence over a whole range of demands. They achieve a high scoring Investigation, show insight into the subtleties of concepts, clarity in the various lengths of written response, and sustained awareness in novel problem-solving contexts. Most are outstanding in the script component of the assessment, but not so good in the Investigation. At the other end of the performance range, it is clear that some candidates are less prepared for these challenges.

The mean scores for main sections of the written exam were much the same as in other years. In Section A (Component 1), the multiple-choice questions, the mean was 18.6/25 compared to 17.4 in 2010; the mean for the written paper (Component 2) was 35.4/75, almost identical to the last two years; and the Investigation mean (Component 3) was 14.1, a score that has barely fluctuated over six years.

Analysis of the item scores for questions on the mandatory Units shows that candidates scored about the same in each: the Unit 1 mean was 49.3% of the marks available and the Unit 2 mean was 47.8%. The extended responses (essays), both from Unit 1, scored about the same on average (Question 8A mean = 8.5; Question 8B mean = 9.3); choice B was answered more frequently. The slight improvement in essay performance was balanced by slightly poorer knowledge evident in the other Unit 1 questions, as discussed below.

The Optional topics showed the same discrepancies in uptake as in previous years but the performance across them was equal: *Biotechnology* had an uptake of 5%, with a mean score of 9.8; *Animal Behaviour* uptake was 9% with a mean score of 9.8; *Physiology, Health and Exercise* (PHE) uptake was 86% with a mean score of 9.9.

There is a difference in success rates between Sections A and B. Section A is designed to span across the Arrangements and test recognition, Section B probes recall and understanding. It takes time, effort and rehearsal by candidates to move from recognition to understanding.

## Areas in which candidates performed well

In Section B, Questions 8A and 8B extended responses were both done well, with many candidates scoring full marks. Many candidates thoroughly and competently explored differences between prokaryotic and eukaryotic cells. Knowledge of detail in the cell cycle and mutations that can give rise to tumours were well understood.

Most candidates wrote to the headings provided and the majority of answers were clearly expressed and legible. Once again, where themes matched those tested in previous years, the well-rehearsed candidates scored easily. There were numerous outstanding performances in each of the Optional topics. Some candidates answered all the questions superbly.

Numerical questions were less frequent this year but they were generally well done, notably B2(b), B5(b), Behaviour 1(a)(i), PHE 2(b)(i). The conversion back from indices to numbers in Biotechnology 4(b)(iii) was a challenge for quite a few candidates.

Many candidates showed good understanding of graphical data: QB1(c), B2(b), B5(a)(i), B6(b)(i); *Biotechnology* 4(b)(i); *Animal Behaviour* 1(a) and (b), and 4(b); *PHE* 4(b)(ii).

There was very good knowledge of the following: greenhouse effect (B2); the ideas of allogenic succession and bioaccumulation, B3(a)(ii) and (b)(i); some aspects of the question on *niche* (B4); the hydrophilic nature of neurotransmitters, B6(a)(i); and techniques following PCR, B7(b).

In Investigations, there was a general improvement in presentation, where candidates followed the prescribed layout; almost all were word-processed. However, while there are clear benefits of typed work over handwritten work from an editing perspective, there were still errors in tabulation and graphing that IT packages cannot highlight, and may even have caused.

As in other years there were some excellent Investigations that were models of good science. The work was interesting, at a suitable level of demand and set up in such a way at the practical level that judgements could be made about the validity of conclusions.

## **Areas which candidates found demanding**

The standard of English employed by most candidates was high, indeed some achieved an enviable level of clarity. However, large numbers do not express themselves adequately. For candidates who write well it is obvious when they have misunderstood a concept: for others, it is difficult for Markers to tell if they have grasped an idea or just expressed it poorly. In general, when there has been adequate rehearsal, answers tend to be well put.

Section B of the exam probes candidates' understanding of concepts: the main knowledge is either set out in the context or checked in the early items of the question.

QB1: This year the long data question tested the Arrangements areas of *parasitism* and *host-parasite specificity*. About two-thirds of candidates could explain parasitism well, B1(a)(i), but only about a third of candidates understood that the parasite in the question is *obligate* because it cannot feed, reproduce or complete its life-cycle outside a host, B1(a)(ii). Most parasites are obligate. Facultative parasites can obtain food away from, and complete their lifecycles without, a host.

The context for the items in B1 requires careful reading. It is clear in the text that only one species of snail can be the second host but mammals other than humans can become infected too and act as primary hosts to the adult flatworms. That is, host specificity is broad.

Commonly candidates thought *broad* referred to the parasite's dependence on both the snail and humans rather than on a range of mammal primary hosts. So in B1(e), many missed the point that keeping cattle away from the lake minimises their infection and also their capacity to put eggs into the lake, and the further point of testing lake water on mice for the presence of second stage parasites.

B1(b): 'Superspreaders' were individuals who missed the drug treatment and were still passing faeces into the lake; they needed health education about the parasite's lifecycle and the benefit of sanitation — not advice on how to wash and keep bacteria from spreading, as many candidates thought.

B2: Most candidates scored well. The main error was failing to attribute enhancement of greenhouse gases to human activity.

B3: Only a quarter of candidates could define *facilitation*, B3A(i), and many missed the idea that biomagnification would increase an already high level of toxicity to the point where no animals could survive a food chain based on *A. bertolonii*. *A. bertolonii* could be used as an indicator, not because its abundance increases with nickel concentration as many thought, but because of its abundance relative to other species.

B4: The usual misconceptions with *niche* showed up. The definition should refer to resource requirements of *a species* and distinguish between fundamental and realised on the basis of competition. It has to be clear, however, that the competition is *interspecific*. Two members of the same species naturally have the same requirements and may occupy the same niche in the same area at the same time. Competitive exclusion is a long-term effect of species with the same niche being present together when resources are limited.

Common misconceptions in B4 included: confused use of *individual*, *organism* and *species*; confusion of habitat and niche; the idea that competition always involves 'fighting'.

B5 tested understanding of protein structure and its implications. Major issues arose for candidates who did not know about levels of protein structure. Most candidates had difficulty with quaternary structure; they thought that myoglobin, made of only one polypeptide, has **less** quaternary structure than haemoglobin with four. Many were also under the impression that prosthetic groups are not present at the tertiary level, even though myoglobin must have a haem group.

B6: The main issue was candidates did not know that activation of membrane receptors brings about signal transduction.

B7: There were several difficulties in this question. The primers in PCR are made of single-stranded *DNA*, not RNA as they are in cellular DNA replication. The screening test gave a negative result for the  $\Delta F508$  mutation, ie showed the mutation was absent. Many took this to be a 'bad news' outcome, ie a positive screening result. Many candidates confused genes and mutations; they thought that only one gene rather than one mutation had been discounted by the test and that other genes might still cause CF.

There are one or two points to clarify in the extended responses.

8A: DNA in a nucleoid is double-stranded; some referred to it as single-stranded, probably to avoid confusion with the paired chromatids that arise in eukaryotic cells; plasmids are *in addition* to the nucleoid; the importance of the cytoskeleton in the dynamic distribution of organelles in eukaryotic cells was commonly missed.

8B: Details of mitosis were poorly described in a large number of responses. The detail needed for this level includes the role of microtubules as spindle fibres, chromosomes aligning on the metaphase plate and events occurring in the correct phases. Chromosomes are attached to centromeres when (just before) metaphase starts; metaphase continues until all the centromeres are attached to a microtubule from each pole, and they are all aligned on the equator/metaphase plate. (Anaphase does not start if even one chromosome is not attached.) During anaphase, the new chromosomes are pulled to opposite poles.

Issues arose when candidates confused meiosis and mitosis and talked about homologous chromosomes pairing up. These candidates (and others) discussed mutations in part (iii) of the essay as they would have discussed germ line or inheritable mutations at Higher. They were unclear that mutations giving rise to tumours are in somatic cells.

Oncogenes are mutated genes where there is a 'gain-of-function', whereas when tumour suppressor genes mutate there is 'loss-of-function'. Oncogenes promote cell division by the overproduction of a stimulatory protein; such mutations can be at any level in signalling and transduction. Tumour-suppressor genes, such as the p53 gene, act at checkpoints; they generate proteins that block progress through the cell cycle when conditions are not met. Loss of function at these points allows cells to divide though damaged and unrepaired.

There was some confusion in answers about the role of the protein MPF at both the G2 and M checkpoints. A little clarification is given below, not to extend the Arrangements but to show the connection.

Transition from G2 into mitosis and from metaphase to anaphase are both governed by checkpoints. The G2 checkpoint controls entry into mitosis: a cyclin protein (M-cyclin) has to reach a critical concentration for triggering the required cell changes. The M checkpoint delays events until all chromosomes are attached to both poles by microtubules and aligned centrally on the metaphase plate. As soon as this is achieved, separation of chromatids is triggered. The key events at this point are the digestion of the proteins holding together the attached sister chromatids and the digestion of M-cyclin proteins, which are currently blocking changes in other cell proteins that drive anaphase. A decline in M-cyclin is associated with the transition to anaphase. (Alberts B, et al (2008), *Molecular Biology of the Cell 5th Edition*, Garland Science, New York, pp1060-1090, Chapter 20 and others.)

Performance in the Optional Units is dependent upon candidates either knowing or not knowing facts; 15 of the 20 marks are for KU.

In the Physiology option, some candidates made the same errors that were seen last year, when relying on inaccurate knowledge from Higher Biology, eg on the regulation of increased blood glucose (see the 2010 EA Report for a detailed discussion).

## **Advice to centres for preparation of future candidates**

### **General**

Centres are advised to issue their candidates with the 'Guidance to Candidates' document and encourage candidates to follow this when producing their reports.

As mentioned in last year's EA Report, many issues regarding Investigations were discussed in the 2008 EA Report. Centres are advised to refer back to these reports. Centres are also advised to use the mark scheme for investigations. These documents can be downloaded from SQA's website ([www.sqa.org.uk](http://www.sqa.org.uk)).

A document, *Suggestions for Investigation*, was produced in 2005 to cover common strategies for types of investigation: this is accessible on SQA's secure website, which centre SQA Co-ordinators can access.

Centres should help candidates understand that it is not enough to incorporate controls and replicates in the design of experiments and then believe that a valid design equates to valid conclusions. Candidates need to know that they must look at their numerical results critically to evaluate how reliable they are. They must check if replicate values vary excessively and judge if variance in replicate values of controls exceeds any treatment effects. This level of science gets the evaluation marks.

An emphasis in this report has been on how critical it is to their success for candidates to have time to discuss concepts and correct misunderstandings. Teachers are advised to make use of the exam commentaries provided in the EA Reports to aid their students' learning.

## Statistical information: update on Courses

Number of resulted entries in 2010	2,177
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Number of resulted entries in 2011	2,288
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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 125				
A	21.8%	21.8%	499	82
B	26.0%	47.8%	595	69
C	27.0%	74.8%	617	57
D	9.4%	84.2%	215	51
No award	15.8%	100.0%	362	-

## **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, therefore, SQA 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 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.