External Assessment Report 2012

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

The number of candidates taking AH Biology increased again and is now about 2,400. This group had the best average grade coming through from Higher since prior attainment information became available in 2006. Their mean score in Advanced Higher was about 2% more than in the last few years.

Improved overall performance has arisen mainly from improvement in the script component (Component 2) of the assessment. The mean score of 17.7 in Component 1, the objective test questions, was one mark down on last year but about normal for the last ten years. Component 3, the Investigation, was identical to previous years (mean = 14.1). But there was an increase from 35.3/75 to 38.2/75 in Component 2: it takes a substantial number of candidates improving performance to shift the average of such a large group.

There was evidence of candidates having more breadth of knowledge and more accurate knowledge than in previous years, as highlighted below. When the Units are compared, against each other, the two Units scored about the same: Unit 1 average, 51.8% of the marks and Unit 2 average, 53.7%. Against previous years, each Unit showed an increase: about 1–2% in Unit 1 and about 6% in Unit 2. A small part of this improvement came from extended responses (essays) where the mean score was 8.5/15, about one mark up on comparable years.

Essay A (on niche and competition) scored 7.3/15 and Essay B (on decomposition and nutrient cycles) scored 10.3/15. However, only about one-third of candidates chose B.

Only 2% of candidates (compared to 5% last year) tackled the Biotechnology option and their mean score was 8.6, down slightly on previous years. Uptake of Physiology, Health and Exercise (PHE) increased by 3%, to 89% of all candidates; scoring was broadly the same as in previous years. Animal Behaviour presentations were unchanged but the mean mark (13.7/20) was about four marks up on previous exams.

Given the breadth of knowledge and understanding required at this level of Biology, candidates face a major challenge putting together good performances in all three components. The number who achieved that this year was impressive. However, there were also many centres where the whole presentation had poor performance; investigations were trivial and perfunctory, and concepts were undeveloped or poorly expressed.

Candidates can reach the highest standards if they spend time in the lab doing practical work and the investigation, and time clarifying concepts with experienced and knowledgeable teachers.

Areas in which candidates performed well

Markers reported more good investigations this year — with independent replication, good controls and attempts at evaluation. In evaluations (Category 5 of the mark scheme), candidates made better use of variance in replicate results when judging the validity of conclusions.

Both essays, Question 8A and Question 8B, were done well. In Question 8A, knowledge of types of competition was extensive and in Question 8B the overall standard was excellent. Many candidates scored full marks in Question 8B. A large number, however, wrote too much and covered more detail than was necessary, or strayed off the point. This slight lack of discipline in sticking to a timescale and a plan can lead to time pressure on later questions.

Animal Behaviour answers were particularly outstanding; this is an option where it is not easy for candidates to grasp the subtleties of concepts without a great deal of discussion and clarification with teachers who, themselves, have a developed understanding. Questions on the other option topics were well done by many candidates, with exceptional answers produced by some in all areas.

On the whole, numerical questions were done well [Section B Q5(i), Biotechnology Q4(c)(i), PHE Q1(c)(i)], and there were few problems reading and interpreting the different styles of graph.

Many candidates performed well with the novel context in Section B Question 1 where the mechanism of RNA interference was introduced as the context for applying knowledge and understanding of DNA and translation of genetic code into protein. Many candidates understood the impact of mutations that stop RNA interference on stem cell regeneration and differentiation.

In Section B Question 2, all of part (b) on cytoskeleton was very well done. Part (a) (ii) was also tackled competently by many candidates, integrating units to link signal transduction with camouflage.

In Section B Question 5, many understood the distinction between bioaccumulation and biomagnification in the unfamiliar context, although they did not all understand how DDT could get from mainland Canada to birds on an island.

Areas which candidates found demanding

General issues

When composing extended responses, rather than making and following a plan, many candidates wrote everything they knew about a topic. While there is no specific penalty for writing too much, there is a time loss that increases pressure on questions needing more consideration.

Many found it difficult to derive 'general conclusions' from data. General conclusions are just that: they require thought to summarise evidence; they do not require evidence to be picked from data unless the question specifically asks for it. Such questions will normally indicate where the data are to come from [Section B Q1(c)(ii); Section B Q1(d)(i) and (ii); Biotechnology Q4(c); Animal Behaviour Q1(b), PHE Q3(c)].

Data in questions come from genuine published work, commonly scientific papers. For many of the data sets used in the exam, the error bars have been removed; where they are left in they need to be considered. Section B Question 1 (c) (ii) and PHE Question 1 (d) were poorly answered by most candidates because they did not see the limitation that overlapping error bars place on conclusions. In Section B Question 1, the proportion of cells is only different in G1 and S. In PHE Question 1 (d), the medicine is only effective in concentrations that differ significantly from the placebo.

Many candidates did not read through the whole of a question before formulating responses to individual items. As a consequence, they wrote too much for items that came first and included material they would need for later items, forcing them to stray from the point or be inventive further on [for example, Section B Q4; Biotechnology Q1].

Specific issues

Comments here relate to the most common errors.

Section B

Question 1 (b) (ii): Although this is single-stranded RNA, *base pairing* is the key for creating the shape; many missed this simple statement.

Question 1 (c) (ii): Not using Figure 2B as stipulated.

Question 1 (d) (ii): Not using both graphs as stipulated.

Question 1(e): No recollection or poor recollection of the *lac* operon and describing 'on' instead of 'off'.

Question 2 (a): Many missed the point that hydrophilic signals bind to receptors to the outside of a cell; many thought that receptors pass the signal molecule inside; many did not know that transduction is the triggering of a new set of events inside the cell.

Question 3: Rote-learned material relating to enzyme kinetics and michaelis constant was included by almost all candidates, although not in the Arrangements, and many appeared to be confused by it. Many candidates thought an active site was a feature of the substrate.

Question 4 (a): Many took ‘identified’ to mean ‘extracted and separated’ rather than ‘probed’. There is an underlying issue for many candidates — they do not understand that there is a mass of DNA in the gel and that the probe is site-specific for the DNA of interest.

Question 5: Many candidates did not take into account the information given about gannets eating fish in the sea and thought they would acquire DDT by eating caterpillars ‘intoxicated’ with DDT.

Question 6 (a): Not stating that low efficiency of energy transfer related to energy *loss* from a food chain.

Question 7 (a): Diapause was referred to as hibernation by many; some candidates used hibernation as the generic term and dormancy, diapause and aestivation as types. In the Arrangements, dormancy is the general term used and diapause is a form of suspended *development*.

Question 7 (b): Many candidates thought that removing hedgerows to make bigger fields put the grain out of reach of the aphids. They missed the point that there would be a drop in aphid population and they had not picked up on either idea affecting the grain — fewer aphids would be feeding and there would be less virus transmission.

Question 7 (c): The term ‘vector’ was poorly understood. There is some inconsistency in the terminology relating to parasites and the spread of pathogens. The Arrangements suggest that *vector* is interchangeable with *secondary host* (p25) so in the exam, a vector is an organism that is involved in passing pathogens on to a new primary host.

Some sources point out that there is a degree of co-evolution between parasite and secondary host (eg *Plasmodium* in *Anopheles*) that is not seen in vectors. The parasite is carrying out a stage of its development in a secondary host but a vector is acting as a reservoir, for example of viruses or bacteria, which have no developmental stage.

Question 8A: The main difficulties in the extended responses came from the concepts of niche and the nature of competition. With niche, many candidates incorrectly described it as an area or location (in the sense of a space) and did not really grasp that, in an ecosystem, an organism’s ‘place’ is something more.

The essay looked for the abstract notion first — a niche is the resources and conditions a species needs. The species has evolved to have these needs and individuals will be able to tolerate some variation. ‘Fundamental niche’ is niche considered from the practical point of view of the species in a habitat; it’s the resources an organism is **capable** of using in ideal conditions. What it actually gets to use, what it can realise, then depends on competition.

The definition of competition is much more bland than most candidates expressed. It is not ‘fighting’, or ‘struggling’ or necessarily aggressive. It is also not just between animals. With a plentiful resource, competition need not occur. It is two organisms trying to use the same resource at the same time when the resource is *in short supply*, eg desert plants obtaining water.

When the competition is intraspecific and resources are limited, the competition is more *intense* rather than more 'fierce', as many candidates put it. They need to think of *intense* in a density-dependent sense: as the resource gets scarcer there is increasingly less for each individual. The concept, once again, is not about aggression.

Options

There were errors in answers to each question in all the options but most were routine. For example, in Biotechnology few candidates knew that unfused myeloma cells are blocked from dividing by components of the growth medium and few understood why growth rate constant would be calculated. In PHE Question 4, many candidates did not answer the question and responded about all the benefits of exercise and little about weight control.

A couple of conceptual issues did show up in answers to PHE Question 1, which was dealing with heart function. A large number of candidates thought that cardiac muscle cannot work anaerobically and many others relate angina pain to lactic acid production, extending their knowledge of muscle fatigue from other courses to heart muscle.

Anaerobic metabolism alone cannot supply enough energy for ventricular contraction. However, in normal conditions about 1% of energy release in heart muscle is from anaerobic metabolism and when oxygen supply is limited this can rise to 10% (Ganong, 2010, p109).

The trigger for angina pain is not well understood. Current studies are focused on 'acid-sensing ion channel 3' (ASIC3) found in cardiac sensory neurons. ASIC3 is a gated channel triggered by protons and enhanced by other substances. It appears to be extremely sensitive to a small drop in pH from a normal of 7.4 to 6.7, only marginally acidic, by which point angina pain is extreme. The mechanism in the heart seems to be cardiac specific: it does not respond to the same pH drop in the general circulation caused by other metabolic processes or by exhaustive anaerobic exercise (Sutherland, 2001; Birdsong, 2010).

Barrett, KE et al (2010), *Ganong's Review of Medical Physiology 23rd Edition*, McGraw Hill, New York.
Sutherland, SP., et al (2001), *Acid-sensing ion channel 3 matches the acid-gated current in cardiac ischemia-sensing neurons*. PNAS, January 16, 2001: vol. 98:2, pp711–716
Birdsong, WT., et al (2010), *Sensing muscle ischemia ... interplay of two ion channels*. *Neuron*. 2010 November 18; 68(4): 739–749

Advice to centres for preparation of future candidates

General

Investigations must follow the principles set out in the candidate guidance: both candidates and teachers need to have a good working understanding of the contents. The documents can be downloaded from the SQA website.

The *Investigation Report Finalised Marking Instructions* can also be downloaded: this is the same document that markers use when grading candidate reports so every teacher should possess a copy and use it to advantage.

The final category (5) in the marking instructions for the Investigation carries most of the marks only Grade A candidates are expected to score ('A marks'). To access these, candidates need to have a good experimental design in the first place, with separate samples from within each treatment and independent repeats of the whole experiment.

It is not necessary, and indeed it is often a drawback, to attempt to measure too many inputs and/or outcomes. Candidates can be so overwhelmed by the amount of data they have collected that they cannot make sense of it in the Discussion section where the A marks are.

Centre staff should provide guidance to candidates on Investigation planning via the daybook by ensuring that there is a sensible, sufficiently biological question to answer, a sound experimental design and an appropriate method of data recording. The details are in the guidance documents.

Centres are advised to use published marking instructions rigorously and check appropriate External Assessment Reports for guidance on errors. These should be shared with candidates.

Statistical information: update on Courses

Number of resulted entries in 2011	2,288

Number of resulted entries in 2012	2,417

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	24.6%	24.6%	594	81
B	27.1%	51.7%	656	69
C	24.6%	76.3%	594	58
D	9.8%	86.1%	236	52
No award	13.9%	100.0%	337	-

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.