

## Principal Assessor Report 2004

**Assessment Panel:**

**Biology**

**Qualification area**

**Subject(s) and Level(s)  
Included in this report**

**Biology Advanced Higher**

## Statistical information: update

Number of entries in 2003	1629 (Pre Appeal)
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Number of entries in 2004	1571 (Pre Appeal)
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### General comments re entry numbers

There is a slight decrease in the number of presentations at this level.

## Statistical Information: Performance of candidates

### Distribution of awards

Distribution of awards	%	Cum %	Number of candidates	Lowest mark
A	16.3	16.3	256	83
B	25.4	41.7	399	69
C	29.3	71.0	461	56
D	12.3	83.3	193	49
No award	16.7	100.0	262	0

### Comments on any significant changes in percentages or distribution of awards

The distribution of awards is very similar to last year with overall candidate performance being very similar. The inclusion of a number of pre-tested questions in Section A allowed an objective comparison with previous candidate performance: candidate ability was broadly unchanged.

## Grade boundaries for each subject area included in the report

Grade Boundaries	Lowest mark	Percentage of maximum marks
A	83	66
B	69	55
C	56	45
D	49	39
No award	0	0

### General commentary on passmarks and grade boundaries

- While SQA aims to set examinations and create mark schemes which will allow a competent candidate to score a minimum 50% of the available marks (notional passmark) and a very well-prepared, very competent candidate to score at least 70%, it is almost impossible to get the standard absolutely on target every year, in every subject and level
- Each year we therefore hold a passmark meeting for each subject at each level where we bring together all the information available (statistical and judgmental). 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 senior management team at SQA
- We adjust the passmark downwards if there is evidence that we have set a slightly more demanding exam than usual, allowing the pass rate to be unaffected by this circumstance
- We adjust the passmark upwards if there is evidence that we have set a slightly less demanding exam than usual, allowing the pass rate to be unaffected by this circumstance
- Where the standard appears to be very similar to previous years, we maintain similar grade boundaries
- 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 are different. This is also the case for exams set in centres. And just because SQA has altered a boundary in a particular year in say Higher Chemistry 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
- Our main aim is to be fair to candidates across all subjects and all levels and maintain standards across the years, even as arrangements evolve and change.

### Comments on grade boundaries for each subject area

The grade boundaries were set at the same marks as last year since the demand of the assessment overall was considered to be the same as last year.

The high literacy demand of Advanced Higher Biology assessment as a whole is acknowledged. From 2005, the structure of the exam will be altered: Section A will remain; in Section B, one of the large data handling questions will be replaced with shorter items of equivalent demand, sampling a wider range of themes; it will also contain only one essay, taken from one of the mandatory units. The optional units will be assessed in the new Section D but over more marks (20 rather than 15) and mainly by means of structured questions rather than a single essay. (Details are in the 2004 (5<sup>th</sup>) Edition of the Arrangements published on the SQA website. A specimen exam in the new format will also be available for the start of the 2004/2005 session.)

Because of changes to the exam specification and style, next year it is expected that the C grade boundary will move nearer the notional standard of 50%.

## Comments on candidate performance

### General comments

The improvement in performance in Sections B and C, testing the mandatory units, is heartening. Some candidates have outstanding knowledge across the whole range of concepts and an ability that allows them to set down answers with awareness and subtlety. These same individuals are also quick to assimilate the key issues in the data questions, even though the contexts are a challenge, and convey this clarity of understanding with relative ease. Many more candidates have some elements of this but not consistently across the exam. However, some performances are very poor. Many markers inferred from the scripts they saw that a significant number of candidates had not been taught basic concepts and had no recent practice in essay writing.

Preparation of candidates for optional units again causes concern this year. Many candidates do exceptional essays on the optional topics but a big proportion of them flounder in options compared to their performance in the mandatory units. Once again markers have raised the question about the level of teacher/lecturer input in preparing candidates for this aspect of Advanced Higher.

The quality of Investigations is continuing to decline: the mean score is now 14.4, about one mark down on last year. Fewer exceptional Investigations were seen this year despite the obvious ability of the candidates in other assessment components

Markers expressed concern that candidates might not be receiving a full allocation of teaching time to fulfil the demands of the Advanced Higher course. There is also a concern that Investigations are not being supervised properly. This may be because in some cases the course is delivered in reduced contact time.

### Areas of external assessment in which candidates performed well

There was marginally better performance in Unit 1 than Unit 2. Knowledge of the cytoskeleton was particularly good and there was very clear understanding of the principles of the sodium-potassium pump. Unit 1 essays were chosen with equal frequency; in Unit 2, around two thirds of candidates chose the population/competition essay rather than the one on air pollution.

About 70% of candidates chose the Physiology essays and the bulk of these attempted D6 on the role of exercise in preventing clinical problems. There were some outstanding essays here and in the other choice, where candidates scored better overall. Of the other four essays in Section D, only the one on silage/nitrogen fixation was well done.

Investigation Reports were very well presented, almost all having been word-processed. Candidates' IT skills were wide-ranging: in the best examples they incorporated their own photos of their experiments, images from the internet properly credited and protocols for experiments taken from university web sites, again cited correctly. It was pleasing to see that candidates were being more judicious in their selection of graphs generated by Excel, although the X axis difficulties continue to cost them marks. More candidates produced hand-drawn graphs this year and in general there were few errors with these.

## Areas of external assessment in which candidates had difficulty

### Examination

Markers catalogued difficulties in just about every question, fortunately not often for the same script. Obviously the selection of Centres they see is limited so the frequency of errors only becomes apparent when their comments are assembled for this report. By far the biggest level of frustration felt by markers came from candidates failing simply to define terms at the start of essays: cytoskeleton, population, population density, niche, diabetes, osteoporosis, obesity, nitrogen fixation, etc.

Candidates frequently launched into the essay about population density without stating that this is the number of organisms of the same species in a unit of space. The point is crucial for underpinning the discussion of competition, which only really becomes significant as density increases. Many do not know that competition will only be relevant if resources are limited. They miss the basic point that the density of a population, even just thinking about this as the number of survivors in an area, is affected by abiotic and biotic factors. And they miss the homeostatic point about biotic factors - that the negative effect they have *on population density* increases in intensity as density increases. This last point is quite subtle and was not often made with awareness.

Niche is not well understood as a concept even though candidates can visualise limitations to niches arising from competition. It seems they can follow how resources such as space and food are compromised when two species are together but they don't recognise the *role* element of niche – that the two species must be trying to do the same job. There is also a general perception that any competition involves 'fighting' for resources. Driving instructors in a small town are competing but they don't *fight* for learners.

There is poor understanding of the 'greenhouse effect' as a normal, indeed essential, process limiting radiation losses from Earth. The distinction between 'greenhouse effect' and '*enhanced* greenhouse effect' is also not secure. The natural role of atmospheric water and carbon dioxide in the greenhouse effect was not clear to weaker candidates and the idea that 'enhanced' proportions of these arise from burning fuels was lost on many. Most know that the effect of combustion is problematic in the long term through temperature rises: just about everyone knows about coral bleaching. There is some conceptual confusion when greenhouse gases are listed: it was common to see sentences like '*Greenhouse gases arise by burning fossil fuels, for example water, carbon dioxide, methane and CFCs.*'.

In the environment question in Section B, the distinction between detritivores and decomposers was a problem and there was widespread ignorance of denitrification, both what it is and that it is anaerobic. Many candidates recognised that excess water in the soil would be a problem but they took the loss of nitrate to be from leaching rather than the soil becoming waterlogged and anaerobic. The whole question was very clearly set in the context of reversing improvements to drainage (paragraph one)!

Knowledge of Unit 1 topics tested was less problematic. A substantial proportion of candidates are confused about which enzyme carries out phosphorylation: phosphatase, phosphorylase and ATPase were very common errors. Many cannot name examples of peptide and steroid hormones, and do not know which are hydrophobic; however they do know the details of how cells process the signals.

In the data handling questions there is still a tendency to overdo quantification when justifying a conclusion. In CSYS papers there were often several marks allocated for describing a graph and it would be routine to see answers with very detailed lists of values. In Advanced Higher (see p56 of the 5<sup>th</sup> Edition of arrangements document) there is little scope to reward repetitive, unnecessary quantification; questions are constructed so that this is not required. Recognising trends is more relevant and only selected key values will be expected.

## **Investigations**

In 2003 some effort was put into clarifying for Centres exactly how Reports should be constructed and, separately, into clarifying what counts as good science in Investigations at this stage in a candidate's life. SQA issued a revised guidance document (*Advanced Higher Biology Investigation Guidance*) for candidates and staff to all Centres with the instruction that it should be passed on to each candidate. There was abundant evidence that many candidates had never read the document – either it never reached them or they ignored it.

There was also an extensive exemplification publication (*Exemplification of Standards: Advanced Higher Biology Investigation*) containing, among other things, specimens of an A grade and a C grade Report and details of how they were marked. In both the preamble to the *Exemplification* and the commentary section of the PA report of last year, there was a substantial amount of sound advice on how to help candidates work towards interesting, challenging and thoughtful investigations. So many pieces of work submitted as Investigations were so poor, it was clear that many staff had not read these documents.

The best Investigation scores were obtained by candidates who had had good teacher/lecturer input in the planning stage of the Investigation and then had followed the *Guidance* document very closely to construct the Report. The worst marks were for submissions that had been cobbled together at the last minute, with little thought or planning. The quality of work presented in the Investigation Report by a number of candidates made some markers wonder whether there would have been sufficient evidence of meeting the standards of the Investigation Unit for these candidates to have passed the NAB for the Investigation Unit. For example, where there is no planning for controls or replicates in experiments, the candidate cannot pass LO1 of the Unit. Centre staff are required to supervise the candidate's work by monitoring the development of the Day Book and to make judgements at an early stage about the quality of the scientific process. This is critical for making decisions about attainment of the criteria for the Unit outcomes. It is felt that the quality of Investigations carried out by some candidates could be improved with more constructive criticism being given by the teacher/lecturer at the planning stage of the Investigation.

A fair number of marks for the Report can be gained for purely technical elements of a write up based on weak science. A top mark can only be obtained by tackling a good biological question in a sound, scientific way, and then discussing the outcome critically in relation to the validity of the data obtained and the biology of the context.

Some advice is provided in the later section on Feedback to Centres.

## Recommendations

### Feedback to centres

#### Arrangements

Centres should ensure that they print off a copy of the new arrangements from the SQA website.

A new specimen examination paper in the new format is now available on the SQA website: you will need to change advice to candidates, the design of prelim exams and in how candidates are prepared for the exam.

#### Investigations

Make sure candidates get a copy of the document *Advanced Higher Biology Investigation Guidance (August 2004)*. This has been issued to Centres as a hard copy and is also available on the SQA website. It is essential that candidates follow this guidance fully when writing their Investigation Reports; simple errors here can cost three or more marks. The document also reminds Centres about the criteria for passing the Investigation NAB, ie judging the quality of the Daybook.

Treat the Daybook as the Investigation, not the final Report. Discuss progress with candidates regularly and focus discussions around what is recorded in the Daybook. This strategy would eliminate moderation issues and could gain about half the candidates easily another five marks: the ones lost through inadequate clarity in planning. View the Report as the best bits of the Daybook written up formally. Retain the Daybook for moderation purposes.

Make sure that the candidate and the presenting teacher have both signed the declaration on the back of the Flyleaf before it is sent off with the Report.

Choose good investigations. Just about any investigation can be done well, so it is not possible here to list successful titles. Here is an example of how a good method can become a good Investigation. A candidate measured the habituation of periwinkles collected from a rock pool; there was a large sample size and a large number of replicates. If the work finishes at this point it is only a well-conducted Higher practical, equivalent to an LO3. The biology is limited to the energy saved from not responding, and the errors relate to the uniformity of the prodding force and lab maintenance conditions. But why go to the bother of looking for rock pool molluscs when the same thing can be done with garden snails. To make it an Investigation there should be a genuine biological question: How does the habituation response of periwinkles relate to the exposure of the shore where they were collected? Measuring habituation can be put to use in finding out something new. (See attached appendix for further advice on Investigations.)

#### Course content

Make sure candidates have a clear grasp of concepts and that they can define terms found in the syllabus. Exam questions and mark schemes are based on syllabus entries.

Discuss concepts to draw out subtleties. Read beyond the monographs and other school level texts aimed at defining the syllabus: undergraduate text books are very well written and easily accessible to most candidates; *Biological Sciences Review* articles are excellent and frequently have items exactly matching our syllabus, including Optional Units; publications from Wellcome Trust, MRC, NCBE, SAPS, SNH, ASAB, BBSRC, New Scientist often contain interesting data, protocols for practicals and knowledge updates. Check the back of the Monographs for details of some of these.

## Investigations

Some Reports are models of the format specified, and describe how good scientific principles were applied in a context relatively new to the candidates. Most, however, lack some or many of the following: informative title, page numbers, contents page, summary of aims and findings, references in the specified format, discussion of biology indicated by results obtained; rigorous evaluation.

Centres should support candidates in the planning and execution of the Investigation. Staff should be aware at an early stage when replicates and controls are not adequate, when procedures are inappropriate for the aims, and when candidates are failing to get results because of poor skills or faulty equipment and should provide constructive feedback at this stage.

It is acknowledged that the time-scale for Investigations and the level of demand are a challenge. However candidates citing 'lack of time' in the Evaluation section of the Report for failing even to consider replicates and controls cannot expect credit for their retrospective awareness. This design flaw should have been spotted early in the planning recorded in the Daybook; if it is not amended after early discussion, then the candidate should not pass the Unit.

Many Centres are criticised for presenting sets of Investigations so similar that candidates could not possibly have had to plan anything; background and protocols are virtually identical except for minor amendments eg the organism, antiseptic or enzyme being tested.

### Specific areas to consider

1. Is the depth of knowledge and level of demand sufficient for AH level? Routine and low level work will only score the low level and routine marks.
2. Are several of your candidates doing the same Investigation? The challenge of the Investigation is lost if all the candidates in a Centre are doing essentially the same protocol - background research is common to them all and there is no scope for creativity and discussion. Try to have all candidates doing different investigative work.
3. Is the work a Chemistry project masquerading as Biology? It may not be adequately biological; check with other departments that the same/similar work is not being submitted for another Advanced Higher course.
4. Make sure enough time is devoted to the work: it is pretty obvious to markers when someone has only spent a few minutes repeating a simple procedure; the work cannot possibly add up to 20 hours. Should these candidates pass the Unit?
5. Check very early on that a procedure and equipment will be adequate; markers find it difficult to believe, for example, that anyone can use a tally counter to record invertebrate heart rates of 300 per minute.
6. Safety is not an SQA matter but it should figure in the planning recorded in the Daybook. It is to be hoped that staff are aware of the local health and safety regulations, eg. on incubation of skin micro-organisms, incubation at 37<sup>0</sup> C, use of pesticides and on use of human blood samples.
7. When preparing candidates for Investigations, discuss the role of replicates in experiment design. Move on from the Higher LO3 point that mean values are more reliable than individual values, to discuss the idea that replicated treatments should produce identical results. If the results are not identical, which is likely in biological work, then there needs to be some discussion about the cause of the variance.

8. Could other factors, not controlled for, be causing the results obtained? Encourage candidates to think the problem through so that the plan anticipates these factors. For example, rate of diffusion affects the spread of materials from wells cut in agar; if bacteriocidal molecules have different size or shape or concentration, whatever their toxicity, killing zones will vary in diameter. Or, if different concentrations of nutrients/growth substances are being added to water culture solutions then there will be osmotic effects; will they affect the growth measurement separately from the substance effect? Or, when monitoring the effect on recovery time of energy drinks in schoolchildren, what other factors have an influence and how many of them cannot be controlled; how are the results to be compared?
9. Conclusions usually focus on trends in mean results but Evaluation discussions should examine the validity and reliability of the conclusions in the light of variation evident in replicates. The more replicate values differ, the more unreliable trends will be. Advise candidates not to reel off routine measurement/systematic errors as the cause of variance.
10. If there are no replicates and controls, should the candidate be passing the Unit? Validity and reliability are compromised without them and Conclusions will be dubious. Results from both replicates and controls need to be discussed with awareness. This is partly what distinguishes A Grade candidates.
11. Procedures may not deliver results in the end. Be sure that candidates can talk sensibly about modifying procedures and are not left lamely having to propose that they would improve their methods by having replicates and controls.
12. Is the accuracy of instruments noted, and in derived values, eg averages, is the implicit accuracy beyond what the instrument could generate?
13. Have mean values been calculated from replicates and plotted? Check that the replicates have not all been plotted – this reveals a lack of understanding of the purpose of the replicates.
14. Are treatments results grouped into a single graph representing the investigation results? Candidates should not plot time course results if only the final values are relevant.
15. Are X axes of graphs drawn by Excel software scaled correctly; do they have grids and plotted points for checking values; are graphs too small to read values?
16. Have too many graph varieties been generated from the same data; is 3-D really needed?
17. Are graphs/results described in the results section; are they analysed for trends and errors in the Discussion section?
18. Does the Discussion make very clear links between the biological background, presented as relevant in the Introduction, and the results obtained by the study? This is partly what distinguishes A Grade candidates.
19. Check for poor quality references, failure to acknowledge sources and plagiarism. It is inappropriate in the Introduction of the Report for a candidate to assemble a series of extracts from sources and claim they are original thoughts.