BIOLOGY

Overall grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 17	18 - 31	32 - 43	44 - 55	56 - 66	67 - 78	79 - 100

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 16	17 - 30	31 - 44	45 - 56	57 - 67	68 - 79	80 - 100

Internal assessment

Component grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 9	10 - 15	16 - 21	22 - 27	28 - 31	32 - 37	38 - 48

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 9	10 - 15	16 - 21	22 - 27	28 - 31	32 - 37	38 - 48

Clerical procedure

The moderators generally agreed that the procedure for the selection of the moderation sample was understood and correctly followed by most schools. It is most important, however, that the teachers keep up to date with these. There are a significant number of examples of schools using old 4PSOW forms and the requirement that the candidates sign the 4PSOW form was missed. **For candidates examined from May 2009 there will be important changes in the procedures used by the IB for internal assessment. The teachers MUST be aware of these changes.**

Teachers who included the “complete”, “partial” and “not at all” breakdown of their marks were providing helpful information to the moderators. This combined with comments and feedback to the candidates made it very clear as to how the teachers were awarding marks.

There are a large number of teachers who take a lot of time and trouble to prepare their Internal Assessment sample. This effort is very much appreciated.

A problem, which directly affects the progression of the moderation, is when teachers do not enclose all the instruction sheets and/or summaries of oral instructions for the investigations in the moderation sample. Most schools complied with this requirement for the investigations involving Planning (a) and (b) assessment though more precise information would be welcome. It is also necessary, however, for investigations where Data Collection is being assessed. When Data Processing and Presentation is being assessed the method (designed by the candidate or provided by the teacher) **and** the raw data are required. Finally when Conclusion and Evaluation is being assessed all the steps in the scientific process are needed. **This will still be true for the revised procedures from May 2009.**

The duration of the practical programmes was generally correct and evidence of the Group 4 Project was usually present though moderators did comment on the absence of evidence for the Group 4 Project for some schools.

A problem which persisted this session concerns collusion between candidates. Too often moderators noted that material is submitted which clearly a copy of another candidate's work. This type of incident is the subject of a Problem Report Form. This will lead to an enquiry into malpractice by the IB examination board.

Areas of strength

Most teachers covered adequate material with very varied practical programmes. Many moderators noted an improvement in the types of investigations used for planning investigations. There are still too many schools that are assessing investigations where purely qualitative data are being collected. **From May 2009 all assessed investigations will require the collection and processing of quantitative data.**

Areas of weakness

A problem raised by many moderators was the trivial nature of some investigations submitted for moderation. Where schools were presenting work of a sufficient complexity this tended to be the case with all of their assessed work.

Moderators noted that some teachers still give too much help for the assessed work. In Planning (a), aims and objectives are being given which are too detailed. For Planning (b), methods were given and were followed with no modification by the candidates. In Data Collection and Data Processing and Presentation less photocopied data sheets were being used but in some candidates were still being told how to organise and process their data.

It must be stressed that when an investigation is used for internal assessment it is the work of the individual candidate which is to be assessed not that of a group. Teachers must provide opportunities within the practical programme where candidates may be **individually** assessed. The problem of overt collusion is treated above but teachers must set assignments that have enough scope to them to ensure that all the candidates are not going to be doing effectively the same investigation. The general aim set by the teacher needs to be sufficiently open-ended and the material and protocols available should be sufficiently diverse.

There was generally a lack of awareness by candidates of the degrees of precision in their measurements. **In the revised programme it will be expected that candidates should develop an awareness of the limitations of their instruments and their methods. They should be using methods of error analysis (e.g. standard deviation and correlation) in their processed data. This appreciation of error in results should form the basis of the candidate's critical evaluation of the investigation.** Of course this requires that the investigations are sufficiently complex and collect sufficient data for candidates to carry out this analysis.

The consistency in the number of decimal places used also presented problems. Some candidates were not consistent with them at all especially in their processed data. If data is measured to one decimal place then the mean calculated from this data cannot be accurate to three decimal places. A lot of these errors are due to a weakness in the appreciation of processing done on calculators or spread sheets.

Grade inflation seems to be a problem in certain schools. It is sometimes observed that candidates have clearly not responded to an aspect of a criterion (e.g. there is no sign of the variables having been identified PI (a) Aspect 3). The teacher comments on this omission and still awards the candidate full marks. It is possible that this may be due to the teacher scaling the marks. The Internal Assessment criteria are for application throughout the IB schools and thus they cannot be treated like this. The criteria must be applied rigorously or the effect of the moderation will be severe down grading.

It has been observed that many schools new to the IB are making a great effort to comply with the IB requirements for Internal Assessment but that some experienced schools seem to be quite lax about it. New teachers in experienced schools need adequate training too.

Rules applied by the moderator

At the start of the moderation session the moderators in the team are provided with guidelines which are intended to bring everyone into line and establish some ground rules for moderating. Following the moderation samples of the moderators work are sent to a senior moderator for remarking. A summary of the ground rules are given below:

- Do not try to compensate for lowering a candidate's mark by raising another candidate's within the sample. These changes will **not** necessarily cancel out.
- Your own marking is subject to adjustment by the senior moderator/principal moderator so you **cannot** comment on the standard of marking on the 4/IAF feedback form to the school.
- Always apply the principle of positive marking. If it is a borderline judgment support the teacher's award and annotate your marking with 'borderline-teacher supported' so that your senior moderator follows your reasoning.
- Do not worry if you find yourself consistently supporting the teacher. If that is what the work deserves then there is no problem.
- Senior moderators should continue to support the teacher where possible even if it means disagreeing with the assistant moderator.

- If you have a query as to the marking standard, contact your senior moderator **immediately**. It is possible to mark other samples while awaiting clarification, but you may have to re-mark all pieces of work in which the same situation occurred once your clarification is received.
- Senior moderators should endeavour to reply to queries as soon as possible.
- Do not change your marking standard once your sample has been sent to the senior moderator/principal moderator as this will not be reflected in the moderation factor. Remember to keep annotating the candidates' work in case an IMR report is called for by the school after the diploma grades are published.
- Choose a sample of eight candidates that cover a wide mark range so that there are no marks in a zone in isolation. Since there are many concerns that it is the high achievers who are most prone to be marked down, a couple of marks above 26 out of 30 should be included where possible.
- Choose a sample that includes a wide range of schools.
- Do not include candidate work that you are unsure about in the sample to be sent to the senior moderator.
- If you have schools in your allocation which have serious problems with IA, avoid including these in your sample. They are atypical. If you are concerned about them fill in a PFR form.
- Do not punish simplicity through downgrading; comment appropriately on the form 4/IAF.
- Trivial investigations will probably be affected by moderation more seriously than complex investigations because they lack scope in discriminating between the candidates. A clear message needs to be sent to these teachers in their feedback.
- Bear in mind that there should be no difference in the application of the criteria to higher level or standard level candidates.

Be sure to read:

- The Examiner's Manual
- Any further guidance from your senior moderator; very importantly the Teacher Support Material (TSM) 1 and 2 on the Online Curriculum Centre (OCC)

There are a number of specific situations that occur regularly. There are a number of specific responses to these. One is where too much help or guidance has been given by the teacher, another is in the presentation of uncertainties to the data.

Where too much help has been given

Inevitably in your allocation you will come across write-ups where a teacher has quite clearly given too much assistance to the candidates. Some common examples:

Planning (a): the research question, hypothesis and/or variables are given. A general aim is fine if the candidates have significantly modified it (e.g. made it more precise).

Planning (b): a method sheet is given which the candidate follows without any modification. All candidates are using identical methods.

Note: A basic or standard protocol may be given by the teacher (e.g. the rate of photosynthesis may be determined by counting the bubbles released by a pond weed) but this must provide enough scope for the candidates to modify it (e.g. establish the independent variable, controlling variables, providing periods of equilibration, ensuring fair testing between the experiments etc).

Data Collection: a photocopied table is filled in by the candidate. **Note**: Data logging by a computer or calculator interface is acceptable. If, however, you have doubts about the degree of automation, contact IBCA to ask the school for details of their data-logging system.

Data Processing and Presentation: a graph with axes already labelled is provided.

Conclusion and Evaluation: structured questions are given to heavily prompt the candidate through the discussion, conclusion and criticism.

In such cases, do not assume that the mark awarded by the teacher should be reduced to zero.
Examples:

Criterion	**Problem**	**Teacher awards**	**Maximum moderator can award**
Planning (a)	Teacher gives the problem or research question	c; c; c = 3	n; c; c = 2
Planning (b)	It is clear that the candidates have been told what apparatus and materials they require.	c; c; c = 3	n; c; c = 2
Data Collection	The candidates have used a photocopied data table with headings and units.	c; c = 3	p; n = 0
Data Processing and Presentation	The candidates have been told, on the method sheet, to draw a graph from their raw data and which variables to plot.	c; c = 3	c; n = 1
Conclusion and Evaluation	The candidate has only indicated as a criticism that they ran out of time and their only suggestion as an improvement is that they should repeat the investigation.	c; c; c = 3	c; n; p = 1

For further guidance contact your team leader.

In all cases, **constructive feedback** to the teacher is needed. Always be positive, be diplomatic, **give them the benefit of the doubt** and give clear, useful advice.

When you are moderating the investigations, remember that we do not know the candidate's prior knowledge or skills. Thus we cannot anticipate the interpretation of the data using a particular piece of theoretical background nor can we anticipate a particular way of analysing the data. We should award marks more for what the candidate has achieved rather than what he/she has omitted.

Errors and uncertainties

It is now expected that the candidates treat uncertainties in their data. This has an impact on Data Collection (DC) Aspect 1 and Data Processing and Presentation (DPP) Aspect 2.

Note: Data processing may well take place in the same table used for the raw data. This is acceptable, there is no expectation for separate tables for raw and processed data.

Degrees of precision (DC)

Where instruments are used the degree of precision should be given (e.g. ± 0.1 cm) where it has an impact on the investigation. This will be particularly true for biochemistry investigations (e.g. enzymology) where laboratory grade reagents are being used (e.g. volumes, temperatures). However, when the biological material that is used, is derived from a natural source (tissue or whole organisms), the natural variation of the material may mean that degrees of precision can be treated as insignificant.

Significant figures (DC and DPP)

The number of decimal places should not exceed the precision of the instrument used if it is given. The number of decimal places should be constant for the data in a column of figures. For data derived from raw data (e.g. means) the number of decimal places should not exceed those of the raw data. In the calculation of mean population density, results to the nearest whole organism are expected.

Deriving uncertainties through processing (DPP)

We are **not** expecting the propagation of errors in processed data. Standard deviations are expected **only** where the data permits (i.e. a sample size of at least 5 and a normal distribution). Candidates may go even further and determine confidence limits through the standard error of the mean. This is acceptable but not obligatory. A candidate may also indicate the range of uncertainties as the range between the highest and the lowest value in a sample. This is acceptable but not obligatory. Candidates may also indicate uncertainties by tracing a trend line through their data on a graph.

Candidate performance against each criterion

Planning (a)

As stated some teachers provided too much guidance e.g. “Plan an experiment to investigate the effect of temperature on the rate photosynthesis of a green plant”. The independent variable has been given by the teacher in this statement.

The aim or research question should contain the name of the organism that was used (ideally the scientific name) or the name of the source material e.g. catalase from the tuber tissue of potato (*Solanum tuberosum*).

Formulating a hypothesis is also still in need of attention. The candidates are frequently not explaining their hypothesis scientifically, yet some teachers still award “complete”.

Candidates are also failing to identify the independent variables or the controlled variables of their experiment. A number of teachers are awarding “complete” when the candidates have not fulfilled this aspect and some teachers still seem to be unaware of what independent and dependent variables are.

Variables need discussing in order to identify those that can be controlled and those that may influence the investigation but cannot be controlled. This is probably the weakest aspect of this criterion both in its treatment by the candidate and in the marking done by the teachers. Either it is missed out or the candidate lists a series of variables without much discrimination. In field work where candidates have been sampling material, the factors that need controlling in the sampling method may significantly affect the results. This is often ignored.

Investigations where candidates are working in groups, such as the Group 4 Project, are to be avoided for the assessment of the two planning criteria, unless the individual contribution of each candidate can be clearly identified. The evidence seems to suggest that this practice is diminishing. **In the revised programme the Group 4 Project will only be used for the assessment of the Personal Skills criterion.**

Planning (b)

Most teachers were providing adequate scope for the candidates to plan their own investigations. However, moderators noted that sometimes the investigations are trivial. There were also reports of investigations that were too similar from one candidate to the next. Teachers in these cases may need to consider setting the planning exercise under test conditions.

In listing materials, candidates often missed some essential items. For instance, it is impossible to investigate a rate without some form of timer. Solutions were often listed or mentioned in the method without giving any idea of their concentrations or volumes, this would be particularly important to control during enzyme activity investigations.

In the control of variables it was rare to find candidates giving their materials time to equilibrate to the environmental conditions, especially where the investigation was using whole organisms (e.g. in transpiration or in photosynthesis).

Candidates appear to be considering replicates of their experiments resulting in sufficient data being collected. **In the revised programme it will be expected that the candidates plan to collected significant amounts of data over the range of the independent variable and at sufficient intervals to observe a trend.**

Data Collection

This criterion received a lot of comments from the moderators. It should be one of the easier criteria to score full marks but it was frequently plagued with omissions.

Raw data must be presented. Candidates in some schools are still presenting averages or rates as raw data.

Some teachers are still selecting investigations that generate data that is too trivial. Their candidates are not being tested effectively on their capacity to measure and to organize the data. The data should be sufficiently complex so that it can discriminate between candidates. Producing significant amounts of complex data does not necessarily require sophisticated apparatus or costly reagents. It can be understood that some investigations are time consuming and do not generate a lot of data in a lesson. Though they have their place in a scheme of work it would be advisable to avoid using these for internal assessment.

Data tables must be accompanied by clear precise titles (e.g. “The data” is insufficient).

The most common problem raised by the moderators, concerned uncertainties. Candidates should be indicating the degrees of precision in their measurements based upon the instruments that they are using. For example Leaf size / cm ± 0.1cm. They should also be consistent in their application of decimal places. From the comments made by some teachers on their candidates' work, they are aware of the need for uncertainties to be given in raw data yet the fact that the candidate has failed to state them does not have an impact on the marks awarded by the teacher. It is clear that "complete" does not mean perfect but there are occasions where the quoting of uncertainties will be very important when evaluating the reliability of the data. E.g. when using the changes in mass or size to determine the water potential of plant tissues the degree of precision of the balance or the ruler used is important.

Qualitative data alone will no longer be adequate for assessment of Data Collection and Processing in the new programme. However, qualitative observations that accompany the quantitative data will be expected.

Data processing and presentation

When quantitative data is produced by an investigation, some teachers still make the mistake of telling the candidates how to process it. Many teachers seem to think that they can teach the mark and recapture method of population estimation and then assess it for DPP at the same time. This type of investigation is inappropriate even if the candidates have not been told what form of processing to use because there is not much scope for the candidates. Either they use the Peterson (aka Lincoln) Index or they do not. Investigations assessed for processing should provide enough scope for the discrimination between the candidates.

There are some signs of candidates carrying out error analysis in their processed data but not enough. **Use of statistical calculation of variation, trend lines or error bars showing uncertainties will be expected in the new programme.**

Several candidates are using spreadsheets to process their data and to create graphs, which is good. **This will become an essential part of the course in the revised programme.** Unfortunately they show signs that they have not yet mastered the basics of graph drawing. For example, trying to plot a curve using three data points is inappropriate. Drawing graphs of raw data may be the first step in analysing the data but it is not likely to score complete. Some candidates think that plotting the data from each of the replicates rather than their means (averages) is adequate. When graphs are drawn manually some candidates do not use millimetre graph paper.

Conclusion and evaluation

Candidates still show little evidence of having consulted literature sources with which to compare their results. Background research to support a conclusion will be essential where it is considered relevant in the revised programme. Correct citation of the source on information will be expected.

Teachers are still ignoring the need for the candidate to criticize and suggest improvements to the investigation. It is one of the areas where the teachers are ignoring the criteria. Moderators are obliged to lower the marks in cases like this. If a candidate fails to evaluate the investigation and suggest improvements, the maximum the candidate can score is "cnn" = 1

When weaknesses are highlighted and improvements suggested they should not be superficial. The evaluation should be based upon the errors and uncertainties revealed by their data.

E.g. If an outlier appears in a series of data one would expect the candidate to spend some time exploring the origins of this error. Too often one gets the impression that the candidate feels that they have to say something to fulfil this aspect so their evaluation becomes trivial or irrelevant. The candidates often fall back on suggesting poor manipulative skills can cause unexpected data, leaving the teacher to evaluate only the conclusions drawn. Statements like "I could have used the balance incorrectly" are not very helpful.

Manipulative skills

The practical programmes, in general, provide adequate scope for assessment of this criterion. In the revised programme this will be assessed summatively over the whole course. Therefore, there will only be one mark for this criterion. Consequently moderators will expect to see signs that the candidates have been involved in a number of tasks of suitable complexity.

Personal Skills

This criterion will only be assessed during the Group 4 Project in the revised programme. So there will only be one mark for this criterion.

The Group 4 Project

This will continue to be an essential requirement of the all Group 4 courses. It is a very valuable exercise in practicing candidate-generated investigations. It is being used by some teachers for the assessment of criteria where the candidate should be assessed on their individual capacities. As the Group 4 Project is a collaborative effort this is not appropriate to use it for assessment in this way. **In the revised programme the project will only be used for the assessment of Personal Skills and nothing else. The project will also be the opportunity for the candidates to show how internationalism operates in scientific enterprises.**

Recommendations for the teaching of future candidates

- Consult the online curriculum centre (OCC) frequently for Teacher Support Materials (TSM). New guidelines and exemplars have been published. **Guidelines for the programmes that started in September 2007 and are examined from May 2009 are already posted.**
- Do **not** use workbooks and work sheets with spaces to be filled in for assessed investigations.
- Explain the criteria to your candidates at the beginning of the course and at intervals during the course.
- Use non-assessed practice exercises for training your candidates.
- Select investigations carefully for assessment so that they are not trivial.
- Provide situations that are open-ended and with enough scope for variation when assessing Planning (a) and (b) (these become the single criterion Design in the new programme).
- Teach the candidates **early on** how to carry out error analysis on their data and train them in data processing techniques.

- Do **not** provide too much guidance. Use investigations where the candidates have to carry out tasks **on their own** or where their individual efforts can be assessed.
- Use the notation c (complete), p (partial) and n (not at all) on the work assessed for internal assessment and provide additional notes on the sampled work (not just for the benefit of moderator but also for your candidates too).
- Provide clear, precise information on the instructions given to the candidates.
- In schools where there are several teachers, practise **internal moderation**.
- Teachers must be vigilant to prevent collusion between candidates when they are assessing the criteria. Setting the planning (design) phase as a test may be a way of avoiding collusion between candidates.

Higher level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 10	11 - 18	19 - 27	28 - 30	31 - 32	33 - 35	36 - 40

General comments

Overall, the 33 teachers who completed the G2 form were satisfied with the paper. Compared with last year's paper, 67% considered this paper to be of a similar standard, 27% a little more difficult while 6% thought it to be much more difficult. 100% of respondents believed it to be of the appropriate level of difficulty. Most respondents felt that clarity of wording; presentation and syllabus coverage were either good or satisfactory.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 3

This question was poorly answered by candidates. Based on a number of widely used textbooks it is unclear if fertilization can be associated with mitosis. Both options B and D were therefore accepted as correct.

Question 12

The wording of option D was considered to be ambiguous and difficult for ESL candidates. 57% of candidates answered the question correctly.

Questions 19

Some respondents believed this question to be ambiguous, leading candidates to choose option D as the correct answer. The question clearly asks about the effect on the immune system and not on the patient. More than 60% of candidates answered it correctly.

Question 20

Several respondents thought this question confusing as the graph starts at 07:00. In the published version of this paper the line indicating the Blood glucose concentration will be extended to 05:00.

Question 30

Some respondents commented that the diagram was incorrect and that the chromatid should have been 'white' for lower case 'c'. The syllabus states that candidates need to know how crossing over can result in exchange of alleles (See assessment statement 8.3.2.). If candidates know that the break is the first thing that happens, then they should get the question correct. Nearly 63% of candidates answered it correctly.

Question 34

Several respondents thought this question confusing and ambiguous. Assessment statement 10.1.3 gives clear definitions and therefore the question could be answered correctly. About 42% of all candidates answered it correctly. The question had a good discrimination index, indicating that the majority of the better candidates were able to answer this question correctly.

Question 35

A comment that "Targeting viral proteins" was not fully covered in the syllabus was given. Assessment statement 10.1.6 includes a teacher note which would have helped candidates to choose the correct option. Furthermore "Targeting viral proteins" is in A, B, C and D; therefore it must be correct.

Question 39

There was a comment about woody stems implying the presence of secondary xylem. Some filicinophytes do have "woody" stems. The rest of the stem clearly allows only one option to be chosen. About 60% of all candidates answered it correctly. The question had a good discrimination index, indicating that the majority of the better candidates were able to answer this question correctly.

Translation comments

Spanish

One comment was received about Q 30. The term "sobrecruzamiento" (for crossing over) is not used in Chile. Questions are always phrased according to the key terms used in the translated syllabus.

Higher level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 10	11 - 20	21 - 26	27 - 36	37 - 47	48 - 57	58 - 72

General comments

There were 30 G2 forms received. Many thanks to the centres who submitted them. 92% of the replies thought that the paper was more demanding than last year's, with all the replies describing the difficulty of the paper as appropriate (83%) or too difficult (17%). 93% thought that the syllabus coverage was at least satisfactory, and 97% thought that the clarity of wording was at least satisfactory. All were pleased with the presentation of the paper.

The areas of the programme and examination that appeared difficult for the candidates

Kidney function, structure of the ovary, use of the action verb 'analyse' and Chi squared

The areas of the programme and examination in which candidates appeared well prepared

Well prepared candidates tackled question 1 well, with a clearer understanding of the action verbs, knowledge of immunity was sound in most cases and the standard of diagrams showed an improvement.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

(a) Marks were awarded for calculations using halves or quarters. Very few candidates failed to gain this mark, and most also managed to compare the results in part (ii).

(b) A surprising number failed to recognise experiment 1 as a control.

(c) The action verb '**Analyse**' was poorly understood, with too many candidates just restating the figures. Few managed to note the three main points that the growth did depend on the living organisms or their extracts, and was independent of their colour and shape.

(d) The concept of the null hypothesis and chi squared was very centre specific. The idea of an even distribution and the idea of significance of results were missed by most candidates.

(e) The idea that the quarters provided more detail, allowing improved statistical analysis was quite well answered.

(f) As in part c, weaker candidates just restated the data instead of analysing it. The significance of **relative** attraction was also missed. Answers should have contained references to both plants. For example 'tomato plants have one have 2 volatile compounds which attract dodder and wheat has only one.

The idea that hexanyl acetate could be used as a repellent was well answered, with a few incorrectly suggesting a herbicide.

(g) Most candidates had some idea that the volatiles could be used for plants to detect each other or to attract desired agents or repel undesirable ones.

(h) This was quite open- ended, however a disturbing number of candidates left it blank.

Question 2

Answers were once again very centre specific, with candidates tending to score very well or very poorly.

'Degenerate' is defined in the syllabus (2.6.5), as is the comparison between competitive and non-competitive inhibition.

When given a specific notation for a genotype, the same notation should be used in the answer.
i.e. $\frac{Tb}{tb}$ and $\frac{tB}{tb}$

were both required for 2 marks.

Question 3

(a) Most candidates gained the marks for the idea that Na^+ moves in and K^+ diffuses out.

(b) The three main points of movement of Na^+ out of the ascending limb, creating a high concentration in the medulla and enabling reabsorption of water from the collecting duct were poorly understood by most.

(c) The role of oxygen as the final acceptor of electrons/protons in the electron transport chain was not understood by the candidates from several centres.

(d) Most gained the mark for saying that clotting prevented the entrance of pathogens, with others using losing the mark for poor terminology such as 'stopping diseases getting in'. On many papers this was the only mark gained in the entire question.

Section B.

Question 4

(a) The diagram of the ovary, even although it is in the syllabus, proved to be beyond the majority of candidates. Some candidates who had an idea of the general shape lost marks by poor labelling, with the follicles and oocytes being labelled as the same thing, rather than the oocyte being shown clearly within the follicle. Similarly the secondary oocyte was often incorrectly shown significantly larger than the ruptured follicle from which it had been expelled.

(b) In general, candidates clearly described the stages in fertilisation from the sperm cell nearing the egg until the combination of the chromosomes; however too many included details from sperm production to implantation of the blastocyst in the uterus, none of which gained any extra marks and put quality marks in doubt.

(c) There were some comments on the G2 forms about the very tenuous links between part c (transcription) and the other two parts of the question. Most candidates who did not make the mistake of describing translation or DNA replication produced very creditable responses. The roles played by RNA polymerase were sometimes attributed to other enzymes.

Question 5

(a) Well prepared candidates scored full marks for naming a disease caused by each of the four organisms. Many weaker candidates seemed to remember, for example, that tuberculosis was on the syllabus and tried to fit it into one of the categories.

(b) All but the weakest candidates failed to score any marks while describing the immune response. Many produced excellent answers.

(c) In spite of the MMR vaccine being specified in the syllabus, many candidates did not know what the letters stood for, and few were specific about the reduction in long term disabilities of the diseases e.g. sterility from mumps. A significant number of candidates still stated autism as a side effect of the MMR vaccine, in spite of a wealth of research to the contrary.

Question 6

(a) Most gained some marks for this section, although many lost marks for not giving specific examples, for example a named enzyme was required if a function of 'speeding up metabolic reactions' was given. Care should be taken that any hormones mentioned are proteins not steroids.

(b) Many candidates had little knowledge of ribosome structure. More were determined instead to (incorrectly) write at length about translation.

(c) Most candidates gained some marks on this section, the weakest ones simply describing exocytosis and endocytosis. Some candidates drew some very clear, annotated diagrams which were perfectly acceptable.

Question 7

(a) Most candidates who attempted this question gained some marks for the diagram of the chloroplast. Common mistakes included too wide a space between the outer and inner membranes and lack of a membrane connecting the grana.

(b) There was huge variation in the response to this section. Some candidates scored full marks with almost perfect answers, whilst at the other end of the scale some of the weaker candidates wrote about something to do with carbon dioxide and carbohydrate formation and little else. A few candidates unfortunately described the light dependent reactions instead.

(c) Most candidates recognised the terms correctly and gained some marks. One common mistake was to describe hydrophytes as living in 'damp' places, instead of in or on water.

Recommendations and guidance for the teaching of future candidates

From May 2009 the examinations will be based on the new Syllabus. All teachers are expected to be familiar with this as there are some topics with significant changes (e.g. the plants topic). There were instances where answers suggested that whole sections of the syllabus had not been taught in some centres. The syllabus should also be made available to the candidates as a revision aid.

Several examiners commented on the number of candidates who seem incapable of answering in the space provided, requiring several extra answer sheets. Whilst some candidates have very large writing, and others will always want to add another sentence, the space provided should be an indication of the maximum length of response. It was encouraging to see well prepared candidates who collected their thoughts by writing a few key words in the margin before starting to answer.

Higher level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 5	6 - 10	11 - 13	14 - 18	19 - 23	24 - 28	29 - 40

General comments

There were 26 G2 forms received. 68% of the replies thought that the paper was of a similar standard to last year's, 16% thought it a little more difficult and 16% much more difficult. All the replies described the difficulty of the paper as appropriate. 88% thought that the syllabus coverage was at least satisfactory, and 96% thought that the clarity of wording was at least satisfactory. All were pleased with the presentation of the paper.

Options and D and E were the most commonly chosen Options. Option G was frequently chosen. Some chose Option H and very few chose Option F.

The areas of the programme and examination that appeared difficult for the candidates

Option D; Variation,

Option E; Types of stimuli and examples of stimuli

Option F; Auxins and Phytochromes

Option G; The part played in soil formation by organisms

Option H; The effect of carbon dioxide and the dissociation of oxygen from haemoglobin and the effects of drugs at synapses

Some of the weaker candidates demonstrated evidence of learning points by heart (possibly from past mark schemes) with little understanding of the subject matter. This led to them finding difficulty in applying knowledge to the questions asked in this paper. This reinforces the concept that the understanding of the topic is essential.

Candidates must read the questions carefully, especially for the data analysis questions- marks were lost occasionally when in one question the candidates were required to state data from tables or graphs, then in the following questions they were then asked to discuss this data. It was in these questions where candidates had most difficulties.

The areas of the programme and examination in which candidates appeared well prepared

A wide variety of skills was seen amongst the scripts submitted from the schools entering candidates in November.

Some candidates and schools were very prepared across the range of topics covered by the examination and candidates demonstrated thorough knowledge and understanding of concepts and skills.

Areas that appeared to be weak were those of calculating percentages and stating definitions which are clearly stated in the syllabus, although much improvement was noted in the definitions compared to previous years.

The strengths and weaknesses of the candidates in the treatment of individual questions

Option D Evolution

D1.

(a) Overall the calculation of a percentage increase here was poorly answered. Of those with correct answers, very few rounded up the answer to 73%.

(b) Many good answers were seen here in the identification of asymmetric limbs leading to less agility and hence a slower pace. Fewer described why asymmetry may lead to a slower place by qualifying that asymmetry may lead to less agility or that owls may recognise those mice with asymmetric limbs leading to different movement.

Some gave a possible conclusion whereby these asymmetric mice would then be caught more readily; which was not asked for in this section.

(c) Many did state that due to the slower running speed, the mice would be more readily caught. It was rare to see though a response that then went on to discuss that due to these mice being more readily caught by owls, that this was indeed a selection pressure that may, over time, lead to a reduction in the population of these mice.

A number of candidates misunderstood the questions and compared the different limb bones involved and gained no marks. Very few candidates earned three marks.

Occasionally some candidates used the data that scientists caught more mice that were less asymmetric than owls did, so less asymmetric mice survive better.

Very few candidates earned three marks.

D2.

(a) This was very well answered on the whole using a full correct chemical definition of the half life of a radioisotope. However some candidates were just referring incorrectly to the mass or the amount of radioactivity being reduces by half.

(b) Other than ^{40}K being useful for dating rocks of over 100 000 year or more and that the half live of ^{40}K is in the region of 1.3 billion years. Few went on to mention that ^{40}K decayed in to ^{40}Ar or that it was the proportion of each isotope is measured or reference to a decay curve.

D3.

(a) Some answers clearly indicated a better use of appropriate language. e.g. homologous structure, than in previous years. However too many answers indicated that this topic clearly had not been understood. Many were referring to the pentadactyl limb being present in many organisms other than vertebrates.

(b) There were two types of answers here. Some very good answers where many different processes that can lead to variation were clearly cited, although no answer was seen where any explanation of these processes were offered. Too many candidates misunderstood the question and wrote lengthy answers about natural selection and/or polymorphism.

Option E Neurobiology and Behaviour

E1.

(a) Most candidates correctly identified January as the month of the baboons made the greatest use of caves.

(b) Most candidate correctly identified a reason for which baboons occupied the caves, all points mentioned on the mark scheme were seen e.g. protection from predators, weather, breeding site.

(c) Many candidates were restating data rather than looking for and stating general trends. Many identified months when the caves were more of less used, but very few referred to more use in the winter or less use in the summer.

(d) Many candidates gave good comparative answers for example that there was no cave use in March for any of the years 2001 – 2002. Too many candidates were however restating data excessively.

E2.

(a) The majority of candidates used correct terminology in describing the transmission of a nervous impulse; sense receptor, sensory neurone, association/relay neuron (or other nomination) and motor neuron to the effector.

(b) Most candidates correctly answered that it is the parasympathetic nervous system that leads to pupil becoming smaller and the sympathetic nervous system that leads to the dilation of the pupil. Few mentioned the role of the circular and radial muscles of the iris.

E3

(a) Many candidates did not answer correctly, being unable to correctly differentiate between a type of stimulus and an example of a stimulus. For example, some stated "hot" as a type of stimulus rather than temperature. Another example was candidates stating touch as a stimulus and then stating a needle prick as an example of a stimulus. Very few candidates earned two marks.

(b) Some good answers were seen here with good knowledge of the role of drugs at synapses. A wide range of drugs were stated – Cocaine, Nicotine, amphetamines, alcohol, THC and benzodiazepines were all seen. Although candidates were stating the general effects of drugs at the synapses as being inhibitory or excitatory, few clearly articulated in sufficient details the effect of the drugs on the synapses. E.g. cocaine inhibiting dopamine re-uptake, or nicotine stimulating synaptic transmission of cholinergic synapses. Few initially stated what psychoactive drugs are. Few included examples of how psychoactive drugs work at synapses; for example that some psychoactive drugs interfere with the breaking down of the neurotransmitter.

Option F Applied Plant and Animal Science

Few candidates answered this option.

F1

(a) (i) The majority of candidates correctly answered the third instar stage as being the stage at which *Chenopodium album* is least effective.

(ii) The majority of candidates answered *Humulus lupus* as being the most effective extract on any of the instars.

(b) Although many candidates correctly stated that imidacloprid has a higher efficiency than *Salvia officinalis, few* candidates went on to gain the second mark point. For example that imidacloprid has a lower efficiency in the fourth stage whereas *Salvia officinalis* is constantly effective against all instar stages. Or that in the fourth instar stage both were efficient to a similar degree. A few candidates discussed the adult and not the instar mortality.

(c) Although many candidates correctly stated that plant extracts were not overall as efficient as imidacloprid, few candidates went on to gain the second mark point. For example that *Humulus lupus* is the most effective extract against the fourth instar or that some other plan extracts were as effective as imidacloprid against the fourth instar.

F2

(a) A number of candidates did not know the definition of net assimilation rate.

(b) Very few candidates could answer this section in mentioning that pruning removes apical meristems and hence this removes the auxins allowing lateral buds to grow.

F3

(a) Most candidates could not draw the structure of a wind pollinated monocotyledonous flower.

(b) Many good clearly labelled diagrams were seen here.

(c) This section was very poorly answered, only an occasional answer gained more than five marks. Candidates from one centre however demonstrated excellent knowledge of how flowering depends upon phytochromes, successfully giving all details of the phytochromes involved.

Option G Ecology and Conservation

G1

(a) Almost all candidates stated the percentage correctly as being 5%

(b) Many candidates could describe the age profile of the elephant population in 1970. Although too many candidates restated data rather than described patterns.

(c) Many candidates gave a reason why the age profile had changed without describing the change in profile seen in 2000 as compared to 1970. Few clearly stated that there were fewer young elephants in 2002 and then gave a reason why this may be the case.

(d) Most candidates were successful in giving good suggestions to maintain the number of elephants in the park. For example; remove predators, ex-situ conservation, provide more food or artificial insemination were some of the answers seen.

G2

(a) Some candidates had clearly studied this section well and knew how to calculate gross primary production. Some candidates were careless in their calculations though.

(b) This section was poorly answered with some very vague answers seen. Some candidates discussed the nitrogen cycle in detail and some exclusively discussed the nitrogen cycle. Many discussed human activities (ploughing, adding fertilizers). Some appeared to not have studied or did not understand the question. Better use of correct vocabulary is expected. For example that decomposers or bacteria and fungi can increase soil mineral content, rather than plant and animals die leading to an increase in soil nutrients. The most commonly gained point was for mentioning the role of plant roots in reducing the erosion of soil.

G3

(a) Most earned at least one mark for the damage caused by UV light. Some appeared to be confused about the relationship of ozone layer and greenhouse effect. Again the answers here lacked correct use of terminology and correct description. For example, some candidates stated that ozone stops UV radiation reaching the surface of the Earth without stating how it might do this. Some gave cancer as a consequence of UV light damage, without stating skin cancer.

(b) Many answers here were excellent and candidates had clearly studied and understood the topic. Some candidates had learnt work by heart but could not successfully describe the process of generating methane. Some discussed only cows generating methane.

Option H- Further Human Physiology

H1

(a) Overall the calculation of a percentage increase here was fairly well answered and gave the answer as 81.8%. Few rounded up the answer to 82%, but still gained the marks for showing the calculation and stating 81.8%.

(b) The majority of candidates successfully answered that calcium reduces the uptake of cadmium and that zinc increases it.

(c) Few candidates used their previous statement and took this further. Most were restating what they had just answered in (b). For example few stated that in the presence of calcium the cadmium uptake is less than the control, then stated that with calcium and zinc, the cadmium uptake is even less. These were the prerequisite statements necessary before being able to conclude that calcium uptake reduces the uptake by inhibiting zinc protein channels.

H2

(a) The definition of partial pressure was often correctly stated.

(b) This was fairly well answered. Candidates did often refer to a change in conformation of haemoglobin due to carbon dioxide, and the subsequent dissociation of oxygen.

H3

(a) Many candidates could outline the transport functions of the lymphatic system, but did not state its role in draining tissue fluid.

(b) Many excellent answers were seen here, fully describing and explaining the event of the cardiac cycle, fully stating for example that as the ventricular pressure rises above the atrial pressure, then this leads to the closure of the atrio-ventricular valves. Or that as the ventricular pressure decreases below that of the atria and below that of the arteries that the semi lunar valves close and the atrio-ventricular valves open. Some candidates only described the passage of blood through the heart without explaining why these events occur as required by the question.

Recommendations and guidance for the teaching of future candidates

- All teachers must be sure that time allows for candidates to study two topics.
- Candidates must have practice in reading and interpreting the questions.
- Practise percentage and percentage increases or decreases.

Standard level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 12	13 - 18	19 - 21	22 - 24	25 - 27	28 - 30

General comments

Overall, the 37 teachers who completed the G2 form were satisfied with the paper. Compared with last year's paper, 79% considered this paper to be of a similar standard, 4% a little easier, 14% a little more difficult while 3% thought it to be much more difficult. 97% of respondents believed it to be of the appropriate level of difficulty, while 3% thought it to be too difficult. Most respondents felt that clarity of wording, presentation and syllabus coverage were either good or satisfactory.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 9

A comment was made that the question could have been confusing as aerobic cell respiration was used in A. This wording was chosen to avoid confusion with assessment statement 2.7.3 which mentions anaerobic cell respiration and so to help the candidates to choose the correct answer.

Question 15

The wording of option D was considered to be ambiguous and difficult for ESL candidates. 57% of candidates answered the question correctly.

Questions 22

Some respondents believed this question to be ambiguous, leading candidates to choose option A and C as the correct answers. Even if random mating does not take place meiosis will still cause variation. Nearly 60% of candidates answered it correctly. The question had a good discrimination index, indicating that the majority of the better candidates were able to answer this question correctly.

Question 25

Some respondents believed this question to be ambiguous, leading candidates to choose option D as the correct answer. The question clearly asks about the effect on the immune system and not on the patient. More than 58% of candidates answered it correctly.

Question 28

Some respondents commented that it was unclear if the question was about the gas concentration in the blood or in the lungs. Just over 68% of candidates answered it correctly.

The question had a good discrimination index, indicating that the majority of the better candidates were able to answer this question correctly. In the published version of this paper it will be made clear that the oxygen and carbon dioxide concentrations pertain to the blood only.

Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 5	6 - 10	11 - 18	19 - 24	25 - 30	31 - 36	37 - 50

General comments

Overall, the 35 teachers who completed the G2 form were satisfied with the paper. Compared with last year's paper, 71% considered this paper to be of a similar standard, 4% a little easier, 21% a little more difficult and 4% thought it to be much more difficult. 89% of respondents believed it to be of the appropriate level of difficulty, while 11% thought it to be too difficult. 97% of respondents felt that clarity of wording was either good or satisfactory and all felt that presentation and syllabus coverage were at least satisfactory.

In Section A, though all parts of the data analysis question were eventually answered well by the candidates as a group, overall success by any particular candidate usually fell well short of the maximum number of marks available. Candidates needed to scrutinize the data (primarily graphical analyses) more precisely and make better use of the background information that was presented. Also, especially in the data analysis questions, candidates often failed to match their responses to the leadoff action verb of the question.

The genetics questions, involving the drawing of a Punnett grid, totally confounded many candidates. However, the notion that the questions were especially difficult was belied by the beautiful answers that many other candidates produced. Acceptable understanding appeared for the questions reflecting biochemistry, ecology, and physiology.

In Section B, candidates overwhelmingly chose to answer Q7. The popularity of this question was probably based on parts (a) (named food chain with trophic levels) and (b) (population growth curve with explanation) which required relatively conventional answers. This sharply contrasted with part (c) (comparison of skin and mucous membranes in pathogen defence) which, being less obvious, required more reflective thought. The result was strong answers for parts (a) and (b) and very weak answers for part (c). Achievement in the various parts of Q5 and Q6 were more balanced for each of the questions.

The areas of the programme and examination that appeared difficult for the candidates

Section A

In Q1 (b), some candidates could not perform a percentage calculation. This kind of simple calculation has appeared in past examinations, yet candidates remained bewildered by the mathematics. Because many candidates were unable to write the correct alleles for a colour blind man and a heterozygous woman in Q2 (b) (ii), they produced flawed Punnett grids.

In part 2 (b) (ii) answers from some candidates revealed confusion between the terms phenotype and genotype. In Q4 (a) candidates often described properties of water enabling blood to perform its role rather than listing them.

Section B

Candidates who answered Q5 tended to dwell on the composition of genes or the details of protein synthesis. Few candidates struck a balance by explaining how the formation of a polypeptide is rooted in a genetic recipe. Q6 (b) required candidates to focus on the random positioning and movement of homologous chromosomes during meiosis. Insufficient attention was given to how reduction division produces haploid cells, each of which is uniquely different in its set of maternal and paternal chromosomes. In Q7 (c), many candidates could accurately describe different ways in which the skin or mucous membranes defended against pathogens, but they failed in constructing a table that showed direct/matched comparisons of known facts.

The areas of the programme and examination in which candidates appeared well prepared

Particular strength was seen in the answers for Q3 (a) about the formation and breakdown of glycerides. The ecosystem and excretion definitions were also generally known well. In Q4 (c), there was good understanding of how the diaphragm functions during ventilation. Almost all candidates gained full marks for knowing different functions of membrane proteins in Q5 (a). Candidates also achieved success in Q6 (c) with their descriptions of the roles of estrogen in females. Realistic food chains in Q7 (a) varied from outstanding to miserable. Drawings and explanations of population growth curves were usually done well in Q7 (b). In general, answers to straightforward questions fared much better than answers to novel questions where adaptation of ideas was required.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

(a) General imprecise answers were often given such as “stays low” rather than “stays below 3ng ml^{-1}” or “minor fluctuations.”

(b) Widespread confusion and unsuitable work. In most cases the workings shown were inaccurate with a great variety of mistakes. Sometime a correct answer was given but the workings did not support the answer. In other cases, no working was even shown.

(c) The data allowed for a discussion in which the effects of the lipid-poor 200 and 300kJ day^{-1} diets on stress hormone concentrations could be compared. Unfortunately some candidates only offered individual descriptions of their effects without further assessments. A few candidates offered real insight by suggesting that kittiwakes were adapting to the lipid-poor diet since peak hormone levels fall before the end of the lipid-poor diets. Many candidates managed to gain at least two of the three available marks.

(d) Most candidates only described the data. There was little attempt to explain what the data showed. Any reasoning with linkage between diet, daily energy needs, and body mass was rare indeed.

It seems that many candidates did not consider the purpose of lipids in the diet and how lipid-rich or lipid-poor diets might contribute to energy availability and storage.

(e) Analysis of the graphs was mostly incomplete. Many obvious features were ignored such as the relatively big improvement of the kittiwakes on a lipid-rich diet in trial 2 and the retention of their ability in the succeeding trials. Candidates tended to gain only one mark of the three available.

(f) Curiously, candidates who struggled with earlier parts of Q1 were able to reason that trial 4 was a test of memory in the kittiwakes.

(g) Candidates had to remain aware of the opening two sentences in the initial paragraph of stem/background and the significance of Graphs A and C. The key was remembering that climate change had reduced the amount of lipid-rich fish on which kittiwakes depend for their learning development. The candidates who kept these points in mind wrote wonderfully coherent outlines which gained full marks. Many candidates limited their success by referring only to fish rather than to lipid-rich fish.

Question 2

(a) (i) Candidates needed to qualify that the cell plate/wall was forming or was new. Unfortunately, some did not make the distinction.

(ii) The stage was often correctly identified but sometimes the cell was designated as eukaryotic rather than plant cell. The latter answer gained the mark since it was more specific to the diagram.

(b) (i) Candidates presented a variety of answers with varying degrees of accuracy. Evidence of understanding that colour blindness is a recessive sex-linked trait on the X chromosome was not widespread, based on the alleles that were given on each side of the Punnett grid. Error Carried Forward (ECF) rules did allow for a mark if candidates made correct crosses of incorrect alleles.

(ii) Some candidates confused phenotypes with genotypes. No credit was awarded for ratios where female carriers rather than normal females were identified.

Question 3

(a) Good descriptions of the formation and breakdown of glycerides were given. Many candidates provided considerable detail in their answers which included more than the maximum number of marking points.

(b) Generally, well answered. If a candidate lost the mark it was because of failure to describe the environment as nonliving/abiotic.

(c) Many candidates mentioned breakdown of dead material but neglected to complete the recycling concept by including the uptake of nutrients by living organisms (plants). It was not enough to say that nutrients were “given to the soil.” Proper use of the terms organic, as in break down dead *organic* matter, or inorganic, as in produce *inorganic* nutrients, would have gained marks. Examples such as bacteria, fungi, or saprotrophs were often cited.

Question 4

(a) "High heat capacity" was acceptable whereas "heat capacity" was too vague. Instead of listing or naming two properties; candidates tended to outline or describe properties. Sometimes candidates confused the terms solvent and solute. Water is the universal solvent not solute.

(b) In their definitions of excretion, most candidates were careful to include the term "metabolic" when referring to waste products. "Waste products" without further qualification, was not credited as it could be fecal.

(c) Explained well by many candidates. Accurate linkages between the phase of ventilation, the motion of the diaphragm and its effect on the volume of the thorax were seen frequently. Sometimes a mix-up of diaphragm 'contraction' and 'moving up' was seen among weaker candidates or those with English as a second or third language.

Section B

Question 5

(a) Maximum marks gained by most candidates. Well done.

(b) A balanced well-constructed explanation with logically sequenced thought was not found very often. Although candidates did know facts about how genes relate to polypeptides, deeper insight was missing. Mutation was overlooked as was the universality of the genetic code. The latter idea leads to the concept that all organisms show the same relationship between genes and polypeptides which, in turn, is evidence for common ancestry and evolution; a major theme in IB biology.

(c) The results here were less favourable than anticipated. Candidates knew that the acid conditions of the stomach enable the catalytic action of pepsin to occur. Finer points about gastric glands and hydrolysis were usually missing. Some candidates did mention the mechanical action of the stomach.

Question 6

(a) Although a wide range in the quality of diagrams still exists, there was improvement over previous years. For many organelles, the mark scheme identified specific criteria to be met before a mark could be awarded.

(b) Many candidates associated reduction division with meiosis but a limitation in terminology constrained candidates from providing top quality answers. Accurate use of the words homologous, maternal, paternal, diploid (2n), haploid (n), and random would have helped candidates describe how the movement of chromosomes results in genetic variety during reduction division. Some candidates had difficulty in adapting memorized information to fulfill the particular question.

(c) In order to gain full marks, candidates usually had to describe the role of estrogen during the monthly hormonal cycle. A stumbling block was how estrogen interacts with other hormones (FSH and LH) through negative feedback and positive feedback. Here accurate detailed information was required.

Question 7

(a) Most candidates knew the correct direction of energy flow in the food chains they presented and correctly associated the autotroph and consumer labels. Either through memorized study or direct field experience, some food chains were outstanding in their realistic feeding order of named organisms. Other food chains were obviously imagined and more general in nature. These were often flawed by one preposterous feeding linkage.

(b) Sometimes, the graph shape was not sigmoid and the range of the three phases was not clearly shown. However, explanations for the shape were usually done well with more than adequate reasoning provided.

(c) Not every candidate who chose Q7 attempted to answer this part. Those who answered, usually prepared two independent columns (one for skin and one for mucous membrane) that listed various barriers against pathogens. Often valid ideas were given but the lists did not have any row-by-row/parallel coordination of ideas, as in a table and therefore lost marks.

Recommendations and guidance for the teaching of future candidates

- All candidates should be given a printed copy of the new Biology Guide (first exams 2009) so they realize what content they are responsible for knowing.
- Candidates should be taught how to write answers that reflect the direction of the 'Command Terms' pages 11 and 12 of the new guide.
- Teachers should integrate the analysis of data in tables and graphs and calculations with units wherever possible throughout the SL course. Percentage calculations must be included.
- Candidates must practise drawing the diagrams given in the syllabus. Attention should be given to accurate labelling, juxtaposition of structures, relative size, and continuity (as in a continuous tube for the digestive system).
- Candidates should practise constructing tables which make direct comparisons e.g. a table comparing the structure of arteries and veins
- A good review programme, including use of old papers and problem solving, is essential to good preparation of candidates for the exam.
- Candidates should be taught how to thoroughly and carefully read the exam questions.
- Candidates should be aware that they are expected to write at least as many facts/clearly stated ideas as the mark value of the question, shown in brackets at the end of the question.
- Candidates should be shown how to write a plan/rough draft for a well-constructed answer, as an approach to writing organized answers. This is especially important for questions that start with discuss or explain. It is important for candidates to practise linking information in their answers. There is no need to repeat the question, since this takes up time and space.

- It is recommended that teachers emphasize the importance of legible handwriting. If a candidate's answer is correct but unreadable, the candidate may lose marks if deciphering the handwriting is impossible and the examiner misinterprets the script.

Standard level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 6	7 - 12	13 - 15	16 - 20	21 - 24	25 - 29	30 - 36

General comments

The 33 teachers who completed the G2 form were satisfied with the paper overall. 78% considered this paper to be of a similar standard compared with last year's paper, 11% thought it a little easier and 11% a little more difficult. None thought it to be much more difficult. All respondents believed this paper to be of the appropriate level of difficulty. 97% of respondents felt that clarity of wording was either good (67%) or satisfactory (30%) and all felt that presentation and syllabus coverage were at least satisfactory.

Option A (Diet and Human Nutrition) and Option E (Neurobiology and Behaviour) were very popular choices among candidates whereas Option F (Applied Plant and Animal Science) was attempted by few candidates. It was obvious that some of those candidates who chose Option F had not been taught this option and had no relevant biological background.

In general, candidates demonstrated reasonable achievement with very few questions left unanswered. Compared to the past; exam performance by candidates this year was at a similar standard or slightly better. There were few poor scripts and many high quality answers. Comprehension was generally good.

Some questions generated long answers.. Often some essential information was forgotten or unnecessary details were added. Some scripts had repetitious answers.

The areas of the programme and examination that appeared difficult for the candidates

Although some understanding was shown, many candidates struggled to answer the questions involving: skeletal muscle contraction, measurements for fitness, role of myoglobin, non-competitive inhibition with a named example, chloroplast structure and function, biochemical variations as an evolutionary clock, endosymbiotic theory, Lamarck's theory of evolution, classification of humans, the human spinal cord and reflex, rod cells and cone cells, and *ex-situ* conservation measures.

In Option C (Cells and Energy), there was a graph with negative data that posed a problem for some candidates. In Option E (Neurobiology and Behaviour) and Option G (Ecology and Conservation) some candidates were confused about the data.

The areas of the programme and examination in which candidates appeared well prepared

Constituents of a diet, energy requirements in humans, examples of social behaviour, operant conditioning, constructing a pyramid of energy, and defining gross production were questions where candidates showed competence.

The graphs and tables were generally understood despite the fact that, in some cases, the graphics were not easy to interpret in relation to the questions.

There has been a slight improvement in the presentation of drawings, but there is still some work to be done for further improvement.

The strengths and weaknesses of the candidates in the treatment of individual questions

Option A Diet and Human Nutrition

A1

(a) Most candidates correctly identified the time period as 2002-2003.

(b) This question was not answered well. Candidates tended to consider what additional data could be collected rather weaknesses in the actual data presented. Many candidates did not understand the question and answered that the study did not show the effect of the doses.

(c) Generally answered well. Some candidates gained marks by including simple subtractions of the 1999 percentages from the 2004 percentages.

(d) Most candidates knew at least one effect of low retinol in the diet.

A2

(a) (i) Most candidates could list three other constituents of a diet.

(ii) Some candidates scored maximum marks by giving accurate information for examples and natural sources of disaccharides and polysaccharides. This was problematic however for many candidates.

Common errors were examples which are not natural sources (chocolate and bread), incorrect pairings, or reversals between the example and the natural source.

(b) Often answered well. Some candidates discussed the problems of getting enough food instead of the different energy requirements for different groups.

A3

(a) (i) Answered well. Candidates could state two types of food additives.

(ii) Answered well. Candidates could outline a harmful effect of a named food additive.

(b) Generally good but, often, there was no mention of the exclusion of fish for vegetarians.

Option B Physiology of Exercise

B1

(a) Usually answered well. The numbers required for the division were easily accessed from the data.

(b) Few candidates got the periods right, they only mentioned that there was an increase in the distance the rats ran.

(c) Very few candidates got this answer right. The majority of candidates did not understand "evaluate."

B2

(a) Most candidates knew that motor neurons stimulate skeletal muscles to contract.

(b) Only a few candidates mentioned the proteins actin and myosin. Most concentrated on the use of ATP and the fact that muscles involved are antagonistic. Knowledge about muscle contraction was lacking.

(c) Candidates had difficulty writing complete discussions about measurements that could be used to measure fitness.

B3

(a) There was a lack of knowledge concerning the role of myoglobin

(b) (i) Generally weak descriptions of sprain injuries were seen.

(ii) Many candidates did not score any marks as they mentioned sprains as one of the answers. Since the previous question was about sprains, it was inappropriate to repeat that idea, especially since this question began with "State **two** other types of injuries……"

Option C: Cells and Energy

C1

(a) (i) The only idea that the majority of candidates mentioned was an increase in biomass with the increase of CO_2.

(ii) Candidates generally recognized that increase in biomass is greater at high light intensity.

(b) Many candidates gained one of the two marks for discussing how an increase in temperature would affect the biomass in the experiment.

C2

(a) Non-competitive inhibition using a named example was not answered well.

(b) Many candidates knew where glycolysis occurs in the cell.

(c) The role of acetyl CoA in metabolism was not understood.

C3

(a) Some candidates produced excellent drawings of a chloroplast with correct labelling, however there were still some candidates who produced confusing sketches.

(b) Candidates had limited success in explaining the relationship between structure and function in chloroplasts.

Option D: Evolution

D1

(a) (I) Most candidates correctly stated that owls have a wider range of RSD values.

(ii) An easy calculation for most candidates.

(b) Many candidates failed to notice the normal distribution of the data presented.

(c) Most candidates did not gain full marks with their suggestions about RSD values in hawks and owls.

D2

(a) Most candidates could name two conditions, other than temperature, that possibly existed on the pre-biotic Earth.

(b) Some very good answers, but, most often, candidates failed to adequately discuss the use of biochemical variations as an evolutionary clock.

(c) Candidates were generally weak in their discussions of the endosymbiotic theory for the origin of eukaryotes.

D3

(a) Mixed results, as many excellent outlines of Lamarck's theory of evolution sharply contrasted with several poor outlines.

(b) Not many candidates could successfully state the classification of human beings.

Option E Neurobiology and Behaviour

Almost all candidates showed a lack of knowledge of spinal reflex and of rod and cone cells. Grooming was understood.

E1

(a) (i) Answered well by most candidates. This was a simple subtraction of values at a designated percentage.

(ii) Some candidates did not understand the axis labelled "percentage of nursing activity during the day" and failed in their calculation.

(b) Poorly answered. Candidates did not understand the graph. Some thought that the bars in the centre of graph represented the middle of the day.

(c) Sometimes drone was given rather than worker.

E2

(a) (i) Many candidates had difficulty in correctly labelling all four components.

(ii) Despite instructions in the question, some candidates outlined a pain withdrawal reflex. Many other candidates did not write a specific answer using precise terminology.

(b) Answered well. Most candidates knew three examples of animals that show social behaviour.

(c) Answered well by a few candidates who adequately distinguished rod cells from cone cells. A frequent misconception among some candidates was that each cone cell is sensitive to all three colours (red, green, and blue).

E3

(a) (i) Most candidates knew that innate behaviour develops independently of the environment.

(ii) Most candidates explained the behaviour of grooming very well.

(b) *Operant conditioning* was usually defined correctly.

Option F Applied Animal and Plant Science

F1

(a) Most candidates failed to produce a successful answer. The calculation was relatively difficult.

(b) Most candidates were able to compare the chicken production between Ethiopia and Nigeria.

(c) (i) It was difficult for most candidates to provide an acceptable suggestion for the differences between family farming and commercial farming.

(ii) Candidates were usually able to gain at least one mark in their discussion of government advice against family farming of chickens.

F2

(a) Candidates could successfully state different uses of plants, other than foods, giving examples.

(b) Candidates missed many ideas about how the temperature of greenhouses can affect plant productivity.

F3

(a) (i) *Inbreeding* was generally known.

(ii) Outlining the concept of inbreeding using a plant or animal example was difficult for candidates.

(b) (i) A few candidates knew two commercial uses of plant hormones.

(ii) A few candidates knew a named example to describe a commercial use of a plant hormone.

Option G Ecology and Conservation.

G1

(a) Most candidates could identify fish at pH 5.0-5.4

(b) Some candidates missed the trends between the expected and observed number of species at lower pH.

(c) Some candidates failed to understand the effect of pH on organisms.

G2

(a) Most candidates could state three abiotic factors.

(b) This was often answered well. Some candidates stumbled on the concept of mutualism.

(c) Some candidates drew their pyramids well; others forgot to keep the approximate proportions. Marks were not awarded for vague or careless answers. A few candidates did not draw pyramids.

G3

(a) This was usually answered well. Many thought dodo birds became extinct because they were killed by humans for food. According to internet resources, food was not the reason since dodo birds tasted terrible. Only a few candidates mentioned species which had become extinct before 1600.

(b) Outlining the use of **one** *ex-situ* conservation measure was difficult for many candidates. A few did it well.

(c) Mixed results. Many candidates knew the definition of gross production, but others did not.

Recommendations and guidance for the teaching of future candidates

- Teachers should guide candidates to answer the options they have been taught in class and not to attempt other options just because the graph or other data looks easier.
- More use should be made of past papers and mark schemes for exam preparation.
- Continuously provide candidates with practice in analyzing various types of data. Ideally, data would be related to the options being studied.
- Candidates must know the meanings of all the command terms and develop their answers based on the command term starting a particular question.
- Candidates must read the questions carefully and be aware of possible linkage between a part (i) followed by a part (ii).