BIOLOGY TZ2

(IB Africa, Europe & Middle East & IB Asia-Pacific)

Overall grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 15	16 - 28	29 - 42	43 - 55	56 - 69	70 - 82	83 - 100

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 16	17 - 31	32 - 44	45 - 55	56 - 68	69 - 79	80 - 100

Higher level and standard level internal assessment

Component grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 16	17 - 22	23 - 27	28 - 33	34 - 38	39 - 48

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 16	17 - 22	23 - 27	28 - 33	34 - 38	39 - 48

General comments

Most schools used appropriate investigations of a good standard. Two problems persist, however, in some schools the complexity of the investigations is not up to IB standards, while other schools are setting investigations for assessment that give too much guidance.

In many schools the criteria are being applied rigorously but in a number of schools the teachers seem to be ignoring the descriptors of the different aspects. In these cases the moderators were marking down.

Ethics

In many schools the IB Animal Experimentation Policy (available of the OCC) is adhered to rigidly while in others it seems to be somewhat disregarded. Schools should review the

investigations carried out in light of this policy and ensure that all experiments are considered from an ethical point of view.

The IB does not wish to inhibit investigations but it does want to stimulate a responsible attitude towards experimentation on animals. Any proposed experimentation involving animals, including humans, should result in a discussion between teacher and student, based on its ethical implications and how to refine the experiment to alleviate any harm or distress to the animal, to reduce in the numbers of animals involved, or to ultimately replace of the use of animals by using cells, plants or computer simulations.

These rules equally apply to those student designed investigations that are not intended to be followed through in a practical session. Some teachers and students seem to think that if it is not followed through they can ignore ethical principles. In these cases the teachers are clearly not counselling their students on what is ethically acceptable.

Moderators continue to comment on investigations that were unsafe or unethical.

Behavioural experiments or experiments on animal physiology are frequently quoted as examples.

Experiments in these areas are still possible so long as they remain within the normal tolerance limits of the animal. Thus, exposing animals to conditions normally experienced in their natural environments is permissible. It is good practice to include a discussion with the students on the tolerance limits of the animal and how these could be established. There are plenty of sites on the web that will help here.

It goes without saying that wild animals should be returned to their natural environment soon after the investigation. Animals obtained by a supplier should be kept under safe and healthy conditions.

Situations that deliberately demand the euthenising of animals are no longer appropriate. Thus, fruit fly genetics must be replaced by, for example, rapid *Brassica* plants, *Sordaria* mould, maize cobs or simulations, such as the virtual fly lab (though this would mean that as a simulation it could not be assessed using the IA criteria).

Dissections are a special case in biology. The guidelines are quite clear on this. The practice of dissections because they are a traditional part of biology course is not an adequate reason for including them. Including them, however, in order to study form and function in the distribution of organ-systems, organs and tissues is valid. Much of this can be done using simulations or dissections of organs purchased in butchers shops.

Fieldwork often involves the sampling of animal populations. This should take place with the minimum of disruption to the environment. The animals should be sampled using techniques that do not cause injury and which limit their stress. The animals should be returned, with due care and attention, to the places where they were collected.

The approach to experiments on human physiology should be reconsidered by a lot of teachers. Using fellow students for investigations into the effect of exercise on the heart rate can be considered unsafe if the health status of the students is not determined first. Some schools are already expecting their students to use a proforma for the signed consent of the participants in experiments. This is good practice.

Some inappropriate examples quoted by moderators include:

- Exposing mud worms to caffeine, heat stress, extreme pHs, medication,70% ethanol.
- Exposing *Daphnia* to solutions of nicotine, caffeine or ethanol.

- Exposing “volunteer” students to “unhealthy” food, fear and even medication (paracetemol)

Clerical procedure

Earlier versions of the 4/PSOW form are **still** being used by some teachers. These do not provide space for the moderator’s and senior moderator’s marks. The latest versions (available on the OCC) should be used. The 4/IA form and list of students is often absent.

It is disconcerting to see that there are teachers who do not appear to be consulting the Handbook of Procedures. This is published and updated each year.

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 that take a lot of time and trouble to prepare their Internal Assessment sample. This effort is very much appreciated. They should be congratulated for their efforts and their students will reap the benefits. It is a lot easier for a moderator to support a teacher’s marks when there are clear notes accompanying the sample.

There is a recurrent problem concerning the information provided by the teacher. This directly affects the progression of the moderation. Teachers MUST 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 DCP assessment. It is also necessary, however, for investigations where Design is being assessed and a significant number of teachers are not doing this. Furthermore, when Data Collection and Processing is being assessed the method (designed by the student or provided by the teacher) is required. When Conclusion and Evaluation is being assessed all the steps in the scientific process are needed for moderation.

A few teachers are not designing practical programmes with sufficient numbers of hours, others are inflating the time spent on an activity. It should also be noted that the Group 4 Project can only count for 10 hours on the 4/PSOW.

Atypical candidates should be replaced in the sample. These would include students whose work is incomplete or transfer students where a substantial part of their work has been marked by another teacher.

When the only marks appearing on the 4/PSOW form are the two marks required for the internal assessment, it causes concern amongst the moderators. There is no indication that the students were marked a number of times using the criteria. One wonders how these students receive the necessary feedback to improve their performance.

Some moderators commented on transcription errors between the marks indicated on the work and the mark on the 4/PSOW form. This should be verified before it is sent.

Schools are sending photocopies of the student’s work. Usually these are of good quality. The problem is that graphs and diagrams using colour can be confusing. **The originals must be sent** and a photocopy kept back.

Areas of strength

The variety of investigations, the duration and coverage of the practical programme were generally good.

The use of ICT in the areas of **1** Data logging, **2** Graph plotting software and **3** Spreadsheets is good though some schools have efforts to make in the use of data bases and spread sheets.

Areas of weakness

Trivial, simplistic investigations that do not generate sufficient data to permit adequate assessment of data processing were too often used for assessment. If there is one significant area of weakness it is in the processing of data. Students are missing quite obvious conventional points (e.g. indicating uncertainties in their data) as well as limiting their processing to the calculation of a mean. Teachers are also missing these points and marking over generously. Sometimes teachers point out the errors to their students and still give full marks.

Choice of inappropriate labs by the teacher was often a major cause for differences in the level awarded by the moderator.

Where teachers apply the criteria rigorously and clearly the moderators make relatively small adjustments to the marks. In schools where the descriptors of the aspects are ignored the moderation can reduce the marks quite severely.

Literature sources are not consulted when they could provide valuable background information in determining the initial research question and in the discussion of the results.

In some schools cross moderation between colleagues in biology is clearly not being carried out. Moderators have observed quite different standards of marking between colleagues presenting work in the same sample.

Rules applied by the moderator

In the event of the teacher providing too much guidance to the students or ignoring the criteria the following scale is applied by the moderators:

Criterion	Problem	Teacher awards	Maximum moderator can award
Design	Teacher gives the problem or research question.	c; c; c = 6	p; c; c = 5 Students could have identified their own control variables
Design	It is clear that the students have been told precisely what apparatus and materials they require and have not modified it.	c; c; c = 6	c; c; n = 4
Data Collection & Processing	The students have used a photocopied data table with headings and units.	c; c; c = 6	p; c; c; = 5 Student could have added uncertainties or relevant qualitative observations
Data Collection & Processing	The students have been told, on the method sheet, to draw a graph from their raw data and which variables to plot or process the data in a particular way.	c; c; c = 6	c; n; c = 4
Conclusion and Evaluation	The student 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 = 6	c; n; p = 3

Candidate performance against each criterion

Design

Too many teachers are setting general themes with little scope for different investigations. The result is that the whole class of students selects the same variables and investigates the same system. Moderators made the following comments this year.

- Group work presented as individual work - all candidates with same plan, same data values.
- Teachers using standard labs and saying they are designed by candidates: for example, effect of antibiotics on bacteria (standard selection of antibiotics on discs put on agar petri dishes and then measure zone of inhibition).

Little research is evident or investigations that are designed with little or no consideration of biological principles. It may be a small point but it would be useful for the student to give the scientific name of the organism being used or the organism that was the source of the material. The trivial name at least must be given.

Research questions need to be focussed. A research question that lacks focus will have an impact right through the rest of the investigation. For example students who decide to investigate several independent variables at once such as the effect of pH, temperature and substrate concentration on the activity of an enzyme.

The three categories of variables must be clearly identified. It is clear that students need to be taught what the different variables are and what their relationship is. Moderators have observed that there is sometimes confusion over what is a controlled variable and what is a control experiment. Sometimes unrealistic controls are being proposed when a control experiment would be appropriate (e.g. set room temperature to 21.1 °C).

The investigations are frequently too simplistic. The range of values of the independent variable was insufficient to establish a trend. The number of repeats was insufficient to permit statistical analysis. E.g. testing the effect of pH on an enzyme using an acidic environment a neutral environment and a basic environment will not establish an optimal pH. Moderators made the following comments:

- Not enough values being used in plans to establish a trend
- Planning very simplistic labs e.g. find the number of people in the school of Chinese heritage with dimples.

Standard protocols will, no doubt, be used by the students when they design their investigations. We are not expecting them to re-invent the wheel. HOWEVER these standard protocols must be significantly modified or applied to the student's own investigation. For example, if osmosis is being investigated and the student uses the method of change in mass of tissue to monitor the effect of solutions of different concentrations on a tissue, this is legitimate. If the investigation is simply to determine the isotonic solution of one tissue then it remains trivial and it repeats many textbook investigations. If the investigation is used to determine the effect of the salinity of irrigation water on different root crops, the investigation becomes more substantial. Osmosis was often presented this year as a Design investigation theme without any modification from a text book method.

In field work, the control of sampling procedures is often almost totally ignored by the students. If a random sample is to be obtained how can it be ensured that it is random?

Planning to use data loggers for the measurement of variables is becoming more common. This is a good thing. However the link between what the probe measures and the dependent variable is often left up to the reader. For example a pressure sensor may be used to measure the effect of catalase on the breakdown of hydrogen peroxide. The fact that a gas (oxygen) is produced by this reaction and that its accumulation in a vessel will cause a pressure change needs to be explained.

It is good practice for students to follow through their own designs. Some schools seem to have their students design an investigation that remains theoretical. The result is often an unrealistic investigation. Even when a teacher does decide to follow through a student designed investigation the result may be an unrealistic investigation. For example measuring the effect of music genre on heart beat rates. This is almost impossible to control and students ought to be counselled against it from the outset.

Students should use decimal / SI units (eg °C not °F and cm not inches). Spoonfuls and cupfuls should also be discouraged.

Data Collection and Presentation (DCP)

A consistent problem repeated by the majority of moderators is the presence of trivial investigations that do not generate sufficient quantitative data for adequate processing. This sometimes stems from investigations that are poorly designed by the students themselves. In this case the teacher can decide not to mark the investigation for DCP or CE. It also can be the product of an investigation set by the teacher which is more problematic.

It may be that class data is required in order for the student to gain access to sufficient data for significant data processing and the determination of uncertainties. The moderators understand this, biological systems are often difficult to coax and slow to give data. If class data is to be used and DCP is to be assessed a number of precautions must be respected. The students must present their own data or clearly identify which is their own data in a pooled data table. The students must plan and produce their own data tables. Copying a table from other students will be counted as collusion and the school's IA work will be subject to an enquiry. Teachers who provide the students with a pre-formatted data table can expect their students to be moderated down.

Despite the clear warnings in the subject guides, teachers are still providing instructions on how to present the data and how to process the data. Their marks will be moderated down. The classic investigations (e.g. mark and recapture, chromatography of leaf pigments, rates of photosynthesis using the sunken leaf disks, rates of reaction of catalase and osmosis) often create problems. Teachers are using standard textbook protocols without modifications. A little imagination and editing could easily solve the problem.

Moderators often had to reduce the marks of the teachers who had missed the following points:

- Data (raw or processed) that is inadequately presented (e.g. with superficial titles)
- There were no quantitative data collected
- There are no units in the table (note: decimal units should be used)
- No uncertainties were given in the tables of data collected using measuring instruments.
- There were inconsistent decimal places in tables
- The decimal places did not correspond to the precision of measurements

There were no associated qualitative observations. E.g. an ecological field investigation is incomplete without some kind of description of the site used

Raw data were plotted in graphs that do not actually reveal anything (e.g. maxima, minima, optima or intercepts)

Raw data were plotted when the mean should have been calculated and plotted (often the mean is actually calculated and then ignored by the student for graphing)

There was no statistical treatment of the data when it was possible

When statistical treatment is applied there is no consideration of its appropriateness. E.g. calculating standard deviations when they had only made 2 or 3 measurements (many teachers marked this as complete and made no comment about it on the student work)

There was no presentation of uncertainties in graphical data either by using trend lines or error bars or uncertainty ranges on the axes.

The error bars, when used, were not explained.

A majority are putting a linear line of best fit even when the data is clearly S-shaped or clearly has a non-linear pattern.

Complete may not mean perfect but when the mistakes are consistent they will have an impact on the moderated marks.

When calculations are made it is important that the pathway to the answer is clear. This does not mean there has to be a worked example but a result that springs up out of nowhere should not be credited.

Conclusion and Evaluation (CE)

Investigations that lead to trivial amounts of data will lead to limited discussion of results and weak conclusions. Insufficient data will not reveal uncertainties and this has an impact on evaluation. So although each criterion is marked on its own merits there will be a knock-on effect through a poorly designed investigation that collects a limited amount of data leading to a weak conclusion and evaluation.

Some students seem to have trouble in analysing their data. There is often confusion over what directly proportional means. Every potential straight line is described this way, even when not true

Some teachers are using simulations instead of real biological investigations. These may be useful for training data collection and processing as they generate large amounts of data quickly. However they are not suitable for assessment, especially the assessment of this criterion. It is not possible to provide a biological explanation in these cases and evaluation is very superficial.

Overall literature values or the theoretical background were not consulted enough by the students. When they were consulted the sources were often not correctly cited. For guidance on the correct way to cite a reference in the Extended Essay the guidelines are very helpful.

Students in some schools show that they have developed a mature sense of criticism of the investigation. Their evaluation of their results is based upon a balanced critical analysis of the data. Students who have not developed this skill tend to remain superficial in their evaluation. The weaknesses they identify are hypothetical (“the seeds could have been dead”) without evidence to back it up. For weaker students the experimental weaknesses are restricted to having a limited amount of time or errors in their own manipulation that once again remain hypothetical (“I could have incorrectly measured the temperature”). Evaluation is a good discriminator of the high achieving students and teachers would do well to remember this when they are marking their students.

Suggested modifications were sometimes superficial and yet marked over generously.

As stated above in clerical procedure, if the method and the data used by the student are not provided by the teacher then CE cannot be moderated.

Manipulative skills

There is evidence of the students being exposed to a sufficient range of investigations. This ensures that the manipulative skills can be assessed correctly.

ICT coverage

This was generally covered adequately by the majority of the schools. Schools seem to have made an effort to equip themselves with the necessary materials to carry out data logging.

Graph plotting using software was perhaps the easiest and most widespread for schools to apply. However the signs are that the students still need to be taught the correct conventions of graphing. There is a tendency to use bar charts for everything amongst the weakest students, perhaps because it is the default setting. Legends (keys) are not always necessary and students do not seem to know how to de-select them. When they are needed the students often have difficulty labelling them appropriately – students often present the different curves as “series 1” and “series 2” When the students used scatter plot, a trend line was not always used when it was appropriate.

It might be an idea to train the students to plot graphs manually before using a graphing program.

The use of spreadsheets for data processing was less apparent in the sampled investigations. When spread sheet tables are inserted into document files the conventions of presenting tabulated data were often ignored or forgotten (e.g. centring numbers, adjusting the number of decimal places, column headings).

Some schools are not fulfilling the requirement for a range of ICT applications to be used in their practical programme. It is the use of databases and computer modelling/simulation that are most often missing.

The Group 4 Project

It needs to be repeated for a very few schools now, the Group 4 Project can ONLY be used for the assessment of Personal Skills. Indeed it is the only occasion when it is assessed. The Group 4 Project CANNOT be used for the assessment of Design, DCP, CE or Manipulative Skills.

Recommendations for the teaching of future candidates

- Share the criteria with the students.
- Read feedback from the previous session and act upon it.
- Consult the Online Curriculum Centre (OCC) for teacher support material (TSM)
- Apply the internal assessment criteria rigorously.
- Ensure that the open-ended theme that you set has enough scope to provide a variety of research questions.
- Give the students experience in identifying independent, dependent and controlled variables.
- Be sure that investigations used for assessment produce quantitative data.
- Encourage the students to make additional observations about their experiment. It is good practice for them to keep a log book.
- Ensure that the investigations have the potential to generate sufficient data for substantial processing.

- Teach the students that plotting graphs of raw data is often insufficient.
- Encourage the students to carry out research into the background literature both before starting an investigation and once the results are complete.
- Do not use simulations for assessment.
- **Do not** use the Group 4 Project for assessment of D, DCP CE or MS. Only use it for Personal Skills. Inappropriate use will be sanctioned.
- Make sure that you are using the most up-to-date version of the 4/PSOW form (available from the **Handbook of Procedures** on the OCC).
- Check to be sure that all the parts of the 4PSOW form are completed correctly.

Higher level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 10	11 - 16	17 - 22	23 - 27	28 - 31	32 - 36	37 - 40

General comments

Over a hundred G2 forms were received with comments on this paper, which is a higher number than in previous years. Teachers are encouraged to complete these forms and send them in, as they help in the evaluation of exam papers and subsequent grading. More than 90% of teachers responding felt that the level of difficulty was appropriate. Of the remaining 10%, more considered the paper to be too difficult, than too easy. Comparing the paper with last year's, most teachers felt that the standard was similar, and those who thought the standard was different, more thought it was comparatively harder than easier. More than 95% of teachers reported that the clarity of wording was satisfactory or good and more than 99% considered the presentation of the paper to be satisfactory or good.

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

Question 1

Proved to be a difficult first question, with fewer than half of candidates answering it correctly and a substantial number of candidates choose each of the distracters. As there is no ambiguity about the correct answer, this must be an area of relatively weak understanding, and teachers should ensure that *t*-test is carefully taught during the course.

Question 3

Was based on assessment statement 11.2.5. It is of course arguable whether a muscle fibre is a cell, but the question was a good discriminator and was answered correctly by over 70%, so this uncertainty does not appear to have worried candidates.

Question 4

Was a slightly unusual test of candidates' knowledge of the functions of life (2.1.3). Although more than 80% answered correctly, the discrimination index was low, suggesting that some stronger candidates answered incorrectly, probably choosing answer A. The presence of genetic material in a structure does not necessarily indicate life, as DNA is chemically stable and can persist in dead organic matter. Also viruses which are usually considered to be non-living contain genetic material.

Question 6

Was criticized by teachers and did discriminate relatively poorly, but this was for the good reason that most candidates knew that ATP is synthesized in the mitochondrion and were able to identify it on the electron micrograph, rather than for the bad reason that they found that the micrograph was unclear, which was the prediction of most of the teachers who commented.

Question 13

Was of concern to some teachers who thought that candidates would not have the confidence to assume that aerobic respiration is as efficient in bacteria as in eukaryotes. No specific knowledge of bacterial respiration is required by the IB Biology programme, but the examiners felt that the question was nonetheless reasonable. Two thirds of candidates chose the correct answer and the discrimination between weaker and stronger candidates was very good. The most popular incorrect answer implied that glycolysis produces more ATP per glucose than aerobic respiration, which indicates poor understanding in some candidates.

Question 17

Was the poorest discriminator on the paper, suggesting that many candidates were guessing their answer. The high percentage of correct answers shows that it was easy to guess correctly. The only distractor that tempted significant numbers of candidates was the idea that photosynthesis might be reduced by enzyme denaturation in desert plants during the middle of the day.

Questions 24 to 26

Were all based on a single pedigree chart obtained from Wikipedia. Some teachers felt that this was an inappropriate source and others that it was inadvisable to ask three questions relating to the same stimulus material. Question 24 proved to have the second fewest number of candidates answering it correctly, but it was not ambiguous or unfair, just difficult. The incorrect answer D was the most popular. Candidates choosing it did not realize that a mother affected by an X-linked dominant has two X chromosomes so could pass on a recessive allele to a son if she is heterozygous for the gene. The correct answer B could be reached if candidates remembered that an affected male parent would only pass on his X chromosome carrying the dominant allele to daughters.

Question 28

Elicited negative comments from teachers, who felt that the appendix in horses and humans was not the ideal example of a homologous structure. These comments were borne out by fewer candidates answering this question correctly than any other on the paper and by poor discrimination between stronger and weaker candidates. Perhaps surprisingly, the most popular but incorrect answer was that fins in fish and wings in birds are homologous features. This suggests that many candidates are unclear about the meaning of homology in Biology (assessment statement 5.4.2). It was probably unreasonable to expect candidates to know that the appendix is homologous in horses and humans, and although this answer could have been reached by eliminating others, the statistics show that rather few candidates managed this.

Question 32

Was found difficult by weaker candidates, suggesting that the distinction between cohesion and adhesion needs to be carefully taught, to avoid confusion.

Question 34

Was curiously poor at discriminating between strong and weak candidates, presumably because some strong candidates carelessly failed to distinguish between pollination of coloured flowers and seed dispersal by coloured fruits.

Question 36

Was criticized by some teachers and admired by others. Two thirds of candidates answered it correctly, with a high discrimination index. Some candidates thought that the sweat glands are more similar in function to the spngy mesophyll of a leaf than are the alveoli of the lungs. This would imply that the cooling is a more important function of a leaf than gas exchange.

Question 38

Was a good discriminator but it was answered correctly by only 51% of candidates, one of the smallest percentages on the paper. Assessment statement 11.2.7 makes it clear that the binding of ATP causes the breakage of cross-bridges between myosin heads and actin filaments

Higher level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 6	7 - 13	14 - 25	26 - 36	37 - 48	49 - 59	60 - 72

General comments

Over 90% of the 243 teachers who commented using G2 forms felt that this paper was of an appropriate level of difficulty and over one-half stated it was of a similar standard to that of 2010 while 25% found it slightly or much easier. Some specified that the data analysis questions were too easy for HL students while others found them very suitable. Reactions to the syllabus coverage, clarity of wording and presentation of the paper were varied but virtually all teachers found them to be good or satisfactory. It might be noted here that there is always a very specific effort made to get maximum syllabus coverage in Paper Two exams as well as the balance of objective levels. Comments were made about the new format of the paper, with boxes for the answers, that the students were somewhat disconcerted, but it does not seem to have disadvantaged them nor has it affected their results.

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

In the data analysis question, the students had difficulty identifying why single mice use more energy than groups of mice. There were a surprisingly large number of students with problems in converting units in the calculation of the dimensions of a mitochondrion. Few students could correctly distinguish between the roles of sense and antisense strands in transcription. In some centres there was poor understanding of excretion and ultrafiltration. In general there continue to be problems with the distinctions between some of the command terms used in questions, particularly between *Describe* and *Explain* and between *Compare* and *Evaluate.* Students often list values or characteristics without reference to the command term in the question.

The levels of knowledge, understanding and skill demonstrated

Most candidates showed a good level of interpretation of the graphs. Most knew the names of the parts of the dinucleotides as well as the differences between the DNA of prokaryotes and eukaryotes, were able to identify organisms at different trophic levels, as well as the general decrease of energy in a food chain. There were excellent answers on enzymes, the effect of temperature and substrate concentration. Many had good knowledge of competitive and non-competitive inhibition although they gained few marks as they did not compare equivalent properties. Many demonstrated very good knowledge of the light-independent phase of photosynthesis, the stages of the cell cycle, factors affecting transpiration, the genetics of Down Syndrome and sickle-cell anemia, the role of the skin in temperature regulation and the principles of vaccination.

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

Section A

Question 1

a) Part (a) was an easy start to the question and almost all candidates gave the correct value.

b) In (b) most students correctly identified the relationship between activity and temperature at the given time, although there was a low but significant number of students who only described the data without being able to state a trend or a relationship

c) The most common answers in (c) were that they were more protected from predators or that there was less competition for food although some students said it was easier for them to find their prey at night (mice are rodents).

d) In (d) candidates were again asked to identify the relationship, this time between temperature and the metabolic rate. Most were able to do this although some inverted the relationship.

e) In part (e) of question 1, candidates were expected to compare the results of the single and group mice. However, many listed values without making the comparisons.

f) In part (f) there were some correct answers related to the sharing of heat in a group of mice and thus a lower metabolic rate, but many referred to groups of mice having less oxygen or that the sharing of tasks diminished the metabolic rate or that the value was a mean, implying a lower value could be expected.

g) There was good general comprehension in (g) of the use of oxygen consumption to measure metabolic rate but many students had difficulty providing clear answers, although most gained at least one mark by saying that respiration requires oxygen.

h) Most students had difficulty in (h) relating the data on the two graphs. Some were able to see that both metabolic activity and activity increased at the same times but others were not able to do so, simply restating data. Many did not make any evaluation of the data. Many implied that temperature was a factor, but not with sufficient clarity.

i) Some students showed no knowledge of the structure of a mitochondrion in (i), although most knew the names.

j) In (j) most students knew the importance of larger surface area but few were able to combine the idea with respiratory processes.

k) Some students left (k) blank, having no idea how to calculate size on a micrograph while others were able to make the calculation but lost the second mark for an incorrect conversion from cm to um or to nm. Candidates needed to know that magnification is calculated by dividing the size of the image, in this case the actual length of the scale bar, by the size of the specimen, in this case the length indicated on the scale bar.

Question 2

a) (i) In part (i), virtually all students identified the phosphate group.

(ii) Most were also able to identify the covalent or phosphodiester bond, although some stated it was an H bond.

b) This question was difficult for most students, although some wrote correct answers. In some scripts, students answered in terms of 3' → 5', whereas others did not refer to the two strands, nor did they relate them to transcription.

c) Few students got full marks as they did not compare relative characteristics. For example, it appears that many candidates interpret "naked" DNA as not being within a nuclear envelope. With this assumption, it is more difficult for them to gain mark on correct pairs of statements.

Question 3

a) Most candidates referred to excretion as removal of wastes with no reference to metabolic processes, thus not distinguishing it from egestion.

b) Many candidates had general knowledge of ultrafiltration but did not express it clearly and concisely. They mentioned high pressure without explaining the causes or that there was filtration of some substances and not others, but again without an explanation.

c) Many candidates lost marks here for lack of precision in their answers. To get marks, they had to refer to amounts, or the composition of the fluids in zones I and II. Many said there was no glucose or urea in II instead of smaller concentrations. Others said there were blood cells or large proteins in both, but did not state that there were present in the same amounts.

Question 4

a) Virtually all candidates were able to identify the diatoms/algae as autotrophs in (i) and many identified the trout as both a secondary and tertiary consumer in (ii), although some seemed to think this part of the question asked for two different organisms here, not a single one with two different positions within the food web.

b) Most candidates explained the decrease in energy along a food chain, most referring to the loss of energy due to respiration or heat, but many did not refer to the fact that it cannot be recycled. Many left out reference to nutrients and the fact that they are recycled.

c) In (c) most displayed a general knowledge of the shape of an energy pyramid, but unfortunately, as many had described energy loss in part (b), they did not refer to it again in part (c). However, most mentioned the loss of energy due to respiration, etc. or the fact that some material is not digestion.

Section B

Question 5

This was a very popular question.

a) Was generally well answered with many candidates scoring marks by including annotated drawings of the changes in enzyme activity.

b) Was answered much more poorly, not due to a lack of understanding of the different types of inhibition, but due to not comparing equivalent factors. For example, most gained the mark for mp (c) for inhibitor attaching to the active site in competitive and to another site in non-competitive. However, many mentioned similar structure to the substrate in the first but there was no equivalent comment for the second, thus no mark.

   Few students could give specific examples of either. It was insufficient to say a heavy metal is a non-competitive inhibitor without specifying the metal and the enzyme.

c) Was generally well answered, with students showing very good understanding of the light-independent reaction. Many included clear, annotated diagrams to support their answers. A few students mistakenly described the light dependent reaction and a few respiration.

Question 6

This question was also answered by large numbers of candidates. The better-prepared ones had little difficulty in scoring highly.

a) In part (a) many students knew the cell cycle and its parts, but did not fully describe each one. Some students went into very detailed descriptions of the stages of mitosis, only worth one mark, instead of describing the others.

b) In part (b) most students should have been able to get full marks, even with some errors, as there was one mark for each statement. However, many students are not clear as to what a cotyledon is and no marks were given for simply stating that a dicotyledon has 2 cotyledons. Also, many were confused as to the plants having 3 or 4-5 flowers or flower parts. No marks were given for the former. Others lacked precision in their answers.

c) Part (c) was often well answered with candidates write detailed accounts of the effects of the different factors on plant transpiration. However, some described the effects of evaporation of the water in anthropogenic terms of cooling the plant. Also some students wasted valuable time describing the transpiration stream in great detail.

Question 7

a) In part (a) most candidates got several marks but few the full five for describing the causes of Down syndrome. There was confusion as to when this occurs and how,. The most common statements were mp e, f and g.

b) Many candidates lost marks in part (b) by not knowing skin colour is an example of polygenic inheritance and describing a dihybrid inheritance. Others simply gave an incomplete account for 5 marks and many were confused as to the difference between alleles and genes.

c) Answers to part (c) were good in many cases. In these scripts, there was complete detail on the cause, the DNA and amino acid changes and the effect on haemoglobin. This is obviously a topic that is well taught in many centres although some students are confused about the effect of the mutation on haemoglobin and its subsequent effect on the shape of the red blood cell.

Question 8

a) Answers to part (a) were varied but mostly lacked precision of terms, using blood vessels instead of arterioles, etc. Some students still believe the arterioles move towards or away from the surface. The description of the role of sweating was often incomplete.

b) Part (b) was also poorly answered on the whole, with many students discussing hormonal changes throughout the pregnancy and/or confusing the names of the hormones involved in the birth process.

c) Part (c) of this question was very well answered by many candidates, showing good understanding of the processes involved in vaccination. Other candidates' answers, however, were vague and confused and in some cases with poor use of terminology and the order of the processes. Others spent time writing at length about the ethics of the use of vaccinations.

Recommendations and guidance for the teaching of future candidates

- Data analysis skills should be developed throughout two years of preparation; suitable practice questions are widely available and are often popular with candidates. Candidates should be encouraged to take a ruler and a calculator into their exam.
- Students need to be thoroughly trained in the meaning of the command terms and how to answer them, along with attention to the number of marks.
- Students should not lose valuable time repeating the question or making a long introduction to the theme, but enter immediately into a concise, concrete answer.
- Where questions involve graphs or tables, it is important to study them with care, paying attention to accuracy of reading the data. Units should always be given with an answer to a calculation or when quoting data from a graph.
- When a question requests a comparison or "distinguish between", it is recommendable that the students use a table to answer, facilitating both the answering and grading processes. Simply listing characteristics of 2 different groups is not sufficient.
- Candidates need guidance in how to choose their questions in Section B and how to consider the mark allocations. If a question is worth eight marks, at least eight statements must be made. The sequence of the statements should be carefully considered, as well as using examples to illustrate an idea.
- Throughout the two-year programme candidates should have plenty of opportunity for writing extended response answers.
- Candidates should have studied the whole syllabus and focus on answering the question in Section B where they have most knowledge, particularly of the parts (b) and (c).

Higher level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 6	7 - 12	13 - 16	17 - 21	22 - 27	28 - 32	33 - 40

General comments

Nearly 90% of teachers responding on G2 forms felt that the level of difficulty of this paper was appropriate. Of the minority who thought that the difficulty was inappropriate, most felt that it had been too difficult. When comparing the paper to last year's, most teachers through the standard similar, but of those who thought it different, more though that it had been easier this year than more difficult. Almost all teachers felt that both the clarity of the wording and presentation of the paper had been at least satisfactory and in most cases good.

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

In the data based questions candidates sometimes failed to understand that as long as experiments are well-constructed, differences in the dependent variable are caused by the independent variable or variables. Some topics were less well known than others, for example polymorphism, processing of visual stimuli, biological control of invasive species and carbonic anhydrase.

Levels of knowledge, understanding and skill demonstrated

There is a trend for factual knowledge of the options to improve and far fewer candidates had no knowledge of their chosen options that was the case some years ago. Areas of particularly strong knowledge were barriers between gene pools, the effects of cocaine, pandemics, *r*- and *k*-strategies and myoglobin.

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

Option D - Evolution

Question 1

The data in this question was challenging and some candidates needed to spend more time reading the stem and thinking carefully about the scatter graphs.

a) Parts (a) (i) and (ii) were intended to key the candidates in to the data and give two relatively easy marks. Most scored them, but those that did not often then scored poorly on the rest of this question.

b) Part (b) was perhaps slightly misleading, given that the expected answer is that there is not clear relationship between genetic and geographic distance in the pairs of colonies.

c) Some candidates overcomplicated their answers to (c) by including differences in geographic distance. This was not intended and the two available marks could be scored relatively easily by giving similarities and differences between the two species in the genetic difference between pairs of colonies.

d) The question relating to Hardy-Weinberg equilibrium in (d) proved too difficult for almost all candidates. To recompense for this, the mark scheme for Option D was eased in a number of other places. All that the candidate was expected to deduce in (d) was that if the species were in Hardy-Weinberg equilibrium for the eight genes investigated, then natural selection was not favouring any allele over another and evolutionary change was not occurring.

Question 2

In (a) (i) and (ii) the concept of polymorphism was not well known. Only a minority gave acceptable definitions of transient and balanced polymorphism. A common error was to suggest that there are equal allele frequencies with balanced polymorphism and unequal ones with transient polymorphism. The examples given in (ii) were often vague and lacked proper species names or contexts. Sickle cell anemia in malarial areas was not accepted as it is unlikely to be transient unless malaria is eliminated or spreads to a new area. Part (b) was answered much more successfully, usually with geographical isolation as the example. Part (c) was also often well answered.

Question 3

This was based on assessment statement D3.7 and elicited very variable responses. The weaker candidates seemed to have little knowledge of the incompleteness of the fossil record and the resultant uncertainties about human evolution, but there were also some excellent detailed and perceptive answers.

Option E – Neurobiology and behaviour

Question 1

Most candidates identified the time in (a) and many also calculated the percentage correctly in (b). Almost all showed the working of the percentage calculation, as instructed in the question. Answers to (c) were variable and large numbers of candidates described the data, rather than evaluating the effect of the recorded colony sounds. A common misconception was that treatment in the control pairs had an effect. This was impossible as the control pairs had no sound played to them; they were untreated.

Question 2

Part (a) was straightforward for well prepared candidates. In part (b) candidates were expected to base their answer on assessment statement E5.4 and outline the roles of the sympathetic and parasympathetic nervous systems. Some candidates failed to distinguish between the control of the heart rate by these parts of the autonomic nervous system and the stimulation of the heart beat by the sino-atrial node. Part (c) was answered in great detail by the best prepared candidates, who described edge enhancement, contralateral processing and convergence. There was some misunderstanding of contralateral processing, with candidates suggesting that all stimuli perceived by an eye are processed by the opposite side of the brain, rather than each side of the brain processing stimuli from the same half of the visual field in both eyes.

Question 3

Some concerns were expressed by teachers about this question. The IB Biology programme stipulates that the effects of cocaine on synapses in the brain and on mood and behaviour should be studied. An Aim 8 suggestion is to look also at the wider consequences for society. A maximum of two marks was awarded for these consequences and even when candidates did not include them, they were able to find six other relevant points if they were well prepared. There was some misinformation about the precise reasons for cocaine causing accumulation of dopamine in synapses, with candidates suggesting that secretion of dopamine increasing rather than reabsorption into the pre-synaptic neuron being prevented.

Option F

Question 1

This proved to be very challenging, but it was balanced by relatively straightforward questions later in this option. The three-dimensional graph was not studied carefully enough by some candidates. Answers to (a)(i) and (ii) were sometimes therefore incorrect. Part (b) was also answered poorly by many candidates. As they increase, both veratryl alcohol concentration and fermentation time cause an increase in the production of laccases, up to an optimum, beyond which there is a decrease. Few candidates described this clearly. Part (c) was more successfully answered and in most cases two acceptable other conditions were given.

Question 2

This posed few problems for well-prepared candidates, though (a) and (b) were not known by all. Examiners struggled in (c) to adjudicate whether certain diseases were genuine examples of food poisoning or not. This was complicated by a distinction existing in English between infections due to bacterial growth in food and due to other methods of ingestion of the pathogen, but not in French where intoxication alimentaire extends to any gut infection from infected or contaminated food or drink. In practice most candidates described examples that are unequivocally food poisoning, often scoring all three marks.

Question 3

Successful answering of this question also involved choice of an appropriate example. A variety were given and accepted. Teachers give their students the best chance of success with thorough teaching of one good example of a pandemic. A distinction should be made between a pandemic, which occurs over a specific period of time, and diseases such as malaria that are endemic over a wide area but are intractable and ongoing.

Option G – Ecology and Conservation

Question 1

This question gave a wide range of marks.

Parts (a) and (c) (i) were answered correctly by most candidates. A few candidates abbreviated the genus names to an initial letter, which is not advised when there are two genera starting with the same initial.

Most candidates answered (b) successfully, but (c) (ii) proved more difficult. Where a question asks for reasons for something being least, among three species, it is necessary to give answers comparing the species, rather than just referring to the one that is least. For example, in this case it was better to say that *Noteophilus biguttatus* eliminates cadmium *more* rapidly than that it eliminates cadmium rapidly.

Part (d) was well answered by many candidates, who referred to biomagnification or bioaccumulation and then explained that animals at higher trophic levels would be most affected.

Question 2

In part (a) many different biomes were suggested, including tundra and desert. Candidates were expected to specify tropical rainforest rather than just rainforest and justify this by stating that both rainfall and temperatures are high throughout the year.

Part (b) was well answered by most, but not (c). Many invalid answers were given, including cane toads. Although the purpose of their release in Australia may have been biological control, they are now better classified as an invasive species in their own right, rather than a biological control. Other answers were too vague to score marks. With topics such as the biological control of invasive species, teachers are encouraged to give their students a real and paradigmatic example, rather than atypical or dubious ones. Some candidates even suggested that rats had been introduced to New Zealand to control invasive birds.

Question 3

In previous papers knowledge of r-strategies and K-strategies was rather poor but there were some detailed and accurate answers elicited by this question. Candidates who were insufficiently prepared tended to score nothing here as it was not possible to guess any part of the answer from the question. Encouragingly few candidates confused the two types of strategy.

Option H – Further Human Physiology

Question 1

The data here was complex, as the effects of the type of fatty acid and the dosage both needed to be considered. Incubation time was something of a distraction, as little could be learned from the fluctuations shown on the graph.

Most candidates answered (a) correctly. There was a very wide range of responses in (b), with many candidates making statements that did not really answer the question. Candidate needed to ask themselves what the effect of each type of lipid was on the percentage, at each of the two concentrations. If they then compared these effects, it was quite easy to score marks. Many instead wrote directionless descriptions of the results. Part (c) was also mostly rather poorly answered. There was a clear hint in the question that the answer should relate to the hydrophobic nature of lipids.

There were some very well argued evaluations in part (d). Candidates were expected to discuss which lipid to use and weigh up whether to use the higher or lower concentration, remembering that lipids are an essential part of intravenous feeding and also that some production of hydrogen peroxide by neutrophils is useful, but not in excess.

Question 2

Part (a) was generally well answered, but (b) less so. Only a minority of candidates knew that carbonic anhydrase converts carbon dioxide in red blood cells to a more soluble form. Answers to part (c) were variable, but some were excellent. Despite the box for answers, some of the best included a sketch graph of the oxygen dissociation curve of hemoglobin and myoglobin.

Question 3

Almost all candidates knew at least something about the roles of gastric acids and *Helicobacter pylori* in the development of stomach ulcers and cancer, and the better prepared candidates were able to explain the chain of cause and effect that can link the bacterium with the two conditions. A fault in some candidates' answers was to be too definite, implying that if *H. pylori* is present stomach ulcers and cancer will always be caused.

Recommendations and guidance for the teaching of future candidates

- Sufficient time should be left for teaching of the options and students should not be left to self-study this part of the programme.
- Where an example is required by the programme to illustrate a biological phenomenon, it should be chosen very carefully, and if students are allowed to make their own choice, this should be checked by the teacher.
- In data based questions, candidates should be trained to understand that experiments with independent and dependent variables investigate the effects of the independent on the dependent variable.
- Students should be exposed to the concept of control treatments, and understand that a control treatment usually has no effect on the dependent variable and is carried merely for purposes of comparison.
- Students should be given experience of experiments where there is more than one independent variable. Biology involves complex situations where several factors work together to affect a variable, so it is not always appropriate to isolate variables and investigate them separately, even though this is encouraged in students' own investigations for IA.

Standard level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 11	12 - 15	16 - 18	19 - 22	23 - 25	26 - 30

General comments

249 G2 reports were received by the time of grade award; that was a substantive increase on the previous year. G2 forms are used to inform those at Grade award regarding the perception of exam papers. All comments are read and discussed and in the case of this examination the comments led to two answers being accepted for question 27. G2 forms are read in English, Spanish and French. The vast majority of teachers thought that the paper was of a similar standard to that of last year and 10% though it was a little more difficult. However, more than 90% of teachers thought that the level of difficulty was appropriate. Most teachers thought that the syllabus coverage, clarity of wording and presentation were satisfactory to good. There were many discriminating questions on this paper and a small number of questions that performed less well. A number of candidates do not answer every question, generally leaving blank some of the more difficult questions. It is worth teachers telling candidates that there are no penalties for getting incorrect answers, so it is always worth answering a multiple choice question in a Diploma Biology exam.

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

Some questions performed in a predictable way and no comments need to be made about them. The comments that follow relate to questions where candidate performance was very good or very poor or questions that aroused comment from teachers on G2 forms.

Question 1

There were a number of concerns raised by teachers regarding the appropriateness of this question. It is covered in topic one, but candidates did find the question one of the most difficult in the paper to answer.

Question 2

Some teachers commented that the wording of the question was awkward but this question proved to be one of the easiest in the examination.

Question 3

A teacher commented that ‘negative’ questions are not meant to be in IB examinations. This is generally preferred, but candidates found this to be an easy question.

Question 4

There was a comment that the term ‘correct for both’ could have been confusing for candidates but this proved to be a straight-forward question for most candidates. .

Question 5

Some teachers felt that the language of this question may prove difficult but the candidates performed well

Question 6

Although this should have been a straight-forward question, candidates found it to be one of the most difficult questions in the examination but it was a good discriminator.

Question 7

As with question 3, this was another 'negative' question though it was well answered.

Question 9

A number of teachers felt that the diagram used for question 9 (and 10) was difficult for candidates to interpret. It is important that candidates are made aware that schematic diagrams are used to identify many structures in Biology. The question proved difficult for candidates with many choosing C for the answer rather than the correct response, A.

Question 11

There were a number of criticisms of this question as being confusing for candidates. Those at the grade award meeting considered these comments but felt that the question was appropriate, though candidates did find it challenging.

Question 14

This question turned out to be one of the most difficult for candidates, but tested candidate understanding of the process of hydrolysis and was a good discriminator.

Question 15

This question turned out to be surprisingly difficult for candidates but another good discriminator.

Questions 17

There were some criticisms of this question on the basis that there are two types of chain in hemoglobin and that this could confuse candidates but they found this to be an easy question.

Question 18

This question was well answered by candidates though some teachers felt that they would find it difficult.

Question 20

This was the most difficult question in the exam though it was a poor discriminator. The question was criticized by a number of teachers as not appropriate, but the assessment statement upon which it was based (5.4.2: Outline the evidence for evolution provided by … homologous structures.) is an outline so candidates should be able to answer this question.

Question 22

This question was the easiest in the examination but a poor discriminator.

Question 25

This was a good discriminator. There was some criticism that the question was not on the syllabus, but it tested their understanding of inheritance rather than a specific example in the syllabus. It was well answered by candidates.

Question 27

This question asked the name of the vessel that directly supplies the heart with blood. Thanks to all the G2 comments received, it was realized that the correct answer could be C (the coronary artery) or D (the pulmonary artery) so both of these answers were accepted as correct. Most candidates indicated D as correct and a large number chose C. A surprisingly large number of candidates chose A (the aorta). .

Question 30

Most candidates answered this question correctly, making it the second easiest question in the exam.

Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 6	7 - 13	14 - 20	21 - 26	27 - 33	34 - 39	40 - 50

General comments

Overall, the 249 teachers who completed the G2 form were satisfied with the paper. Compared with last year's paper, 133 considered this paper to be of a similar standard, 48 a little easier, 8 much easier and 13 a little more difficult. 229 of respondents believed it to be of the appropriate level of difficulty, while 7 thought it to be too easy and only 2 too difficult. 149 of respondents felt that clarity of wording was good and 84 thought it was satisfactory. Only 3 believed it was poor. 175 of the respondents felt that presentation of the paper was good and 57 though it was satisfactory.

In Section A, most candidates were able to answer the data based questions correctly. In only a few cases candidates failed to analyse the data completely. Acceptable understanding appeared for the questions reflecting ecology, and physiology.

In Section B, candidates overwhelmingly chose to answer Q5. The popularity of this question was probably based on parts (a) named food chain and (b) the outcomes of the greenhouse effect on the Arctic environment, which required relatively conventional answers. This sharply contrasted with part (c) on natural selection of bacteria through the use of antibiotics which required more reflective thought. Many candidates directly did not know the effect of antibiotics on bacteria and how these could determine natural selection. The result was strong answers for parts (a) and (b) and very weak answers for part (c). Achievement in the various parts of Q6 and Q7 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 (d) seemed to be difficult to most candidates. This kind of simple calculation has appeared in past examinations, yet candidates find difficulty in the mathematics. Although very straightforward, many candidates found Q2 hard. Several candidates confused the rough endoplasmic reticulum with the Golgi apparatus. Many candidates were able to say in 2 (b) that the substances from the RER were processed in the Golgi, but never mentioned the formation of vesicles. Q 2 (d) was only answered by very few candidates. Many candidates believed that the differences were in the age of mitochondria or the metabolism occurring in them, failing to realise that the differences were due to the different planes in which mitochondria were seen under the microscope.

Section B

Candidates who answered Q5 tended to dwell on the food chain and effect of global warming on the Arctic environment. The effect of antibiotics on bacteria and the selection pressure they exert in 5 (c) was not well answered.

Q6 (b) required candidates to describe the function of phagocytes and was not well answered

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

Particular strength was seen in the answers for Q3 (a) where most candidates knew the bonds in DNA. The function of mitochondria was also generally known well. Many candidates gained full marks for knowing differences between prokaryotic and eukaryotic DNA in Q3 (c). Candidates also achieved success in Q4 on Down syndrome. Realistic food chains in Q5 (a) varied from outstanding to miserable. In general, answers to straightforward questions fared much better than answers to novel questions where adaptation of ideas was required. . In Q7 (a), many candidates could accurately describe different ways in which the condensation and reduction reactions occur. Many were able to write complete chemical reactions.

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

Section A

Question 1

a) Most candidates said that the time under water was 40s. Only a few gave a different value, sometimes quite close but not precise enough.

b) Almost all candidates could describe the trend in heart rate after the dive.

c) Most candidates had this answer correct, but some mentioned that ducks had to do anaerobic respiration because there was no oxygen in water. This is not true, as there is a lot of oxygen dissolved in water, only that the ducks are not able to obtain it.

d) There were a significant number of candidates that were not able to do this calculation,

e) Many candidates were able to compare the effect of changing the speed on blood flow.

f) Most candidates realised that more blood flow went to the legs to supply energy and that less went to the other organs in order to increase the supply to the legs.

g) Only a few candidates had this answer wrong.

h) Most candidates correctly answered adrenaline. A few mentioned the hypothalamus (not a hormone) and only a small number of candidates mentioned insulin.

Question 2

a) Candidates needed to distinguish either the rough endoplasmic reticulum or ribosome. Unfortunately, some candidates confused it with the Golgi apparatus.

b) Candidates presented a variety of answers with varying degrees of accuracy. Most only mentioned the importance of the Golgi in this process. Very few mentioned the vesicles.

c) Most candidates obtained one mark as they mentioned the formation of energy compounds, but more detail was required to obtain full marks.

d) Only a small number of candidates were able to answer this question correctly.

Question 3

a) (i) and (ii) were in general well answered.

b) Generally, poorly answered. The candidates who were able to say that polymerase was used to form the complementary strand by a semiconservative process, were not able to explain how. Some candidates recognized the function of polymerase in proofreading, so were given a mark.

c) Generally well answered. Some candidates only made one comparative statement so scored only one mark.

Question 4

a) Most candidates could correctly answer this question.

b) Many candidates mentioned the non-disjunction and the separating of sister chromatids or chromosomes.

c) This also applies to part d). Evidence of understanding that colour blindness is a recessive sex-linked trait on the X chromosome was not widespread, although some very good answers could be seen.

Section B

Question 5

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. On the other hand, some candidates wrote food chains that were improbable to exist thus scoring no marks.

b) Well-constructed explanations with logically sequenced thought were to be found quite often. Most candidates made reference to the fact that polar bears would lose their habitat.

c) The results here were less favourable than anticipated. Many candidates had a mistaken idea of how antibiotics act making selection pressure in bacteria.

Question 6

a) Most candidates scored full marks in this question. .They knew the cause, consequence and transmission of AIDS.

b) The fact that phagocytic leucocytes engulf foreign matter was well known by most candidates. This is in general what was known of their action. A little bit more detail was required to score full marks. Only a few candidates mentioned chemotaxis or detection of the foreign matter by the white blood cell. Very few mentioned that these cells are present in blood and tissue fluid.

c) This question had many very good answers. Most candidates had understood the method of homeostasis and how a norm is restored by different mechanisms. The control of body temperature was also usually well answered. Some candidates only listed the mechanisms activated by heat or by cold therefore scored no marks.

Question 7

a) This question was usually either very well answered or completely wrong answers were attempted. There were some very good chemical reactions showing the processes of condensation and hydrolysis.

b) Most candidates were able to describe the effect of temperature and substrate concentration on the activity of enzymes.

c) There were some very complete and accurate answers to this question, but in many a case the answers were vague and confusing. Most candidates managed to describe the production of oxygen by plants, usually describing the experiment of the sea weed under a test tube. Describing how the uptake of carbon dioxide was measured gave some trouble. Many candidates mentioned the change in mass as a method to measure the rate of photosynthesis, but failed to explain it.

Recommendations and guidance for the teaching of future candidates

- Candidates should be taught how to write answers that reflect the direction of the 'Command Terms' pages 11 and 12 of the 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 should practise constructing tables which make direct comparisons e.g. a table comparing the structure of eukaryotic and prokaryotic DNA. This could also be done in a complete answer.
- 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. This would allow students to score the two quality marks.
- 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 - 5	6 - 11	12 - 15	16 - 19	20 - 24	25 - 28	29 - 36

General comments

Of the 236 G2 forms submitted, the vast majority thought that the paper was of a similar standard to that of last year, while a few though it was a little more difficult and a few thought it was a little easier. Of the respondents, the vast majority thought that the level of difficulty of the paper was appropriate while a few thought it was too difficult.

Clarity of wording was thought to be good by 62% and satisfactory by 37%. 74% thought the presentation of the paper was good and 25% thought it was satisfactory.

There were differences in the degree of difficulty presented by the different options. The data in Option F was much harder to understand for most candidates.

As always Options A, E and G were the most popular. Option F was by far the least popular option in terms of the number of candidates who answered it.

The standard of performance showed a wide spread, but generally candidates showed reasonable achievement, and there were also some very good answers seen. Surprisingly, some candidates attempted more than the required two options, and some questions were still left unanswered.

It should be noted that the papers are now prepared so that they can be e-marked. Students should be made aware that it is essential to write inside the boxes or on additional answer sheets only as examiners will see scans of these areas.

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

Answering questions calling for analysis, explanations, and calculations seemed to be the areas which proved more difficult to all candidates. Also, writing good definitions and knowing the difference between discussion and list or outline was an area of difficulty for many candidates. Few candidates were able to write concise answers. Candidates do not always read the question correctly and this can mean they get no marks for that question.

Options C and F seemed to provide the greatest challenge. The data in F proved difficult for many candidates.

Some candidates are still not responding to the command terms “explain” or “discuss” appropriately. The former needs explanations (G3 b being a prime example where many candidates received 0 marks because they named but did not explain factors that affect the distribution of animal species). “Discuss” needs a balance of arguments. Few candidates scored well on A3 c where they were required to discuss ethical issues concerning animals and animal products. Calculating % changes is still clearly a challenge for many candidates.

The levels of knowledge, understanding and skill demonstrated

Although there has been some progress, many candidates still have trouble reading graphs and using that information to make a calculation or to explain the results and its probable meaning. The drawing in E2 was well done by many but there were some strikingly poor diagrams.

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

Option A: Human nutrition and health

Question 1

The data in A1 was well understood by most candidates who were able to compare the data in A1 (b) and suggest behaviours to influence their levels of vitamin D. Many candidates gave only one behaviour, thereby denying themselves the opportunity for a second mark. Most explained that people could expose themselves to more or less sunlight but few discussed dietary supplements.

Question 2

A2 (a) was well answered by most, though many candidates did not use SI units in their answers. A2 (b) was not well answered as many candidates simply listed did not use appropriate scientific terminology. In A2 (c) many candidates simply listed issues rather than discussing them. They also tended on the whole to offer one side of the argument rather than a balance and an indication of the relative importance as is required by the command term.

Question 3

A3 was answered very well, with many candidates achieving full marks.

Option B: Physiology of exercise

A relatively small number of candidates answered this option, but those who did generally achieved well.

Question 1

In B1 (c) there were some problems with candidate understanding of the term 'backflow" though it was defined at the beginning of the Option to aid student responses. This perhaps highlights the importance of noting/highlighting/underlining key terms in the stem of questions to aid in responses.

Question 2

B2 (a) (i) was well answered by candidates but many clearly did not know the required terminology to enable them to answer B2 (a) (ii). B2 (b) was well answered.

Question 3

B3 (a) was well answered but many candidates were not able to achieve full marks in B3 (b).

Option C: Cells and energy

A relatively small number of candidates answered this option, but those who did generally did not do well, though there were some excellent answers.

Question 1

C1 was well answered by most candidates

Question 2

In C2 (a) many candidates struggled to distinguish between fibrous and globular proteins. Fewer still could name a correct example of each. C2 (b) had some excellent responses, but many were very poor.

Question 3

In C3 many candidates discussed the Krebs cycle, rather than the link reaction as required. Careful reading of the question is vital.

Option D: Evolution

Question 1

Candidates had little trouble with the data presented in this option and D1 was well answered, though D1 (iii) presented problems for students who did not engage with the command term "compare".

Question 2

D2 (a) was well answered but D2 (b) presented a problem for many candidates who could not outline the contribution of prokaryotes to an oxygen rich atmosphere.

Question 3

D3 was reasonably answered by most candidates, though at six marks it was usually long for an SL option. Many candidates were able to discuss a few points but not enough to gather full marks.

Option E: Neurobiology and behaviour

Question 1

In E1 the graph seemed easy to read, but calculation of the percentage decrease (E1 (b) proved a challenge for many. Calculations require candidates to show working. Many did not and lost an easy mark. In E1(c) evaluation of the effect and was poorly answered.

Question 2

E2 was either done very well (the majority of candidates) or very poorly. It is important to emphasis clear drawing and annotation.

Question 3

E3 was well answered on the whole, though a few candidates confused inhibitory with excitatory drugs.

Option F: Microbes and biotechnology

Question 1

F1 (a) was challenging for candidates as they appeared to find the data was very difficult to interpret, though candidates were only required to interpret it in two dimensions. Despite the small numbers taking this option, there were more complaints from teachers about this part of the exam than any other.

Question 2

F2 (b) proved difficult for many candidates who appeared to not know the subject matter.

Question 3

In F3 (a) most candidates were able to achieve marks but few fully explained their answers as required in the command term.

Option G: Ecology and conservation

Question 1

The graphs were straight forward and candidates on the whole responded well to it in G1.

Question 2

The rest of the option did not cause any great trouble. In G2 (a) most candidates were able to explain the concept of an ecological niche and distinguish between a fundamental and realized niche.

Question 3

G3 (a) was answered very easily and many candidates scored all three marks. Most candidates named the rainforest or desert in their answer. G3 (b) was less well done, simply because many candidates simply listed the factors rather than explain them as required by the question.

Recommendations and guidance for the teaching of future candidates

- The importance of the command terms cannot be overemphasised. Comparisons require comparatives (more, greater, fewer than….etc) or a clear table to distinguish differences (or similarities if relevant). Similarly “evaluate” a hypothesis requires information that supports or refutes it and the candidate must state as such, not just regurgitate data from the question.
- Candidates should read the questions carefully. This may seem obvious, but there are always candidates for whom this seems to have not happened.
- More practice at answering questions that require the candidate to discuss or explain should be done. Invariably suitable examples are required in these questions - specific examples the candidates don't seem to have.
- Many candidates run out of space for their answers; it is not necessary (or wise) to rewrite the stem of the question. Pertinent phrases that make the point are often better. Try to get candidates to avoid restating the words in the question because they will gain no marks.
- Biological mathematical skills appear to be weak. Stress that candidates should always write units, even if not really required e.g. Calculate the % difference = 4%
- Similarly explain to candidates why, occasionally, arbitrary units are used in expressing data.
- 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 subject guide. Attention should be given to accurate labelling, juxtaposition of structures and relative size.
- 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. This is especially the case now that scripts are scanned for marking.