Biology

2013 Chief Assessor's Report

Government
of South Australia

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BIOLOGY

2013 CHIEF ASSESSOR'S REPORT

OVERVIEW

Chief Assessors' reports give an overview of how students performed in their school and external assessments in relation to the learning requirements, assessment design criteria, and performance standards set out in the relevant subject outline. They provide information and advice regarding the assessment types, the application of the performance standards in school and external assessments, the quality of student performance, and any relevant statistical information.

SCHOOL ASSESSMENT

Assessment Type 1: Investigations Folio

Assessment tasks in the investigations folio were mostly appropriate; students carried out a large range of practical investigations. The design of most tasks gave students the opportunity to achieve across the performance standards. There was good evidence in design practicals that the students had been allowed the opportunity to formulate a question to be tested. The best examples clearly identified which of the investigations was the design practical. A number of alternative practical exercises, such as dissections and microscope activities, were carried out, with mixed results. These activities allow evidence to be assessed against the assessment design criteria — for example, I3 'Manipulation of apparatus and technological tools to implement safe and ethical investigation procedures' and A3 'Demonstration of skills in individual and collaborative work'. However, these tasks may not allow students to show evidence against other criteria; for example, it is difficult to assess the analysis and evaluation assessment and design criteria if no data have been collected, no variables manipulated, and no conclusions drawn, especially if the tasks are prescriptive.

Best practice in investigations resulted when tasks clearly stated the expectations for the students and were open-ended enough to allow students to demonstrate their own design decisions and to have elements of control in the investigation. Common investigations that were carried out well included investigations of osmosis and diffusion, the factors affecting enzyme reactions, and the factors affecting photosynthesis in plants. In addition, investigations into the factors affecting respiration were common and generally appropriate. Moderators saw a range of ecosystem investigations, although this theme often would not have a corresponding investigation, because the subject outline only requires a minimum of three practical investigations. Investigations that made it difficult at times to confirm assessment decisions included practicals where there were multiple independent variables; some students coped with this approach, but many appeared to struggle with it. Other investigations that sometimes made it hard to confirm grades included those that consisted of a series of questions and answers; they often lacked an appropriate degree of detail and reference to Stage 2 concepts. Some simulation investigations (e.g. 'peppered moths' on coloured background) did not allow students to provide evidence at the higher levels of the performance standards for analysis and evaluation. Good examples of appropriate investigations often included an abstract and an introduction where background biological concepts are integrated into the actual investigation being carried out. These were especially effective when they referred to the hypothesis being tested, the variables being manipulated, and the variable being monitored and recorded. Best practice in introductions included an appropriate description of variables that are measureable and specific, with a high degree of detail and coherence. Good introductions also included an account of the factors that needed to be controlled to ensure a fair test. It should be noted that these introductions do not need to be excessively long, nor do they need extensive referencing.

Good examples of student work included detailed methods that could be easily replicated and appropriate diagrams that adhered to scientific conventions. Best evidence for confirmation of specific feature I3 included either student commentary or teacher rubric/comment, or both, of the skills demonstrated in the manipulation of apparatus and relevant safety aspects that were addressed. Care is needed to ensure that evidence is presented to cover I3. Similarly, evidence for specific feature A3 can be covered with a mixture of student commentary and/or teacher rubric/comment.

Data were generally presented well, with best practice evident when appropriate formats for tables and lines of best fit on graphs were selected, using scientific conventions for column headings, units, full titles, consistent significant figures in numerical data, and appropriate axes and labels for graphs.

A common difficulty in confirming student grades often arose in the analysis and evaluation section of the investigation report. Most teachers were aware of the revised specific features in this section, although some used the version from previous years. The best examples of student work showed an understanding of the specific features in the analysis and evaluation section to include demonstration of knowledge from the 'Intended Student Learning' in the 'Skills' section of the subject outline. Hence the best examples of student work included a discussion of systematic and random errors specific to the investigation undertaken. These students also included a discussion of precision, reliability, and accuracy, an interpretation of information and data (including valid conclusions and patterns and trends identified), and an interpretation of the data and evaluation of the procedures used in the investigation (e.g. a critical evaluation of the procedure and suggestions for improvements). This is the level of detail needed for a student to fully meet the higher levels of the performance standards. Good examples of student work in analysis contained discussion of the numerical results seen and linked these results to the hypothesis, followed by a discussion of the biological implications of the findings. Weaker evidence showed a lack of understanding of key terms such as reliability, accuracy, random errors, and systematic errors.

Good evaluation of procedures and suggestions for improvement referred to specific features relevant to the investigation and likely to impact on the data collected as opposed to trivial points that are not about the investigation or are likely to have minimal impact, or just generic statements about investigation in general.

There is no word count for practical investigations and their length often depends on the number of specific features being assessed. However, the 'Intended Student Learning' in the 'Skills' section of the subject outline states that students should be able to write concisely, so students should take care to avoid writing unnecessarily long reports.

The knowledge and understanding assessment design criterion is assessed to varying degrees in investigations. It is done so successfully when there are clear links between the background theory and the investigation being carried out. In good examples of student work, these are combined in the introduction to the investigation and/or in the conclusions made following the investigation outcome.

Issues investigations were generally completed well and often showed the best level of achievement in this assessment type. Issue questions were mostly appropriate and allowed good evidence of KU2, ‘Use of knowledge of biology to understand and explain social or environmental issues’, to be assessed. Some examples of work that did not provide appropriate evidence were simply a discussion or a project on a topic. The evidence should clearly show that different aspects have been considered and that the requirements of the subject outline (page 52) have been addressed, namely, ‘identification of alternative views’ and ‘a summary of results or findings and conclusions drawn’. Word counts were generally adhered to well, with most examples of work demonstrating understanding that the 1500 word count includes ‘an evaluation of information gathered’, which may incorporate a discussion of the accuracy, bias, credibility, and suitability of sources of information used.

Assessment Type 2: Skills and Applications Tasks

It was often easier to confirm student grades for the skills and applications tasks than for the investigations folios. Nearly all the tasks were in the form of tests and generally they had a representative mixture of multiple-choice, short-answer, and extended-response questions. Good examples of tests were seen when questions of examination quality were used, either past examination questions or modified past examination questions. Best practice also included a mixture of hierarchical skills following a Blooms-style approach (e.g. name, state, describe, discuss, explain), together with problem-solving questions involving novel scenarios. It was hard to confirm grades at the higher level without this hierarchy and mixture of question types. Ideally, evidence was presented across all four themes from the subject outline. The marking of student work was generally appropriate, with some instances of leniency. Moderators found it most helpful when marks schemes were included in the teacher’s package of materials.

Poor task design sometimes made it hard to confirm grade levels, especially at the higher levels. For example, the unselective use of photocopied published materials resulted in tests with repetitive questions, which tested the same concept in multiple-choice questions and then again in short-answer and/or extended questions. Appropriate structuring of the test and careful proofreading are recommended to overcome this. Tests were generally of appropriate length and in the range of 50 to100 marks per test, although some tests were too long and/or consisted of multiple tasks. The practice of having one assessment task split over multiple ‘sittings’ is not in the spirit of the requirement of the subject outline that there should be between eight and ten summative tasks in total, including the tasks in the investigations folio and the external examination.

Assessment of at least one specific feature in the investigation assessment design criterion was generally included and appropriately tested. This assessment was usually in the form of the graphing of tabulated data, together with some questions about aspects of the design, such as identification of variables.

EXTERNAL ASSESSMENT

Assessment Type 3: Examination

The mean score for the 2013 examination was 53.2%, which compares with previous means of 55.5% (2012), 56.8% (2011), 55.9% (2010), 56.3% (2009), and 59.9% (2008). The range of examination marks was from 10 to 190 out of a possible 200. The mean marks for Sections A, B, and C were 61.2%, 50.3%, and 51.3%, respectively.

SECTION A: MULTIPLE-CHOICE QUESTIONS

Fourteen students scored full marks in Section A. The means of facilities and ranges of facilities for each of the last 6 years are shown below. (The facility for a question is the percentage of students who gave the correct response.)

Year	*Mean (%)*	*Range (%)*
2013	61.2	24 to 92
2012	62.6	22 to 88
2011	62.8	14 to 91
2010	62.7	17 to 97
2009	64.4	34 to 89
2008	65.4	17 to 86

Multiple-choice questions vary in difficulty from easy knowledge through to difficult knowledge and problem solving. This variation in question difficulty is reflected in the range of the question facility, as seen in the table above. Most questions are also intentionally discriminating so that, ideally, the less knowledgeable students are likely to choose the four responses with equal frequency, whereas the more capable students will show a distinct preference for the correct response. Data from the 2013 multiple-choice questions show that students in the top decile preferred the correct response for all questions.

The table on page 6 indicates the percentage of responses for each alternative for each question in Section A:

Comments on selected multiple-choice questions follow.

Question 5

Students need to read the alternatives carefully, and not simply be attracted to particular words, such as ‘denatured’ in this case. It is the enzyme that is denatured by the boiling water, and alternative M describes the effect of this denaturation.

Question 10

Students are expected to know that bacterial cells, being prokaryotic, lack a nucleus, and that this eliminates alternative J as a possible answer. As the table shows, alternative J was chosen by more than half the students. Only the top decile showed a preference for alternative K.

Question	*Percentage of Responses for Each Alternative*			
	J	**K**	**L**	**M**
1	13	51	24	12
2	4	91	3	2
3	13	5	49	34
4	79	17	2	2
5	2	40	4	54
6	13	12	10	64
7	4	3	3	89
8	3	90	4	2
9	92	2	1	4
10	53	31	14	2
11	42	16	7	35
12	7	79	5	9
13	8	27	62	2
14	14	11	15	59
15	11	8	53	28
16	55	21	3	21
17	11	51	23	14
18	21	2	75	2
19	6	19	24	50
20	4	32	11	53
21	0	1	20	79
22	15	13	17	54
23	58	13	22	6
24	53	12	12	23
25	4	44	43	9

Question 11

Presumably those students who chose alternative M did not take into account that the chromosomes shown (in Stage 1) were members of a homologous pair. During meiosis they would appear as shown in Stage 2, but not as shown in Stage 1.

Question 19

Predictably, this question proved to be the most demanding in Section A. Students needed to realise that the only drug that could be removed from patients with damaged glomeruli would be the one that was not removed by filtration. The students who chose alternative M (the majority) apparently used the information in the graphs, but ignored the additional information. The correct alternative was preferred by the top two deciles of students.

Question 25

Random errors are an unavoidable feature of measurement. Their effect can be reduced by increasing the sample size and averaging the data. To say that there were no random errors on occasion A indicates a misunderstanding of this concept. On the other hand, the consistent difference between the data collected on occasions A and B is a clear indication of systematic error. Further investigation would need to be carried out to determine if one or neither of these sets of results was correct.

SECTION B: SHORT-ANSWER QUESTIONS

In general, 2 marks are allocated for one well-expressed piece of information.

Questions that require an explanation are worth 4 marks and therefore, in order to obtain full marks, students must supply two relevant and connected pieces of information.

The mean mark for Section B was 50.3%. As with Section A, the examiners aim to produce short-answer questions that vary in difficulty from easy knowledge through to difficult knowledge and problem solving. The mean mark for each question is shown in the table below:

Question	*Mean Mark/Maximum Mark*	*Mean Mark (%)*
26	5.86/10	58.6
27	0.84/4	21.0
28	7.45/16	46.6
29	3.93/12	32.7
30	2.68/6	44.7
31	6.04/12	50.3
32	5.33/10	53.3
33	7.38/14	52.7
34	13.89/24	57.9
35	6.95/12	57.9

Teachers and students should note the following comments:

- Many students fail to gain marks as a result of misinterpreting questions. Students are encouraged to read questions carefully so that their responses are relevant to the questions asked.
- Many students ignore the instruction to give one fact or reason and, instead, give multiple answers. In this circumstance any single wrong answer will lose the student all relevant marks.
- A number of students rewrite or paraphrase the question. There are no marks for this practice, which wastes valuable examination time.
- Many students are careless in their use of biological language. Students who do not use terms from the subject outline correctly will be penalised.
- Students are reminded that they may use the extra answer page in each booklet if they need more space to answer a question. However, students should make it clear in the first part of their answer that the extended answer or a replacement answer is given on another page. Students are also reminded to use the extra page in the booklet in which the question appears.

Question 26

(a) This part was generally done well, with most students stating ‘mutation’. Some students provided more detail than necessary, such as deletion mutation or frameshift mutation. There is no penalty for doing this, but marks are deducted if students provide additional information that is incorrect. ‘Transcription’ was a common incorrect response.

(b) Most students answered part (i) correctly, but common incorrect answers for part (ii) were 6 and 8.

(c) Many students scored some marks as they were able to link the number of differences in amino acid/gene sequences to similarity but not to the idea of recent common ancestors or time for mutations to accumulate.

Many answers indicated a basic understanding but did not link the concepts well. Some terms appeared to be not well understood: genes, codons, base sequences, and amino acid sequences.

Question 27

Only a few students (about 12.5%) scored full marks for this question. Most scored zero. Although students would be expected to know that mitochondria contain DNA, they would not be expected to have studied it in any detail. They should also know that cells contain many mitochondria. This question was really about PCR, not mtDNA. Many students wrote about mtDNA (e.g. that it is inherited from the mother), but this did not address the question about why the need for PCR may be reduced.

Question 28

(a) This part was answered reasonably well.

(b) Many students received full marks for this part. Mislabelling and the lack of labelling were common problems.

(c) Students needed to limit the features to diffusion in order to gain maximum credit.

(d) Most of the good answers made a link between a lipid such as cholesterol and a functioning cell membrane.

(e) Students are reminded that no marks are awarded for simply restating information in the question. The good answers linked spindle fibres to their role in cell division. The names of the stages of mitosis are not required knowledge.

Question 29

(a) Very few answers referred to the need for DNA to be extracted from the cell. Reference to the use of a restriction enzyme often did not mention the need for specificity.

(b) Many answers tenuously associated plasmids with bacteria and received some credit. Although it was not necessary to mention the role of *Agrobacterium* in transferring DNA to a new organism, many of the better quality answers did so.

(c) Many answers provided either an advantage or its effect on society, but very few connected these ideas in an appropriate way. Reference was often made to individual benefits but the question clearly asked for an advantage to society.

Question 30

(a) Most answers identified an increase in surface area.

(b) Many answers incorrectly referred to larger eukaryote cells as being responsible for the engulfing of the photosynthetic prokaryote cell, or stated that the chloroplast was the cell being engulfed rather than the organelle that would eventually evolve. Some provided evidence for endosymbiosis rather than describing the process.

Question 31

(a) This part was answered reasonably well. It was evident that students did not correctly apply their understanding of activation energy to the idea of many small steps.

(b) Many answers demonstrated the ideas of substrate specificity and induced fit, and stated that either activation energy is lowered or the enzyme places stress on the bonds of the substrate, enabling the breakdown reaction to occur.

(c) Students generally had a good understanding of the ATP cycle, the structure of ATP, and how energy is released when it is broken down into ADP and phosphate. Common incorrect answers included the idea that energy was made available when ATP was synthesised from ADP and phosphate. Some students who misinterpreted the question discussed the breakdown of glucose and the production of ATP rather than the breakdown of ATP itself as the 'immediate source of energy'.

Question 32

(a) Many answers correctly identified features associated with *r* or *K* reproductive strategies but then opted to assign one of these strategies to the komodo dragon. A large number of answers reflected a poor understanding of the term 'continuum', often referring to the '*r*-continuum' or the '*K*-continuum'. Some students listed features of each strategy and then ignored one group of features.

(b) This part was generally answered well but low-scoring answers often failed to link the lack of genetic diversity to the mode of reproduction (asexual).

(c) Many responses described speciation due to geographical isolation, or inter-species breeding by the single female dragon, and so did not answer the question. A small number suggested that the female may have been pregnant before she was transferred to the island. Although this was not the expected answer, it did receive credit.

Question 33

(a) Most answers that were accepted as correct identified the structure as a 'villi' rather than a 'villus'. Many students seem to be blissfully unaware of the singular and plural forms of words such as mitochondrion/mitochondria and bacterium/bacteria, and either stick with one form, or use them interchangeably.

(b) To gain full credit it was necessary to specify this as a blood capillary (not just capillary).

(c) The most common error was to name the structure rather than state its function.

(d) Many answers did not focus on the well-being of people predisposed to coeliac disease. Instead they discussed how eating foods with high fat content (for example) can lead to heart disease, diabetes, and weight gain.

(e) This question identified students who have a good understanding of translation and who could articulate their ideas. The concept that specific amino acids are transported by different tRNA molecules was not explained well. Many answers did not identify any steps in the process — this is unfortunate, as it is a fundamental concept in the Stage 2 Biology course.

Question 34

(a) This part was generally done well. Common errors included: scales too small the grid space allocated, poorly drawn or inappropriate lines of best fit (either straight lines or ‘dot-to-dot’), and extrapolating the lines beyond the range of the data supplied.

(b) Some answers reflected a lack of careful reading of the question and included descriptions of changes to the cane toad and dingo populations. A proper description of the pattern of results required some reference to the data.

(c) Despite there being some good answers to this question, some students suggested that the dingoes would ‘adapt’ or become ‘immune’ to the cane toad toxins. The better answers referred to the change in the gene pool of the dingoes.

(d) Good answers to this question correctly compared the effects on the whole food web of removing a producer against removing a predator. Some answers began an explanation of the changes that would occur but described one effect or the other, without making the comparison.

(e) The most common accepted answers were Tasmanian tiger and dodo. Presumably those who named species such as pandas were confused between endangered and extinct. Some students provided obscure examples that were found by markers to be correct, but one wonders why those students would take that risk.

(f) Good answers concisely explained that the natural habitat of a species will provide all the requirements needed for the species to survive and reproduce.

Question 35

(a) Good answers related metabolic activity to the release of heat.

(b) This part was generally answered well. Common reasons for not scoring full marks included the inclusion of ATP, light, and/or chlorophyll in the equation.

(c) Many good answers correctly linked the rise in temperature with the decrease in hormone, and hence a decrease in metabolic activity. Unsuccessful answers often talked generally about the nervous and hormonal responses to temperature change.

(d) Most students could state the differences between the speed, duration, or mode of transmission of hormonal and nervous messages.

SECTION C: EXTENDED-RESPONSE QUESTIONS

Each extended-response question is marked out of 15, with 12 marks being allocated for content (each well-made point is worth 2 marks) and 3 marks for communication. Question 36 had three content parts, with each part being marked out of 4, and Question 37 had two content parts, with each part being marked out of 6.

In awarding a communication mark, the following factors were taken into account:

- Is the response at least half a page long, and is it structured in sentences and paragraphs?
- Does the response use correct grammar and spelling?
- Does the response clearly explain concepts, using relevant and concise biological language?

Students should be able to fully answer an extended-response question in about one page of writing. It is unnecessary for students to rewrite the question or to provide an introduction to their response. Both of these practices waste time, receive no credit, and may even result in a reduction in the communication mark.

Question 36

Part 1

Most responses identified at least one factor that would need to be kept constant but many made vague statements about ‘conditions’ and then listed two or three factors as subsets of this word (nutrients, temperature, etc). Many incorrectly referred to ‘amount of penicillin’ as a constant. The better answers listed a more specific factor such as ‘amount’ of bacteria. Temperature was commonly cited as a constant, rather than as a variable that had to be the same for all mice, and rarely was this related to metabolic rate.

Most students attempted to explain why the two factors needed to be kept constant in reference to the experiment. The better responses explained the difference between independent and dependent variables and the impact of this on results. Terminology such as reliable results and fair test was used regularly.

Part 2

Many answers identified that this was the control group and went on to explain that this group would be compared with the treated group. However, only the better responses referred to the effect that penicillin had on the survival rate of the mice. Many answers indicated that the aim of the experiment was to study the effect of streptococcus on the mice, rather than the effect of penicillin in treating the streptococcus infection.

Part 3

This part of the question was done poorly. Few answers explained coherently why reliability is important. The required answer was related to reproducibility of the results or the importance of results for drawing valid conclusions or accurate interpretations of the results, or accepting or rejecting a hypothesis.

Some students simply repeated terminology (e.g. reliability is important because the results have to be reliable) whereas others gave incorrect explanations, such as reliability is important to ensure results are accurate. Many students wrote about the importance of the experiment as the results would be used to develop drugs for human beings, rather than referring to reliability from a science perspective.

Most students were able to suggest an appropriate improvement that relates to reliability. The most common suggestion was to increase the sample size, and often students knew that a larger sample size could reduce the effects of random errors. Some said 'to increase sample size so an average could be calculated' but they did not say how that would help to minimise the effect of random errors. The weaker responses referred to repetition and averaging across experiments.

There was confusion between random and systematic errors and how these could be minimised or detected: some students used both in the same sentence (e.g. 'a larger sample size will reduce random and systematic errors').

Mistakes included talking about trying different concentrations of penicillin, or trying it on different species.

Question 37

Part 1

The better responses identified the cell division as meiosis, and went on to describe the pairing of homologous chromosomes, the separation of the homologous chromosomes, and the reduction in (or halving of) the chromosome number. A few described mitosis. A small number named meiosis and then described mitosis.

There was a lot of confusion about the purpose of the first and second meiotic divisions, with many suggesting that it was the second division that reduced chromosome number. Quite often the description of what happens to homologous chromosome pairs was a side note, rather than a focal point. There was also a lot of confusion with terminology, such as chromosome v. chromatid, diploid v. haploid, pairs of chromosomes separating (with no mention that they are homologous), which made it uncertain whether the student really understood the process.

Some answers included elaborate detail about independent assortment and crossing over without mentioning key processes of this type of cell division, such as homologous chromosomes pairing, or members of pairs separating.

There was evidence of misconceptions such as fertilisation being needed before meiosis could occur, or that eggs/sperm divide by meiosis.

Some students gave almost their entire answer in the form of a series of diagrams, rather than giving information in the text, or giving a partial explanation with reference to the diagrams. Quite a few students drew good diagrams that were completely different from their written text, but did show the process correctly. Such a mismatch between diagrams and description does not indicate a clear understanding of the process.

Part 2

It was necessary to describe the process of inhibition by competitive or non-competitive means. This section was done well by nearly all students, who gave both explanations in their answer. However, many had learnt the theory but did not apply it to this situation. There was a lot of reference to substrates, without the connection that the ‘substrate’ in this case was the receptor on the egg cell. Hence only the better responses referred to the inability of the enzyme to bind to the receptor on the egg cell rather than just repeating the information from the stem of the question.

Most answers received some credit for stating that the diploid number cannot be restored if the sperm cannot fertilise the egg. A higher level of understanding was shown by the description of haploid cells fusing and creating a diploid cell. The better responses had described this as part of their description of meiosis.

OPERATIONAL ADVICE

Many teachers followed the correct procedure of including the approved learning and assessment plan (LAP), or a photocopy of it, in the moderation bag. They appropriately detailed changes to their approved LAP, and provided a rationale for the changes, on the addendum form. The addendum needs to be completed when tasks vary from those in the approved LAP and submitted with the approved LAP and the moderation materials. When making changes to an approved LAP, teachers are advised to take care to ensure that the changes do not alter the plan in such a way that it would no longer be approved. When teachers include neither the LAP nor an appropriate addendum it is more difficult for moderators to confirm assessment decisions.

Teachers should ensure that they follow the correct procedure for any missing student work, including work that has been seen and marked by the teacher. It is essential to complete the Variations — Moderation Materials form; if this form is not included, work is assumed to be missing for invalid reasons and this reduces the quality of the evidence and hence the grade when holistic assessment of student work is considered.

Most student work that was received matched the work that had been requested, and was separated clearly between students and between assessment types. Some teachers went to lengths to remove student names and school names from work. Many schools also sought to preserve anonymity by ensuring that school names did not appear on student work. These actions are a matter of choice for the school.

GENERAL COMMENTS

Evidence of how teachers arrived at the overall grade for each assessment type was useful in helping moderators to confirm student performance; this evidence varied considerably, ranging from complex calculations, to lists of grades for assessment design criteria (often at the specific feature level), to highlighted pages of performance standards. Although moderators focus on the quality of student responses, information about how the aggregation of these grades was achieved was helpful in enabling them to confirm grades.

Teachers’ comments on students’ work are encouraged as they help moderators to verify decisions that teachers have made about the standard of that work. There is no particular preference for either marks or grades to be displayed on a student's piece of work, but some evidence of the teacher's assessment should appear on the work. Work that is unmarked or marked only with ticks is not a useful indicator of a teacher's assessment of a student's performance. The role of moderators does not include marking student work.

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