Biology

2011 Assessment Report

Government of South Australia

SACE Board of SA

BIOLOGY

2011 ASSESSMENT REPORT

OVERVIEW

Assessment reports give an overview of how students performed in 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 (40%)

Most assessment groups followed their learning and assessment plans effectively and this assessment type typically consisted of the required issues investigation and three or four practical investigations. The design practical investigation was generally clearly distinguishable to the moderators. Best practice was often demonstrated by a clear task sheet that outlined the expectations to be met for the students to be successful. Good examples then related the assessment design criteria to the work that would be carried out, recorded, and written by students. Task sheets were sometimes missing or limited, and this made it difficult for moderators to verify that students had been given the opportunity to demonstrate ability at higher grade levels and hence confirm their results.

Evidence of planning of investigations was generally good. Students' work overall showed a sound understanding of variables and in the better examples a measurable hypothesis had been formulated. Further clarity was sometimes needed in students' work in order to determine which decisions had been made by the student as opposed to structures that the teacher had provided, especially in the design practical investigation.

Some assessment of students' work was overgenerous in its interpretation of 'coherent, and detailed' versus 'well-considered and clear'. The former description is appropriately applied to student work only if the investigation could be repeated readily and easily from reading the method described by the student, with no additional interpretation required. This would include a detailed explanation of the method of data collection and recording, and a prepared data table that is ready for the results to be inserted.

Many pieces of work lacked evidence relating to specific feature I3 (Manipulation of apparatus and technological tools to implement safe and ethical investigation procedures) and specific feature A3 (Demonstration of skills in individual and collaborative work). However, some good evidence was seen for these features in the form of a teacher's checklist and/or in written self and/or peer review in students' work.

Many students showed evidence of their ability to display data appropriately in tabular and graphical form. Best practice was seen when students' responses adhered to appropriate conventions (e.g. consistency in column headings, titles, an appropriate degree of resolution, the use of negative numbers, choice of axes, labelling of axes, and lines of best fit). A mixture of computer-drawn and hand-drawn graphs was included. Some students need to be careful when using computers to draw graphs, as computers sometimes make inappropriate decisions for students (e.g. axis scale and choice of a line of best fit).

Many students formulated conclusions well and often displayed the ability to make connections and evaluate links between data and concepts. The discussion section of a practical write-up or report was often a key indicator for moderators in confirming student performance, particularly at the higher grade bands. Students' work in this section was variable; strong responses included in-depth discussions, demonstrating the ability to discuss errors (random and systematic), sample size, precision, accuracy, and resolution as well as evaluating procedures in terms of multiple strengths and weaknesses and making multiple appropriate suggestions for improvement. The weaker responses often included an attempt to evaluate the investigation with general commentary only, with either no appropriate suggestions or superficial and generic suggestions made in one or two sentences.

Some students had completed written practical investigations using templates or worksheets where they had to give answers in single words or short sentences (e.g. 'The independent variable in this experiment is ...' or 'State one possible random error and one systematic error in this investigation'). This form of written work for practical investigations, where there is excessive structure or little space available for student responses, does not give students the opportunity to achieve at the higher performance standards.

The choice of issues pursued in the issues investigations was usually appropriate and a wide range of investigations was seen across the different biological themes. The issues investigation was often completed at a standard exceeding, or at least equal to, the standard of the practical investigations. Good task outlines matched their expectations of student work with the requirements in the subject outline, which clearly states what should be included in a completed issues investigation, and aligned with assessment design criteria. Some tasks deviated from the expectations in the subject outline. Some task designs and the resulting student work indicated confusion over the difference between an investigation that was centred in the environment topic and an investigation that examined environmental issues. For example, a sand dune transect investigation alone does not address environmental issues, but it could do so if questions were asked about factors affecting the habitat or the human impact on the environment. Within assessment groups, there was evidence that students had been given the opportunity to formulate their own question and were generally able to produce an appropriate issues investigation, rather than just present a topic report. In only a couple of instances did all the students in a class have the same question, which is undesirable. This can lead to concerns about plagiarism, or difficulty in ascertaining which student critically and logically selected information about the issue.

Good responses had an appropriate balance between discussion of the issue and evaluation of the source material. Word-count was generally adhered to well, except in a few cases where it was ignored or where there was a misunderstanding that the 1500-word maximum should include the evaluation of information gathered with the rest of the report. A few multimedia presentations were provided as student evidence, with mixed success in demonstrating the relevant performance standards.

A range of citation methods was used, with best practice typified by the consistent use of appropriate in-text referencing or footnotes.

Assessment Type 2: Skills and Applications Tasks (30%)

Nearly all skills and applications tasks were in the form of tests. Most tests assessed and recorded performance to the standards rather than in marks and percentages. Many teachers recorded student evidence in terms of both performance standards and numerical data. Most tasks were of suitable length, and only a few teachers wrote lengthy tasks for students to complete. Most students' work included three or four tests. Occasionally student presentations were seen as multimedia tasks and the standard of these was variable. Most tasks, as outlined in the learning and assessment plans, were carried out under teacher supervision, which is in accordance with the specifications in the subject outline.

Marking was generally appropriate and moderators could usually confirm the decision of the teacher by looking at the evidence in students' work. Where the school's assessment was generous, the discrepancy was often due to reliance on marks and percentages rather than making a judgment of student work against the performance standards.

Most tasks were appropriate in matching the content of the test with what is described in the subject outline, although there were some examples in which the content did not match the subject outline and others in which the content had been removed some time ago. Monohybrid inheritance and Punnett squares have not been part of the curriculum for many years. Teachers are reminded to base their work on the current version of the subject outline, which is available on the SACE website. It is not appropriate to use 'past tests' without checking their content carefully, and ensuring that they are appropriate for assessing the assessment design criteria. Best practice in skills and applications tasks involved the use of appropriate questions from past examinations or questions of examination quality. Some tests were not of the appropriate standard. The questions they contained had been taken from item banks and often included little stimulus material of the type typically seen in questions of examination quality. They did not allow students to demonstrate evidence of knowledge and understanding or application at the higher grade bands.

The best-designed skills and applications tasks allowed students to communicate biological knowledge and information in a range of formats. Typically, tasks that included a range of multiple-choice, short-answer, extended-response, and graphical exercises provided these opportunities. Sets of student work that did not contain any extended-response questions made it difficult for students to demonstrate evidence of learning at the higher grade boundaries. Good tests contained a range of question types, with students asked to provide some straightforward responses (e.g. state, name, identify) and also to show evidence of higher order thinking skills (e.g. describe, discuss, and explain), and the ability to apply knowledge to answer questions in new contexts, addressing specific feature A1 (Application of biological concepts and evidence from investigations to solve problems in new and familiar contexts). Students' answers to extended-response questions often contained useful evidence to allow moderators to confirm student performance across all grade levels.

EXTERNAL ASSESSMENT

Assessment Type 3: Examination (30%)

The mean score for the 2011 examination was 56.8%, which compares with previous means of 55.9% (2010), 56.3% (2009), 59.9% (2008), 58.4% (2007), and 58.7% (2006). The range of examination marks was from 6 to 195 out of a possible 200. The mean marks for Sections A, B, and C were 62.8%, 55.6%, and 51.5%, respectively.

SECTION A: MULTIPLE-CHOICE QUESTIONS

Thirty-two 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 (%)*
2011	62.8	14 to 91
2010	62.7	17 to 97
2009	64.4	34 to 89
2008	65.4	17 to 86
2007	61.5	28 to 92
2006	62.9	20 to 96

The examiners attempt to set multiple-choice questions that 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, less knowledgeable students are likely to choose the four responses with equal frequency, whereas more capable students will show a distinct preference for the correct response. Data from the 2011 multiple-choice questions show that the top 10% of students preferred the correct response for all questions.

The table below indicates the percentage of responses for each alternative for each question in Section A:

Question	*Percentage of Responses for Each Alternative*			
	J	K	L	M
1	14	7	79	0
2	9	28	6	56
3	30	4	62	4
4	1	4	3	91
5	7	6	75	11
6	21	60	4	14
7	6	82	4	8
8	26	49	16	9
9	4	5	37	54
10	73	9	14	3
11	47	39	8	6
12	10	10	61	18
13	83	3	6	8
14	16	6	3	74
15	26	49	9	16
16	17	44	17	22
17	11	34	22	32
18	77	6	14	4
19	24	2	10	63
20	1	1	8	90
21	13	13	6	69
22	82	5	7	6
23	79	8	8	6
24	33	17	41	8
25	54	8	11	27

Comments on selected multiple-choice questions follow.

Question 10
This was the most difficult multiple-choice question, but students in the top decile showed a clear preference for the correct answer. Apparently, many students did not realise that hormones allow communication within a multicellular organism, and that this includes multicellular plants.

Question 11
Near the beginning of meiosis, homologous chromosomes come together in pairs (synapsis).

Question 17
The overall input or output of carbon dioxide results from the combined effects of photosynthesis and respiration. At a light intensity of 10% the rate of photosynthesis is lower than the rate of respiration.

Question 24
The high number of students who chose alternative J (33%) suggests that they either ignored the fact that the word ‘origin’ was emphasised, or did not realise its significance.

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 55.6%. As with Section A, the examiners aim to produce 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	3.28	6	54.7
27	5.51	12	45.9
28	10.37	20	51.9
29	5.44	8	68.0
30	4.19	6	69.8
31	5.18	8	64.8
32	5.94	12	49.5
33	9.28	18	51.5
34	6.55	12	54.6
35	10.95	18	60.8

Teachers and students should note the following comments:

- Many students fail to gain marks because they misinterpret 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. No marks are awarded 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 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) The most common incorrect responses were ‘protein synthesis’ and ‘transcription’. A few students described the process instead of naming it, as requested.

(b) Some students described protein synthesis, without focusing on the *roles* of mRNA and tRNA. Many answers did not mention that the tRNA transported a *specific* amino acid.

Question 27

(a) Answers suggested a reasonable understanding that male ants have half the number of chromosomes that female ants have. However, a number of students repeated the information in the question (haploid/diploid) or specified numbers of chromosomes.

(b) 'Mitosis' was a common answer but a significant number of students stated 'meiosis'.

(c) The inability of many students to articulate their ideas was highly apparent in their responses to this question. The chromosomes do not line up randomly; the pairs are sorted independently.

(d) This part was generally done well, though in some answers 'species' was confused with 'individual'. Some answers did not gain full marks because they referred only to survival. Many answers referred to catastrophes (most frequently some kind of disease or pathogen) that could be survived if variation existed.

Question 28

(a) This part was generally answered well. Most answers described (and often named) either one or both of the well-known methods of chemical inhibition.

(b) In many answers the question was rephrased and there was evidence that many students found it difficult to express their ideas. Very few answers explained the low chance of the same sequence of DNA arising independently more than once. The idea that similar sequences of DNA are strong evidence for shared ancestry eluded most students.

(c) The evidence of circular mitochondrial DNA was identified by many students, but some appeared to ignore part of the question and discussed evidence that was not mentioned on page 18.

(d) A number of diagrams showed a double membrane plus a third folded membrane (often labelled 'cristae'). Students who described the function of mitochondria were apparently more familiar with this than with their structure.

(e) (i) Most students scored 2 marks for saying that the surface area-to-volume ratio of the mitochondrion is higher than that of the cell.

(ii) Many of the answers seemed to be based on the idea that the highly folded *inner* membrane produces a large surface area — not that the *external* size of the organelle is smaller than that of the cell.

Question 29

(a) Many answers suggested that sensory receptors detect environmental changes. A common error was then to state a role that extended beyond that of receptors.

(b) This part was done well, with most answers stating fundamental differences between nervous communication and hormonal communication.

(c) A common error was to include ATP in the equation.

Question 30

(a) Most students answered this part correctly, with a number adding that different genes would be activated even though the genetic material was the same.

(b) Common incorrect answers were binary fission, budding, and mitosis.

(c) Most students answered this part correctly. Incorrect responses included reference to sources of difference such as independent assortment, crossing over, and random fertilisation.

Question 31

(a) This part was answered correctly by a large number of students.

(b) The most common error was to include an abiotic factor.

(c) Many students explained that speciation had not occurred and that this was probably due to either a lack of time allowed for speciation or a lack of different selection pressures. Some answers suggested that the fish species diverged and then converged. Students who did not read the question carefully gave stock responses about speciation resulting in the inability to interbreed.

Question 32

(a) Most students described the isolation of a gene rather than how a gene can be incorporated in the DNA of rice. Only a few described the process of incorporation with any detail, and most just mentioned a method (e.g. microinjection).

(b) Incomplete answers such as 'unknown effects', without justification or example, did not receive full credit. Advantages were handled quite well. A number of students thought that their response had to relate to the previous part of the question and mentioned advantages of beta carotene and vitamin A. 'Allergy' was quite commonly stated as a disadvantage.

(c) Most students identified strain 2, but many did not give an explanation. Some students were not able to interpret the diagram and stated that none of the strains had incorporated DNA from the daffodil and the bacterium. They may have (incorrectly) thought that all the DNA fragments needed to be present.

Question 33

(a) Common errors included extrapolation, and incorrect labelling of axes. There were also a few scale issues, particularly for the *y*-axis. Some lines of best fit were not drawn well.

(b) Inappropriate responses were often written as a conclusion or a question, rather than as a prediction.

(c) Many students mentioned numbers from the graph and the table and compared them, but did not go on to say that the trend or pattern of the

results was similar or the same. The more astute students took careful notice of the words in bold and referred to both the graph and the table.

(d) Many students mentioned limited resources, but did not explain how this would make the current growth pattern of the human population unsustainable.

(e) Some students gave quite good examples of what might happen in a food web if one species became extinct. However, most students did not explain the importance of biodiversity to communities.

Question 34

(a) Students need to take care with the spelling of biological terms that are used in the subject outline. 'Succession' would be an acceptable answer. If students choose to provide additional information, it must be correct for them to gain full credit. In this case 'primary succession' is not correct.

(b) This part of the question was answered correctly by most students, although it seems that the concept of trophic level is not well understood. A number of students stated that autotrophs are responsible for returning resources to a community.

(c) Some students did not explain that pioneer organisms alter their environment, making it less suitable for themselves and more suitable for other species. Instead, they simply stated that *r*-selected species, and then *K*-selected species, move into the area. Poor responses stated that organisms adapt to the new environment.

(d) The process of photosynthesis seemed to be well understood and many students could relate it to increasing levels of carbon dioxide that resulted from clearing of the rainforest. Some students explained how slashing/burning/combustion creates an increase in CO_2 by releasing the carbon in the tissues of the plants. Poor answers stated that photosynthesis produces or creates energy. There were also some simplistic explanations of photosynthesis, referring to carbon dioxide being converted into oxygen. Some students focused on oxygen, but the question clearly referred to levels of carbon dioxide in the atmosphere.

Question 35

(a) It was evident that many students do not understand the concepts of random error, sample size, reliability, precision, accuracy, and validity. In many cases these terms were used interchangeably. Many students stated that a large sample size will reduce random error rather than reduce *the effect of* random error. Others answered correctly but then contradicted themselves by mentioning accuracy or validity. Some students seemed to have the misconception that averaging results increases precision.

(b) Most students identified blood cholesterol level as the independent variable.

(c) Many students did not describe the decrease and the increase in deaths caused by cardiovascular disease. Often they attempted to explain the results

rather than describe the pattern of results. There was a tendency to discuss each data point rather than the trend.

(d) Some students were able to correctly link both variables, supported by data from the graph. A significant number stated that deaths went up with increasing cholesterol, ignoring the low cholesterol levels. Some responses, such as 'blood cholesterol affects deaths', were too general, whereas others stated a hypothesis rather than a conclusion. Some students provided conclusions that referred to chance, risk, or rate, rather than using the independent and dependent variables provided.

(e) Most students answered this question correctly. They were expected to include the units for blood cholesterol levels in their answer.

(f) Although many students mentioned, for example, improved cardiovascular output or more efficient blood flow, they were not able to link these to the well-being of an individual. Answers generally lacked detail and were often repetitive in both parts of the question.

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. Questions 36 and 37 each had three content parts, each of which was marked out of 4.

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 the form of 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 are time wasting and receive no credit, and may even result in a reduction in the communication mark.

Question 36

Part 1
Students needed to understand that the shape of levothyroxine has to be the same as, or similar to, that of thyroxine so that it can bind to the receptors on target cells and induce a reaction in the cell. The shape of the molecule is specific and complementary to the shape of the receptor. Many students confused the role of levothyroxine and thought that its job is to protect and repair the thyroid gland, or that it is part of the immune response. Irrelevant discussions about the immune response were common.

Part 2
Students who understood the question explained that one benefit of taking levothyroxine is to regulate cell metabolism and discussed the importance of homeostasis or thermoregulation. However, most students simply stated that metabolism can be regulated but did not elaborate. Many students had a better

understanding of possible harmful effects of taking a synthetic drug and referred to unknown side effects or allergic responses. A number of students also recognised that dosage is an issue in controlling metabolism and linked this to weight control and temperature regulation.

Part 3
A significant number of students did not seem to understand the hierarchical concept, and described the physical position of the thyroid gland or its role in the body. Some students simply discussed the degree of importance of the thyroid gland.

Question 37

Part 1
The description of processes needed to refer to concentration gradients and energy requirements. Most students did this but went into great (and unnecessary) detail about the nature of the exchange surface itself. Many students described the movement of glucose across the walls of nephrons, ignoring the reference to villi in the question.

Part 2
Most students realised that the answer to this part required them to mention ATP as the immediate source of energy for cellular reactions. The wording of answers was variable and reflected the persistent problem that students have with this topic. Although students seemed to understand that ATP production is tied to aerobic respiration, they frequently used the terms 'created' and 'produced' to describe energy being released in aerobic respiration. Many students still refer to ATP as a 'form of energy'. Equations for the ATP cycle were commonly (and correctly) used.

Part 3
The better answers described processes such as active transport, mitosis and meiosis, protein synthesis, DNA replication, and endocytosis, and described in detail the events that require energy within these processes. High-quality answers referred to the movement of the cytoskeleton in mitosis, endocytosis, exocytosis, vesicle movement, and the energy required for the synthesis of macromolecules. Students with limited understanding referred to breathing, heartbeat, and digestion.

OPERATIONAL ADVICE

Moderation is facilitated when cover pages and/or task design pages refer to the assessment design criteria.

Many teachers followed the correct procedure of including a copy of the approved plan and used the addendum, with appropriately detailed changes, and a rationale for the changes. Some teachers, however, included neither an approved learning and assessment plan nor an addendum; this made the confirmation of teachers' decisions difficult. The addendum should be used to inform moderators when the tasks do not match the approved plan.

Teachers should ensure that they follow the correct procedure when student work that has been seen and marked by the teacher is missing from the nominated sample. It is essential that the correct protocol is followed. A 'Variations — Moderation Materials' form should be completed (see under Forms on the subject page on the SACE website). If this form is not included, work is assumed to be

missing for invalid reasons and this attracts penalties when holistic assessment of students' work is considered.

There was considerable variation in the packaging and presentation of materials. Best practice was typified when: the students' work received matched the student list requested on the blue form; work was separated clearly between students and between assessment types; and everything was clearly labelled.

GENERAL COMMENTS

Evidence of how teachers arrived at their overall grade for an assessment type was useful in helping moderators to confirm student performance; this evidence varied considerably, ranging from complex algorithms, to tally lists of grades for assessment design criteria (often at the level of specific features), to highlighted pages of performance standards. The primary focus for moderators was always on the quality of student responses, although secondary information as to how the aggregation of these grades was achieved was helpful in confirming grades.

Teachers' comments on students' work help moderators to confirm decisions that teachers have made about the standard of student work. There is no particular preference for either marks or grades to be displayed on a student's piece of work, but some form of assessment should appear. Unmarked work or pieces of work marked only with ticks is not a useful indicator of a teacher's assessment of a student's performance.

Chief Assessor
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