2022 Biology Subject Assessment Advice

Overview

Subject assessment advice, based on the 2022 assessment cycle, gives 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, and the quality of student performance.

Teachers should refer to the subject outline for specifications on content and learning requirements, and to the subject operational information for operational matters and key dates.

School Assessment

Teachers can improve the moderation process and the online process by:

* ensuring student samples are marked and have relevant annotations to support assessment decisions made against the performance standard in both assessment types
* ensuring student work has word counts indicated on student samples for the Investigations Folio tasks
* by uploading each student sample for each assessment type in a single accessible file where possible.

Assessment Type 1: Investigations Folio

The Investigations Folio should include a minimum of two practical investigation tasks and one Science as a Human Endeavour investigation. In the practical investigation tasks, the students should have had at least one opportunity to deconstruct a problem for which the outcome is uncertain. They should then design a method to investigate one aspect of this problem. The design of method should not just be a repeat of existing methods.

Assessment design criteria to be used for this assessment type are Investigation, Analysis and Evaluation and Knowledge and Application.

Teachers can elicit more successful responses by:

* being careful not to over scaffold tasks, especially if undertaking completion practicals, to ensure students have the opportunity to show evidence for the higher level of performance. Excessive scaffolding restricts the student from showing their critical thinking and ability to analyse and evaluate
* ensuring choice of Science as a Human Endeavour topics are appropriately linked to the Stage 2 Biology subject outline, and should have clear reference to Biology, not other sciences
* choosing a deconstruct and design investigation where the outcome is uncertain and requires the student to undertake some research and then use the information found to design a method that is more than just selecting an alternative independent variable
* ensuring that students do not include a discussion of improvements to experimental design. This is not a requirement for this task in the current subject outline and will limit their opportunity to use the word count for aspects of the task that are required.

The more successful responses commonly:

* provided detailed and highly relevant evidence of their deconstruction within the maximum of four sides of an A4 page (IAE1/KA4)
* provided an appropriate and creative deconstruction of a problem for which the outcome was uncertain (IAE1)
* included justification and sufficient evidence to show their depth of understanding of the problem, and how various relevant factors should be considered to enable that specific problem to be investigated (IAE1)
* using their deconstruction, developed a clear, highly logical design to investigate one aspect of the problem; a single variable to be investigated (IAE1)
* developed a design which included a highly relevant and detailed list of materials and a method that was logical and able to be performed (IAE1)
* provided appropriate justifications for the materials chosen and the method suggested (IAE1)
* identified relevant factors appropriate to the investigation being carried out (and not generic) which could not be controlled and why they could not be controlled (IAE1/KA4)
* designed a highly appropriate blank data table with correct columns and headings (including units) that could be used to record the data collected. This inclusion shows evidence of a number of key understandings of designing an experiment; an understanding of sample size, measurement/units and conventional representation of data (IAE1/IAE2)
* presented the data in a clear manner that was highly accurate. Use of titles, units, significant figures etc were all highly consistent. Graphs were well presented, with accuracy and of appropriate size (IAE2)
* demonstrated a highly effective ability to analyse the data (including outliers), critically with depth, accuracy and effectively linked the trends to relevant biological concepts (KA1) (IAE3)
* provided a plausible explanation for when a trend in the data was not as would be expected (IAE3)
* constructed a critical and highly effective evaluation of the investigation; identified potential relevant sources of random and systematic errors, with reference to how these could affect the data. In addition, specifically referenced the data to indicate where these errors may have affected the data (IAE4)
* used terminology with a high level of accuracy and effectiveness when discussing errors, (IAE4/KA4)
* provided highly relevant limitations to the conclusions that were not simply a repeat of the evaluation of errors (IAE3)
* included relevant biological knowledge in both the practical reports and SHE Investigation that was well explained and referenced effectively (KA4)
* explored an appropriate and contemporary topic linked to the Stage 2 Biology subject in the Science as a Human Endeavour report. The biology was well explained and clear and detailed connection between science and society was provided. It was evident which SHE key concept(s) were being explored, and there was an explicit and well explained connection to specific people in society that may be affected (KA1/KA3/KA4).

The less successful responses commonly:

* provided a deconstruct which was brief, and consisted mostly of listing of ideas, with a basic or limited definition and with minimal link to the design, and little or no justification about how the factors need to be considered in the design (IAE1)
* used a mind map as the format for the deconstruct but did not include much detail about the research or any justifications linked to the design (IAE1)
* selected a sample size that was too small and offered limited and often unclear instructions for the method, which was often basic or not able to be performed (IAE1)
* included a hypothesis where the independent and dependent variable were not identifiable (IAE1)
* listed variables and did not explain how they could affect the data (IAE1/IAE4)
* presented data that was often not aligned to conventions used in science
* missing titles and units on graphs and table
* not referencing the average, or how the average was determined
* did not employ appropriate column and row structure
* incorrect use of significant figures
* repeated units in each cell rather than in the heading of the column.
* displayed graphs inappropriately, often in the wrong format and quite small in size
* incorrect use of scales on the axis
* lack of labels or incorrect labels
* line of best fit missing or not accurately drawn
* incorrect use of graphing programs producing graphs that did not represent the data appropriately (IAE2).
* provided a general summary of the data, omitting the outliers, with little reference to the actual data, or to the relevant link to the relevant Biology (IAE3)
* lacked limitations to conclusions or provided inappropriate descriptions. Often referring to limitations of the method or just repeating the need to increase the number of trials or incorrectly referred to external factors such as running out of time to conduct the experiment (IAE4)
* showed a lack of understanding of terms such as reliability, precision, accuracy, and validity (IAE4)
* used generic terms and/or only definitions when attempting to identify errors and their effect on the data and made no/little reference to the actual data (IAE4)
* identified the sources of potential random and systematic errors incorrectly and/or mixed them up (IAE4)
* focused on the biology in the Science as a Human Endeavour (SHE) report, rather than on how the information demonstrated one of the SHE Key concepts
* often the Key concept was not identifiable as it was not explicitly introduced or explained
* referencing was often incomplete, and limited
* the topic was inappropriate, not well chosen or lacked sufficient connection to a SHE Key concept, e.g. generic topics such as CRISPR or DNA manipulation.

Operational Advice

If students present their responses in oral or multimodal form, 6 minutes is the equivalent of 1000 words. Students should not speed-up the recording of their videos excessively in an attempt to condense more content into the maximum time limit.

From 2023, if a video is flagged by moderators as impacted by speed, schools will be requested to provide a transcript and moderators will be advised to moderate based on the evidence in the transcript, only considering evidence up to the maximum word limit.

If the speed of the recording makes the speech incomprehensible, it affects the accuracy of transcriptions and it also impacts the ability of moderators to find evidence of student achievement against the performance standards.

Assessment Type 2: Skills and Applications Task

Three or four Skills and Applications Tasks provide evidence of students’ knowledge, understanding, and application of science inquiry skills, key biological concepts, and the connections with science as a human endeavour by discussing the interaction between science and society.

Assessment design criteria to be used for this assessment type are Investigation, Analysis and Evaluation and Knowledge and Application.

Teachers can elicit more successful responses by:

* ensuring tasks, in particular supervised tests, are well balanced with a sufficient proportion of question types (e.g., recall, difficult and problem-solving questions)
* ensuring the content of tests are broad and deep across the topic and do not have questions testing the same concept multiple times in the same task
* ensure that when marking student responses correct answers are not inferred from poorly expressed answers which results in inflation of the student’s achievement
* encouraging students to use the appropriate biological terminology when providing answers to written questions. When student responses are not well expressed, then this needs to be reflected in the assessment of KA4
* applying an appropriate reduction to the marks allocated when contradictory statements are provided, indicating that the student does not have a fully correct understanding of the concept
* to ensure that Science Inquiry Skills and Science as a Human Endeavour questions are sufficiently represented across the folio of tasks
* to provide opportunities for students to practise how to answer questions, remembering that one well-defined point is the equivalent of a mark. It is essential that the test is designed so that the allocation of questions, and marks is adequate across all of the specific features being assessed in the task to ensure the result is reflective of student ability
* to ensure that when using online formats for tests that may have automated marking features, that the marks awarded are accurate and reflective of the standard being assessed
* designing non-test SATS that are not overly scaffolded and that enable students to demonstrate deep and broad knowledge and understanding and critical and evaluative thinking

The more successful responses commonly:

* answered a range of application and problem-solving scenarios highly effectively (KA1)
* planned their written-response answers, then responded directly, concisely and accurately with the appropriate amount of detail to obtain full credit (KA4)
* used key terminology effectively to provide well-considered answers that had sufficient information, presented logically for the number of marks allocated to the question (KA1, KA2)
* analysed data accurately and clearly, referring to data when required, thus showing their understanding of concepts (KA1, IAE3)
* featured evidence prompted by a broad range of item types (short answer questions, SHE and inquiry questions) and that applied to a variety of familiar and unfamiliar contexts (KA1, KA2)
* showed the ability to use the information provided in scenarios and then effectively analyse the information to demonstrate a clear understanding of the interaction between science and society (KA3)

The less successful responses commonly:

* answered basic definition or recall type questions incorrectly, and were not able to provide clear answers to more difficult and/or application type questions (KA1, KA2)
* could not effectively connect one concept to another, even when provided with information in the stem of the question (KA1, KA2)
* used general terms to answer questions, rather than the correct biological terminology and had answers that were not well structured (KA4)
* addressed SHE type questions inappropriately, as they referred to generic statements rather than specifically using the information provided in the stem of the question (KA3)
* paraphrased the question rather than answering it or misinterpreted the meaning of the question and therefore provided an irrelevant answer (KA1, KA4)

External Assessment

Assessment Type 3: Examination

The subject outline indicates that Stage 2 science inquiry skills and science understanding from all Stage 2 Biology topics may be assessed in the examination.

It also states that questions:

* will be of different types
* may require students to show an understanding of science as a human endeavour
* may require students to apply their science understanding from more than one topic.

All specific features of the assessment design criteria for this subject may be assessed in the external examination.

Section 1: Multiple-choice Questions

Multiple-choice questions vary in difficulty from easy knowledge (recall) to difficult knowledge and problem solving. Many questions are intentionally discriminating so that more capable students will show a distinct preference for the correct response. In 2022, the top students showed a clear preference for the correct response in all of the multiple-choice questions. We have provided feedback for questions in Section 1 that challenged a significant proportion of the cohort.

Question 2

The most popular incorrect response referred to thymine. Students may have missed the fact that the gene for rRNA is made of DNA and does contain thymine.

Question 3

Most students did not answer this question correctly. If students drew a diagram of a DNA molecule and labelled the coding and template strands, they would clearly see that the transcribed mRNA molecule has the same base sequence as the coding strand (with thymine replaced by uracil).

Question 4

Almost half of the students answered this question correctly. Students needed to use the information in the equations along with their knowledge and understanding of enzyme-controlled reactions.

Question 8

The most popular incorrect alternative indicates that many students either did not know that fermentation in yeast produces carbon dioxide, or did not read the question carefully. It is also possible that some students did not realise that fermentation is an anaerobic alternative in some animal cells.

Section 2

As for Section 1, the examiners aim to produce questions that vary in difficulty from easy knowledge through to difficult knowledge and problem solving.

Teachers and students should note the following:

* many students fail to gain marks as a result of misinterpretation of questions. Students are encouraged to read questions carefully so their responses are relevant to the questions asked
* providing multiple responses when instructed to only give one fact or reason risks introducing contradictory information, indicating that the student does not have correct knowledge and/or understanding
* a number of students rewrite or paraphrase the question. There are no marks for doing this and valuable examination time is wasted through this practice
* students need to be careful with their use of biological language. Clear and concise answers that use relevant terms from the subject outline correctly make it easier for markers to understand what a student is trying to convey in their response, and hence award marks
* students who usually depend on an autocorrect function when inputting text are reminded that, in the Biology e-exam, this function is not activated. Students are encouraged to use the spell-check option in each text box to ensure that their communication is as clear and accurate as possible
* it was evident to markers that some students ignored the instruction to ‘Use Source X to answer question ...’ Consequently, the answer provided by these students lacked the reference to relevant information or concepts
* accessing the sample Biology examination and familiarising themselves with the assessment platform will enable students to focus more on the biology of the questions than the technology required to respond to them.

Question 16

(a) This question was generally answered well.

(b) The more successful responses identified that the gene would not be expressed and that this would lead to uncontrolled cell division. *The less successful responses* did not go on to explain that an increase in methylation would lead to decreased expression of TSG.

(c) The more successful responses identified that there was a newly synthesised strand and made the link that, without DNMTs, methylation patterns would not be copied into daughter cells.

*The less successful responses* did not recognise that the methylation patterns would only be absent on newly synthesised strands and / or did not state that semi-conservative replication produces two identical molecules.

(d) The more successful responses demonstrated a good understanding of the action of inhibitors.

Less successful responses did not use the terms ‘active site’ and ‘complementary’ correctly.

(e) The less successful responses suggested that the iDNMTs would bind to other enzymes and thus inhibit them.

Question 17

(a) The less successful responses arrived at an incorrect answer by dividing by 3.

(b) The less successful responses did not explain that the tRNA anticodon is complementary to the mRNA codon.

(c) Most students answered this question correctly.

(d) Most students answered this question correctly.

(e) The more successful responses demonstrated an understanding that additional exons in the mRNA would result in the addition of amino acids to the protein, and that the shape of a protein affects its function.

Less successful responses missed the idea of additional amino acids being added to the polypeptide.

Question 18

(a) Less successful responses provided an unnecessary description of the cell cycle.

(b) Less successful responses implied that less activation energy is needed overall, rather than at each step.

(c) (i) Less successful responses made vague statements, such as ‘so the results are reliable’, and/or did not refer to the independent variable.

(ii) The more successful responses stated a qualifier, such as ‘age of mice’ or ‘type of drug’.

(d) (i) The less successful responses did not demonstrate an understanding that the cholesterol drug was being applied to TNBC cancer treatment.

(ii) This question was generally answered well. The less successful responses discussed ethics, which is not a limitation, or discussed limitation that was not related to the scenario.

Question 19

(a) The less successful responses ignored the importance of significant figures and gave answers such as 78.1 or 78.14.

(b) (i) The more successful responses qualified their answers with statements such as ‘the intensity of light in the field’, or ‘the amount of rainfall in the field’.

(ii) as for (i).

(c) The less successful responses referred to the average rather than each of the plant types tested.

(d) The less successful responses ignored the term ‘significance’, referring to absolute change and not proportional change.

(e) Some of the less successful responses referred to reducing systematic errors or suggested a way to reduce errors. Others suggested increasing sample size and repeating the investigation.

(f) The more successful responses explained how increased glucose from photosynthesis would be used to make more ATP from respiration, and that this would be used by the plant for growth.

Question 20

Most students were able to identify communication and collaboration links, as well as development links in the article. *The less successful responses* struggled to explain how the ideas in the article demonstrated the SHE key concept.

Question 21

(a) Many students could not articulate a clear understanding of heterotrophs and autotrophs.

The less successful responses correctly explained why fungi are heterotrophs, but then neglected to explain why fungi are not autotrophs. Other less successful responses described autotrophs as organisms able to create or produce energy.

(b) Most students answered this question correctly.

The most common less successful response was ‘cytoplasm’.

(c) Most students answered this question correctly by describing exocytosis.

The less successful responses confused details of endocytosis and exocytosis, or stated that the vesicles leave the cell.

(d) Most students answered this question correctly.

Question 22

(a) (i) The less successful responses did not explain the link between sweating and reduced blood volume.

(ii) The less successful responses described the blood vessels moving closer to the skin, rather than blood flow to the skin surface increasing.

(b) Most students answered this question correctly.

(c) Most students answered this question correctly.

(d) The less successful responses did not clearly describe how insulin decreases blood glucose level.

(e) (i) Most students correctly identified the effect of increased water consumption on blood osmolarity. The less successful responses did not articulate why blood osmolarity decreased.

(ii) Very few answers received full credit for this question. The less successful responses did not clearly state the effect on blood volume or blood osmolarity, or described the opposite response to increased consumption of water.

Question 23

(a) (i) Most students answered this question correctly.

(ii) Most students answered this question correctly.

(b) Most students answered this question correctly. The less successful responses described a mechanism that maintains reproductive isolation (e.g. temporal isolation).

(c) Some of the less successful responses did not state that DNA-DNA hybridisation is conducted between two species. Others described a link between separation time (not temperature) when re-heating the DNA and the relatedness of species.

(d) The most common less successful responses described convergent evolution, or divergent evolution, and omitted many key details in the speciation process.

(e) The less successful responses described geographical isolation.

Question 24

(a) The more successful responses correctly identified that cloning produces genetically identical cells, and thus maintains a low genetic diversity. The less successful responses stated that cloning reduces or decreases genetic diversity.

(b) This question was not answered well, with many incomplete or inaccurate descriptions of crossing over, independent assortment, or fertilisation. As the question asked for descriptions, simply naming these processes did not receive credit.

(c) The more successful responses explained that the Cavendish banana plants are more susceptible to the fungus due to their low genetic diversity.