2023 Biology Subject Assessment Advice

Overview

Subject assessment advice, based on the 2023 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. In addition, teachers should guide students to ensure they do not exceed the word count or page limit for specific tasks
* 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:

* ensuring students are including the appropriate components of the report to the word count or page limit. Teachers are reminded that in investigation reports the introduction including the hypothesis and all variables (independent, dependent, constant, and their explanations), any summary or analysis of the results, and evaluation of the procedure and conclusion are included in the word count. Students who choose to use tables to organise their argument or analysis rather than include this information in the body of the text, e.g. when writing about the experimental variables, should be aware that this information is included in the word count. The use of appendices e.g. for including raw experimental data or a set of calculations, should be kept to a minimum and does not contribute to the student grade
* being careful not to over-scaffold tasks, especially if undertaking completion practicals, to ensure students have 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 have clear reference to Biology, not other sciences
* assisting students to choose topics that will enable them to explore the connection between society and science, and not simply regurgitate biological information, for example a generic CRISPR-Cas 9 or Cancer focus will not enable the student to critically examine this connection
* 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
* choosing tasks that enable students to best demonstrate their biological knowledge and ensure tasks sheets have clear intent and purpose. For example, the catalase practical may be simple, however, it could limit the ability of a student to demonstrate their ability to analysis data and evaluate procedures, especially in the context of deconstruction and design tasks, which is required to be outcome uncertain
* not requiring students to include extensive statistical analysis of the data which is not a requirement of the subject outline. When used incorrectly, this can impact the understanding demonstrated by the student.

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; clearly showing knowledge in relation to all the types of variables, including considering a single independent 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 justification
* for the materials chosen, including, for example, details of equipment and brands
* for the key steps of 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 few 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)
* analysed the results clearly and explicitly, connecting to the relevant biology without the use of distractors, such as r2 values and other statistical analysis, which is not required (IAE3)
* constructed a critical and highly effective evaluation of the investigation; identified potentially 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, and the key terms associated with these (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 focus on definitions 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 simplistic mind map as the format for the deconstruct but did not include much detail 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 (IAE2)
* missing appropriate titles and units on graphs and tables (IAE2)
* not referencing the average, or how the average was determined (IAE2)
* not employing appropriate column and row structure in constructing the data table (IAE2).
* incorrectly using significant figures, especially when calculating averages (IAE2)
* repeating units in each cell rather than in the heading of the column (IAE2)
* displaying graphs inappropriately, often using the wrong format, with line of best fit missing or not accurately drawn (IAE2)
* displaying incorrect use of scales on the axis (IAE2)
* 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)
* did not provide a specific explanation for why variables must be controlled, often using very generic description rather than linking to how it might affect the data (IAE3)
* lacked limitations to conclusions or provided inappropriate descriptions. Often referred to limitations of the method or just repeated the need to increase the number of trials, or incorrectly referred to external factors such as running out of materials or time to conduct the experiment (IAE4)
* showed a lack of understanding of terms such as reliability, precision, accuracy, and validity. Often wasted words by simply providing definitions of these terms rather than linking to the actual data collected or the specific investigation (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). Often reports were formulaic, copied and pasted and not specific to the investigation
* identified the sources of potential random and systematic errors incorrectly and/or mixed them up. Often referenced mistakes in the method rather than sources of uncertainty (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 (KA3)
* linked SHE Key concepts to biology not related to the subject outline (KA3)
* often the SHE Key Concept was not identifiable as it was not explicitly introduced or explained, or the work considered all concepts and so did not address them with sufficient detail (KA3)
* referencing was often incomplete and limited (KA4)
* the topic was inappropriate, not well chosen, or lacked sufficient connection to a SHE Key concept, e.g. generic topics such as CRISPR-Cas 9 or DNA manipulation (KA3).

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 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 is broad and deep across the topic and tests do not have questions testing the same concept multiple times in the same task
* including questions that are not familiar in context to the student, enabling students to demonstrate their application of their knowledge and understanding more effectively
* ensuring 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
* ensuring the time allocated for a supervised SAT has an appropriate number and type of questions included (KA1/KA2)
* ensuring that Science Inquiry Skills and Science as a Human Endeavour questions are sufficiently represented across the folio of tasks
* providing 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 the specific features being assessed in the task, to ensure the result is reflective of student ability and the relevant achievement grade
* providing opportunities for students to do SATs using an online platform to better prepare them for assessment type 3
* ensuring 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)
* had logical answers that directly responded to the question in a concise and accurate manner with an appropriate amount of detail to obtain full credit (KA4)
* used key terminology effectively to provide well-considered answers that had sufficient information 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 (multiple choice questions, short answer questions, SHE, and science 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 and/or the SHE key concepts (KA3)
* answered science inquiry questions with appropriate detail and correctly by using key concepts and associated terminology highly effectively (IAE3/KA1/KA4).

The less successful responses commonly:

* answered basic definition or recall type questions either incorrectly and/or inconsistently, 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 source or stem of the question, or incorrectly applied knowledge of a concept to a question (KA1/KA2)
* used general terms to answer questions, rather than the correct biological terminology, and had answers that were not well structured or included contradictory information, suggesting the concept being tested was not well understood (KA1/ KA2/KA4)
* paraphrased the question rather than answering it or misinterpreted the meaning of the question and therefore provided an irrelevant answer (KA1/KA4)
* were not able to determine the difference in the level of detail required in “describe” and “explain” questions (KA1/ KA2)
* addressed SHE type questions with minimal detail, as they referred to generic statements, rather than specifically using the information provided in the stem of the question (KA3)
* were not able to use science inquiry skills terms, such as precision, random error, or accuracy correctly, and either were not able to provide an answer or incorrectly connected terms to a type of error (IAE3/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 the more capable students will show a distinct preference for the correct response. In 2023, the top students showed a clear preference for the correct response in all the multiple-choice questions. Feedback is provided below for questions in Section 1 that challenged a significant proportion of the cohort.

Question 3

Fewer than half of the students were able to determine that the mutated DNA strand would code for the same amino acids, and therefore have no effect on the resulting protein.

Question 4

Nearly one-third of the students thought that fungal cells are prokaryotic.

Question 5

Many students thought that Process C could be meiosis, indicating that they may have confused the terms haploid and diploid.

Question 6

This question was challenging. The most popular incorrect response was that the cells contain 16 pairs of chromosomes at the start of prophase II. The separation of the members of homologous chromosome pairs occurs in meiosis I (the ‘reduction’ division).

Question 8

Less than a third of students showed a good understanding of exocytosis and/or many students did not realise that synapses are not effectors.

Question 9

Approximately half of the students thought that less urine would be produced or that it would be more concentrated.

Question 15

Only students in the top two deciles showed a clear preference for the correct answer, indicating that the terms precision, accuracy, and resolution, as described in the subject outline, are poorly understood.

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) *The less successful responses* commonly included ‘enzyme’ or ‘RNA’.

(b) *The less successful responses* were either vague or did not link their question to RNA, instead focusing on amino acids.

(c) *The less successful responses* missed the connection between shape and function.

(d) *The less successful responses* referred to the role of RNA in catalysing reactions, despite the requirement of the question.

(e) *The more successful responses* were able to connect a feature of mitochondria or chloroplasts with endosymbiotic theory.

*The less successful responses* confused mitochondria and chloroplasts as independent organisms or discussed fossil evidence for prokaryotes existing before eukaryotes.

Question 17

(a) *The less successful responses* described DNA replication.

(b) This question was generally answered well.

(c) *The more successful responses* articulated that the TLR7 protein has a 3D shape that is complementary to the shape of molecules on the HPAI virus.

*The less successful responses* referred to active sites, or neglected to connect the shape of the TLR7 protein to other pathogens.

(d) *The less successful responses* claimed that sequencing the genome would enable researchers to identify whether the TLR7 gene was present in the black or mute swan, despite the source stating ‘the TLR7 gene was present in all species that were tested’.

(e) *The more successful responses* comprehensively connected the need to implement protection measures for the black swan to social and economic considerations, such as impacts to the farming/agricultural industries.

Question 18

This question had the lowest mean mark for Section 2.

(a) *The more successful responses* indicated an understanding that an individual inherits one member of a homologous chromosome pair from each parent, and thus were able to explain that the mother had inherited the same form of the marker from each parent, whereas the father was heterozygous.

(b) *The more successful responses* disagreed with the lawyer and were able to provide evidence from the electropherogram for at least one of the markers.

(c) *The more successful responses* indicated that a small number of markers provided a less convincing ‘match’.

*The less successful responses* provided vague descriptions of DNA profiles being ‘inaccurate’.

(d) *The more successful responses* referred to privacy, confidentiality, or informed consent.

Question 19

(a) *The less successful responses* did not mention aquaporins which are clearly stated in the subject outline.

(b) *The less successful responses* used terminology loosely, such as mentioning ‘concentration’, without being specific. The roles of a semi-permeable membrane and a concentration gradient in osmosis was often not well understood.

(c) *The more successful responses* linked internal membranes to increased surface area.

*The less successful responses* did not explain how the increased surface area contributes to an increase in the rate of photosynthesis.

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

(ii) *The less successful responses* made vague reference to weather conditions or temperature.

(iii) *The more successful responses* indicated the need to increase the sample size and calculate the

average.

(e) *The less successful responses* stated that if stomata were open wider the absorption of light would increase.

(f) *The less successful responses* made no reference to respiration and its effect on the net release of oxygen.

(g) *The more successful responses* stated that a low stomatal density would reduce water loss.

(h) *The more successful responses* discussed the problem, solution, and societal impacts in reasonable depth.

*The less successful responses* simply repeated information from the source and did not provide a link between science and society.

Question 20

This question had the highest mean mark for Section 2.

(a) The most common incorrect response was anaphase.

(b) *The less successful responses* did not *describe* a source of genetic variation, although most of them identified mutation.

(c) This was generally answered well.

(d) This was generally answered well.

(e) *The less successful responses* did not specify that the mitotic index in cancer tissues would be higher than for most non-cancer tissues.

Question 21

(a) *The less successful responses*, instead of referring to enzymes or proteins, mentioned cells denaturing.

(b) *The less successful responses* did not recognise that the thermostat had been reset to approximately 40°C, and so a temperature of 38°C would result in a response to increase the temperature.

(c) *The less successful responses* described vasodilation as blood vessels moving closer to the skin, rather than blood flow being diverted.

(d) (i) This was generally answered well.

(ii) *The less successful responses* were confused about the role of ADH, and/or referred to blood osmolarity incorrectly.

Question 22

(a) This was generally answered well.

(b) *The less successful responses* stated ‘nucleus’.

(c) *The more successful responses* stated a factor from the subject outline.  
*The less successful responses* stated an example, not a factor.

(d) *The less successful responses* stated ‘bias’ or ‘poor memory’ without explaining the effect on validity. Some confused accuracy with validity.

(e) *The less successful responses* addressed DNA modification, when the question specifically stated histone modification.

(f) *The more successful responses* recognised that the level of CO2 in the blood increases, and they were then able to correctly link this to a decrease in blood pH and a subsequent increase in breathing rate.

(g) (i) This was generally answered well.

(ii) *The more successful responses* described the role of glucagon in restoring a low blood glucose

level to normal.

Question 23

(a) *The less successful responses* did not state that genetic drift would reduce the size of the gene pool.

(b) *The less successful responses* did not explain how DNA-DNA hybridisation may be used to determine the relationship between species.

(c) *The less successful responses* stated an effect of human activity, rather than a human activity.

Question 24

(a) *The less successful responses* did not state that there are many mitochondria per cell, and/or did not make any reference to the role of PCR in amplifying DNA.

(b) *The more successful responses* stated that 150 years was not sufficient time for many mutations to occur.

(c) (i) This was generally answered well.

(ii) *The less successful responses* simply stated that interbreeding is prevented, but did not explain how

this maintains separate species.

(d) *The less successful responses* confused secondary succession with natural selection and speciation. They also did not make the point that species alter their (living and non-living) surroundings.