2021 Biology Subject Assessment Advice

Overview

Subject assessment advice, based on the 2021 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

Assessment Type 1: Investigations Folio

The Investigations Folio needs to include a minimum of 2 practical tasks and one Science as a Human Endeavour investigation. In the practical investigations, 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. These tasks do not carry individual weightings.

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

Teachers should ensure that they are using the current subject outline and the current performance standards to assess their students’ work.

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 factors could be investigated (IAE1)
* constructed hypotheses using appropriate scientific conventions (IAE1) and were also able to highly effectively link the relevant Biology to their analysis, and provide explanations for how the hypothesis was supported (or not) (IAE3)
* using their deconstruction, developed a clear, highly logical design to investigate one aspect of the problem, identified in their own deconstruction in which a single variable was manipulated (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 (e.g. reasons for choosing a particular range of temperatures, or choice of enzyme or the volume or concentration required for a particular solution) (IAE1)
* identified relevant factors appropriate to the investigation which could not be controlled and why they could not be controlled (IAE1/KA4)- these were specific and not generic
* designed an 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)
* followed the specifications that are shown in the subject outline for a practical report including the word count and required elements and therefore recognised that the introduction of their investigation report needed to be concise and relevant and that it should include the hypothesis and variables which is a part of the 1500-word count (KA4)
* presented the data in a clear manner that was highly accurate. Use of titles, units etc. were of consistent accuracy. Graphs were well presented, with accuracy and of appropriate size (IAE2)
* demonstrated a highly effective ability to analyse the data (all of, including outliers), critically with depth and accuracy (IAE3). In addition, they were able to link the trends to relevant biological concepts (KA1)
* able to explain possible sources of uncertainty related to outliers in the data, or if the trend of the data was not as would be expected (IAE3)
* able to critically and highly effectively evaluate the investigation for potential relevant sources of errors; both random and systematic 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)
* when discussing the errors, used the terminology highly accurately and effectively (IAE4/KA4)
* limitations to the conclusions that were provided were highly relevant, and not simply a repeat of the evaluation of errors (IAE3)
* in both the practical reports and SHE Investigation the relevant biological knowledge was clearly evident and was well explained and referenced effectively (KA4)
* explored in the Science as a Human Endeavour report an appropriate and contemporary topic linked to the Stage 2 Biology subject. The biology was well explained and there was clear and detailed connection between science and society. 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 definition and with limited link to the design, and little or no justification about how the factors need to be considered in the design (IAE1)
* designed investigations with multiple independent or dependant variables (IAE1)
* ‘deconstructed’ a problem for which the outcome was well-known (e.g. the effect of temperature on enzyme activity) or used a ‘design’ that simply repeated existing experiments (e.g. using potato cubes and testing surface area) (IAE1)
* failed to use a suitable sample size and offered limited and often unclear instructions for the method (IAE1)
* provided a hypothesis where the independent and dependent variable were not identifiable (IAE1)
* variables were generally listed and not explained in relation to how they could affect the data (IAE1/IAE4)
* data presentation was often not to convention:
* 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
* graphs were often of 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 discussions that lacked clarity that suggested the hypothesis was partially supported, rather than explaining that the hypothesis was not supported and then explain that some of the data was consistent with the Biology or expected trend (IAE3)
* provided an overview of the data, with little reference to the actual data, or to the relevant Biology (IAE3)
* did not provide or described inappropriate limitations to conclusions. Often just repeating the need to improve sample size or increase the number of trials or incorrectly referred to running out of time or not having enough room to conduct the experiment (IAE4)
* showed a lack of understanding of terms such as validity, reliability, precision, and accuracy (IAE4)
* used generic terms and/or only definitions when attempting to assess errors and their effect on the data and made no/little reference to the actual data (IAE4)
* unnecessarily discussing improvements or enhancements, a requirement that is not in the current subject outline
* included an abstract or appendices in their report instead of including anything that is relevant in the appropriate part of the report itself (KA4)
* in the Science as a Human Endeavour (SHE) report, focused on the biology rather than having a focus on the 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 chosen by the student for the SHE report was often not ideal, and the connection to Biology was weak at best. Some topics chosen seemed better suited to other science courses such as Chemistry.

Other comments

Teachers are reminded that copies of research materials and/or the evaluation of source material is no longer part of the evidence required in Assessment Type 1 and should not be included in uploaded materials.

Teachers are reminded that students should include on the report the word count and that students need to be concise when writing their reports. Reports that exceed the word count should expect to be penalised. The deconstruction and design should be contained within four single sided A4 pages, and must be legible. Shrinking of deconstructions from A3 to A4 makes the work difficult to read and is not consistent with the requirements of the subject outline.

It is a requirement of the subject outline for students to have an opportunity to deconstruct a problem and design an investigation where the outcome is uncertain. Some common biology practical e.g. activity of catalase and surface area/osmosis potato cube practicals, provide less opportunities for students to effectively design an experiment where the method is not simply a copy of another. Teachers are encouraged to consider the focus of their practical investigations and to ensure the concept of outcome uncertain is achieved in their assessments.

Teachers should be careful not too over-scaffold tasks, especially if undertaking completion practicals to ensure students have the opportunity to show evidence for the higher level of performance. Over scaffolding restricts the student from showing their critical thinking and ability to analyse and evaluate.

Choice of Science as a Human Endeavour topics should be linked to the Stage 2 Biology subject outline, and should have clear reference to Biology, not other sciences.

It is recommended that teachers include an assessment of all the specific features that are relevant to the assessment type in their PSR.

The specific features on the PSR should be congruent with what is assessed in the tasks and with what is identified in the LAP.

Assessment Type 2: Skills and Application Tasks

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.

These tasks do not carry individual weightings.

The more successful responses commonly:

* were able to effectively answer a range of multiple-choice questions including application and problem‑solving scenarios (KA1)
* planned their written-response answers, then responded directly, concisely and accurately with the appropriate amount of detail to obtain full credit (KA4)
* analysed data accurately and clearly, thus showing their understanding of concepts (KA1, IAE3)
* was found in sets of evidence where well-designed tasks were used, and that included a range of question types (multiple-choice questions, short answer questions, SHE and inquiry questions), that covered a broad range of the concepts in the topic being assessed, and that were set in a variety of familiar and application 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)
* utilised the information in the stem of the question to develop a clear, coherent and relevant responses to a wide range of questions, with varying levels of difficulty (KA1, KA2, KA4)

The less successful responses commonly:

* had difficulty with both basic definition or recall type questions, 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)
* were found in tasks that had a large proportion of basic ‘recall’ questions and straight forward ‘application’ questions and hence the students did not have the opportunity to demonstrate a high level of understanding (KA1, KA2)
* provided limited opportunities to demonstrate understanding of the interaction between science and society (KA3) or inquiry skills (IAE2, IAE3, IAE4)
* paraphrased the question rather than answering it or misinterpreted the meaning of the question and therefore provided an irrelevant answer (KA1, KA4).

Other comments

Teachers are reminded that:

* weightings are not attributed to individual tasks or percentages to individual specific features. The whole set of student evidence in Assessment Type 2 should be used to make the assessment decision and construct the PSR.
* the subject outline requires SATs to provide sufficient opportunities for students to demonstrate evidence of their understanding of Science as a Human Endeavour and Science Inquiry Skills.
* SATs should be designed to include a range of question types that allow students to apply and transfer knowledge in new and unfamiliar contexts. Highly scaffolded questions and those requiring recall, limit achievement at the higher levels.
* when marking student work:
* answers that have incorrect and correct statements need to be treated by teachers as incorrect
* student answers that are not well expressed, then this needs to be reflected in the assessment of KA4
* a decision for a particular specific feature in the PSR (for example KA3 or IAE3) should not be based on a single 2 to 4-mark question in one Skills and Applications Task. There should be enough evidence across the tasks to discriminate between student evidence of different quality.
* assessment of the communication of knowledge and understanding of biological concepts and information, using appropriate terms, conventions and representations is integral to the assessment of all student responses in Skills and Applications task questions. No separate marks should be awarded for the quality of the communication.

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.

When considering the data and drawing comparisons between examinations in different years it is important to keep in mind that:

* in 2018 a new Biology curriculum was introduced, and this included a change to the examination format. This was the first significant change to the format since 2006
* there was disruption to teaching due to the pandemic in 2020 and also that 2020 was the first year that an electronic examination (e-exam) was set for Biology.

The mean score for the 2021 examination was 43.6%, which compares with previous means of 47.3% (2020), 54.0% (2019), 51.4% (2018), 59.4% (2017), 58.1% (2016), and 59.3% (2015).

The mean marks for Sections 1 and 2 were 54.1% and 42.1% respectively.

Section 1: Multiple-choice Questions

Multiple-choice questions vary in difficulty from easy knowledge (recall) to difficult knowledge and problem solving. This variation in question difficulty is reflected in the range of the question facility. In 2021 the facilities ranged from 37 to 87 (the facility for a question is the percentage of students who gave the correct response). Many questions are intentionally discriminating so that more capable students will show a distinct preference for the correct response. In 2021, the top students showed a clear preference for the correct response in all of the multiple-choice questions.

Question 1

Most students answered this question correctly.

Question 2

Most students answered this question correctly.

Question 3

The facility for this question was 45%. While the correct alternative was clearly favoured by students in the top deciles, the incorrect alternatives were chosen with almost equal frequency. It may be that many students did not read the stem of the question carefully, and simply chose a statement that they thought was correct.

Question 4

Most students answered this question correctly.

Question 5

Slightly fewer than half of the students answered this question correctly. The first and last alternatives were the most popular incorrect selections, indicating that many students could not distinguish between the terms ‘autotrophic’ and ‘heterotrophic’.

Question 6

More than 70 percent of students were able to determine that the diagram depicted meiosis, but barely more than half of that group (mostly the top 3 deciles) distinguished that it was a plant cell.

Question 7

This question required students to use the information provided. 44 percent of students chose the correct alternative

Question 8

Slightly fewer than half of the students answered this question correctly.

Question 9

Most students answered this question correctly.

Question 10

Slightly fewer than half of the students answered this question correctly. The large number of students who selected the third alternative indicates that the role of the CNS in a reflex response is not well understood.

Question 11

This question was poorly done, with a facility of 40%.

Question 12

Most students answered this question correctly.

Question 13

This question had the highest facility (87%).

Question 14

This question had the lowest facility (37%), with the top decile showing a clear preference for the correct alternative.

Question 15

Slightly more than half of the students answered this question correctly. It seems that the concepts of random errors (and how to minimise their effect) and systematic errors (and how to identify them) are poorly understood.

Section 2:

The mean mark for Section 2 was 42.1%. As with 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.
* Many students ignore the instruction to give one fact or reason and, instead, give multiple answers. Students are reminded that in this circumstance any single wrong answer will mean that the answer cannot be awarded full marks.
* 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 are familiar with an autocorrect function when inputting text are reminded that, in an 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 concept when attempting to answer the question.
* Accessing the sample Biology examination and utilising all tips and practice opportunities will enable students to focus more on the biology of the questions than the technology required to respond to them.

Question 16

(a) Most students were able to link the change in amino acid sequence to a change in the shape of the protein. The more successful responses then explained that a change in the shape of the protein would inhibit the function of p53. The less successful responses stated that function would be affected/changed, without qualification.

(b) Most students correctly described the function of the cas9 protein and guide RNA. The less successful responses described the use of labelled probes rather than a guide RNA molecule.

(c) (i) The more successful responses explained an ethical issue with a clear elaboration focusing on the collection of samples. The less successful responses were vague or stated more than one ethical issue.

(ii) The more successful responses explained that the large costs involved in the collection of the genetic information would be an economic burden on the government/taxpayer. The less successful responses focused on treatments and costs associated with them.

Question 17

(a) Generally answered well.

(b) (i) Most students recognised that the primer is complementary to the start of the target sequence to be amplified. The more successful responses recognised that the primer provides the starting point for the addition of free nucleotides by DNA polymerase. The less successful responses were very general and that did not state the specific role of primers.

(ii) Generally answered well. The less successful responses mentioned that DNA polymerase creates the hydrogen bonds between the two DNA strands.

(c) Most students understood the role of heating in separating the DNA strands. The less successful responses stated that cooling was required to enable free nucleotides to bind or neglected to explain the ‘repeated’ aspect of the question.

(d) The more successful responses explained that a comparison was not possible to confirm the authenticity of the sample, since the thylacine is extinct. The less successful responses did not mention the need for comparison.

Question 18

(a) Most students answered this question correctly.

(b) The more successful students described the pairing and separation of homologous chromosomes in meiosis I, followed by the separation of sister chromatids in meiosis II. The less successful responses neglected to mention homologous chromosomes, stated that the cells are diploid at the end of meiosis I, or simply described meiosis.

(c) Generally answered well. The less successful responses referred only to the same amount of DNA and ignored that it is also identical.

(d) The more successful responses recognised that the degree of variation was higher in the molly for a variety of reasons. The less successful responses neglected to mention that mutation was a source of variation in bacteria.

(e) Very few students recognised or stated that the Amazon molly reproduces asexually by mitosis.

(f) The more successful responses linked the missing or switched off genes to absent proteins (gene products). Very few students went on to explain that these absent proteins prevent meiosis (gamete formation).

(g) Most students recognised that increased DNA methylation switches off genes. The more successful responses provided an elaboration explaining how methylation switches off genes.

Question 19

(a) Most students answered this question correctly.

(b) The more successful responses linked survival of organisms to a range for one of the examples of harsh conditions listed. The less successful responses did not refer to one of the examples or did not state that tolerance limits refer to a range of conditions.

(c) Most students answered this question well.

The less successful responses described exocytosis as ‘active transport’.

(d) Most students recognised that ATP provides energy for cells.

The more successful responses added that this energy is released by the conversion of ATP to ADP and Pi. The less successful responses stated that the breaking of the bond between the phosphates releases energy. The subject outline clearly states that ‘energy is required to break chemical bonds and energy is released when new bonds are formed’.

Question 20

Question 20 had the highest mean mark of all questions in Section 2.

(a) Most students answered this question correctly.

(b) Most studentsrecognised that a larger gene pool increases a species’ chance of survival. The less successful responses stated that a larger gene pool helps organisms adapt.

(c) The more successful responses showed a clear understanding of the steps involved in natural selection - genetic variation, differential survival and reproduction, and altered gene frequencies over time - and applied them to the example in the question.

(d) The majority of studentscorrectly identified that specialisation leads to a reduction in the size of the gene pool. The more successful responses then linked this to an increased chance of extinction of the species.

Question 21

(a) Most students answered this question correctly.

The less successful responses added irrelevant information that made their answer incorrect.

(b) (i) The more successful responses correctly described the role of receptors, sensory neurons, and interneurons in the brain.

(ii) Less successful responses did not mention that taste receptors are specific, and that the brain is able to distinguish which receptor was stimulated.

(c) (i) The more successful responses identified informed consent as an ethical concern.

(ii) The less successful responses simply stated that salt could be harmful to humans.

(d) Less successful responses did not explain the effect on the data of a factor that could not be held constant.

(e) The more successful responses identified that the small sample size of five participants would impact the reliability of the data.

(f) (i) The less successful responses did not provide answer to one significant figure (consistent with the data provided).

(ii) The more successful responses stated a conclusion that linked the dependent and independent variables.

(iii) The less successful responses stated conclusions based on independent variables that were not part of the data in the question.

(g) The more successful responses stated that the conclusion only applied to the participants tested, or only applied to the type and concentrations of salt used.

The less successful responses commented on a source of error rather than a limitation of a conclusion.

Question 22

Question 22 had the lowest mean mark of all questions in Section 2.

(a) The less successful responses did not link the inability of people who have diabetes to produce insulin to the uncontrolled production of ketone bodies.

(b) The less successful responses did not describe the role of the brain in controlling breathing rate.

(c) The less successful responses did not realise that the brain would interpret and respond to an increase in ketone bodies in the same way that it would respond to an increase in carbon dioxide, as both result in a decrease in blood pH.

(d) The more successful responses correctly identified the role of gliflozins in the reabsorption and absorption of glucose into the blood.

(e) The more successful responses identified that both gliflozins and insulin reduce blood glucose level, and that treatment with both would likely result in the level being too low.

Question 23

(a) Most students answered this question correctly.

The less successful responses stated meiosis or binary fission or used a unique spelling that was ambiguous.

(b) (i) The less successful responses were unqualified, such as ‘temperature’ instead of ‘optimum temperature’.

(ii) See part (i).

(c) The less successful responses did not state that skin cells are specialised and/or did not explain why other cell types are not used.

(d) (i) The less successful responses simply suggested a reason for funding, with no elaboration, and/or did not make the link to who may benefit.

(ii) The more successful responses mentioned the importance of regulating safety and ethics.

(iii) The more successful responses explained the importance of unbiased, independent regulation.

Less successful responses stated that the researchers would be the most suitable monitors.

Question 24

(a) The more successful responses explained that bacteria reproduce asexually, and that the concept of interbreeding to produce fertile offspring cannot be applied to them.

(b) The more successful responses clearly outlined that the rRNA gene sequence is highly conserved or that it is found in all bacteria.

(c) The more successful responses stated that the mechanism was a post-zygotic barrier and that the hybrid offspring were inviable, meaning that they were unable to produce fertile offspring.