2020 Biology Subject Assessment Advice

Overview

Subject assessment advice, based on the 2020 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

While COVID flexibilities enabled teachers to adjust their Learning and Assessment Plans, the Investigations Folio still needed 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.

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.

These tasks do not carry individual weightings.

The more successful responses commonly:

* provided detailed evidence of their deconstruction within the maximum of four sides of an A4 page (IAE1/KA4)
* constructed hypothesises using appropriate scientific conventions rather than forms such as: “I guess that X will happen” or “The reaction will increase as the temperature rises because there is an increase in kinetic energy and velocity resulting in molecules reaching the activation energy and increasing the reaction of the enzyme.” (IAE1)
* provided an individual, creative, and thoughtful deconstruction of a problem for which the outcome was uncertain. (IAE1)
* from their deconstruction, developed a clear, logical design to investigation one aspect of the problem in which a single variable was manipulated (IAE1)
* produced a design which included a detailed list of materials and a method in a well-structured format and with sufficient detail that it could be implemented without further information. There were also justifications for the materials chosen and the method suggested. For example, reasons for choosing a particular range of pHs, or a specific number of samples for each concentration of plant hormone. (IAE1)
* identified factors which could not be controlled and why they could not be controlled (IAE1/KA4)
* included a blank data table with correct columns and headings (including units) that could be used to record the data collected. This provides evidence of both an understanding of sample size, measurement to be made and representation of data (IAE1/IAE2)
* made it clear where the four A4 pages of their deconstruction and design finished and where the report on their investigation began (KA4)
* recognised that the Introduction of their investigation report incorporating the hypothesis and variables is included in the 1500-word count and hence provided concise and relevant information (KA4)
* followed the specifications that are shown in the subject outline for a practical report (KA4)
* represented their data in a simple, concise manner using appropriate conventions for tabulation and graphing (IAE2)
* wrote analyses of their data which were logical and critical, rather than essentially just describing what the data table and/or graphs showed. They made reference to specific data points or specific trends in their analysis and linked the trends to relevant biological concepts. They made logical conclusions with clear justification based on the data they had collected (IAE3)
* undertook critical evaluation of the procedure they had used in their investigation by considering the likely random and systematic errors, rather than noting that they ran out of time, made mistakes reading measurements or dropping equipment. They connected errors to the effect they had on the data (IAE4)
* explored, in their Science as a Human Endeavour report, a contemporary direction of scientific research or innovation related to Stage 2 Biology and clearly linked it to one of the SHE key concepts. They narrowed their discussion down to one of the elaborations to provide evidence of their depth of understanding of the interaction between science and society rather than trying to cover the key concepts too broadly (KA3, KA4)
* in both their SHE task and their investigation reports, showed biological knowledge that was relevant to the topic and was detailed enough to be at Stage 2 standard (KA1)
* providing specific sources/evidence for each main point (KA4).

The less successful responses commonly:

* deconstructed a problem that had little connection to a Stage 2 Biology topic or even, in some cases, to a Stage 1 Biology topic (IAE1)
* omitted to identify the deconstruction question (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 pH on enzyme activity) or used a ‘design’ that simply repeated existing experiments (e.g. using liver and hydrogen peroxide) (IAE1)
* based their deconstruction and design investigation on a heavily scaffolded or structured ‘question and answer’ task sheet. This restricted the student’s potential to demonstrate depth in their problem-solving or creative deconstruction and design (IAE1)
* provided very vague deconstruction and design elements with an aim and hypothesis that were not specific and often included multiple variables (IAE1)
* failed to use a suitable sample size and offered sparse instructions for the method (IAE1)
* repeated much of the information from their deconstruction in the report of their investigation whereas a summary would be sufficient (KA4)
* represented data using tables which:
* did not employ appropriate column and row structure
* repeated units in each cell rather than in the heading of the column
* lacked a column for the average
* used a random mix of significant figures (IAE2).
* graphed results with:
* incorrect scales
* lack of labels or incorrect labels
* incorrect type of graph according to the data obtained. For example, using a bar graph when a line graph should be used, using a dot-to dot graph when a line of best fit should be used
* relied on graphing programs to graph the data without choosing the correct graphing parameters in the graphing program, hence creating a graph that was not the appropriate style (IAE2).
* 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. (IAE4)
* misunderstood that the limitations that are referred to in the Science Inquiry Skills section of the subject outline (Recognise the limitations of conclusions). They referred to aspects of the procedure such as running out of time or not having enough equipment, or group members not making correct reading. They have not recognised that any conclusion they could make was limited by the tests that they carried out. Examples of such limitations may include: only testing a small range of temperatures or pHs, having tested a single type of plant, hand sanitiser, or bacterium (IAE4)
* made conclusions which did not reflect the data that had been obtained (IAE3)
* exceeded the specified word count in their investigation report (KA4). Reasons for this included:
* putting an excessive amount of background research into their introduction
* not realising that the word count includes the hypothesis and any discussion of variables
* repeating the information in the data tables and/or graphs by describing them again in words rather than summarising the trend before analysing them
* 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)
* selected a Science as a Human Endeavour key concept such as ‘Development’ as the focus of their investigation, then only gave a history of the technique or innovative direction rather than relating it to the interaction between science and society (KA3)
* dwelt too much on the biological background of the chosen topic in the SHE report instead of showing evidence of the interaction between science and society (KA3/KA4)
* chose to investigate a contemporary topic that had little connection to Stage 2 Biology and hence they found it difficult to explain the biological concepts involved (KA4).

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.

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

Many teachers omitted a record of their assessment of KA3 in AT1, even though this is the prime Assessment Type for the assessment of this specific feature.

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 Applications 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:

* took time to read the stem of multiple-choice questions carefully to ensure that they understood exactly the intention of the question (KA1)
* planned their written-response answers, then responded directly, concisely but with the appropriate amount of detail (KA4)
* analysed data succinctly, thus showing their understanding of concepts (KA1, IAE3)
* emanated from students who had well-designed tasks that included a range of question types (multiple-choice questions, short answer questions and paragraph questions), that covered a broad range of the concepts in the section being assessed, and that were set in a variety of familiar and novel contexts (KA1, KA2)
* showed the ability to analyse scenarios or questions and then to use the information to demonstrate a clear understanding of the interaction between science and society (KA3)
* utilised the information in the Source material to develop a coherent response (KA1, KA2, KA4).

The less successful responses commonly:

* did not recognise that, in short answer questions, parts within a question were related and hence did not make use of the stem of the question for their answers or for the following parts of the same question (KA1. KA2)
* used general terms to answer questions, rather than the correct biological terminology (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)
* required students to respond to excessively long (15 mark) extended response questions which are often difficult for mid-range students
* did not have sufficient opportunity to show that they understood in depth the interaction between science and society because the task included relevant questions worth very few marks (3-4 marks) or, in some instances, no SHE questions at all, even though it is a requirement of the subject outline to assess SHE in AT2 (KA3)
* paraphrased the question rather than answering it.

Teachers are reminded that:

* 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 awarded for the quality of the communication.
* 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.
* 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.
* The subject outline requires a set of SATs should include opportunities for students to demonstrate evidence of their understanding of Science as a Human Endeavour and Science Inquiry Skills.

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 2020 examination was 47.3%, which compares with previous means of 54.0% (2019), 51.4% (2018), 59.4% (2017), 58.1% (2016), 59.3% (2015), and 55.4% (2014).

The mean marks for Sections 1 and 2 were 58.7% and 45.7% 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 2020 the facilities ranged from 28 to 93. (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 2020, the top students showed a clear preference for the correct response in all but one of the multiple-choice questions.

Question 1

Most students answered this question correctly.

Question 2

Although the facility for this question was 44, the incorrect alternative L was chosen by a significant number of students in all deciles. Even some of the more capable students seemed to overlook that anticodons are on tRNA, and that RNA molecules contain U, not T.

Question 3

Most students answered this question correctly.

Question 4

Most students answered this question correctly.

Question 5

More than half of the students answered this question correctly.

Question 6

Just under two-thirds of the students answered this question correctly. It required the application of biological knowledge in a new (unfamiliar) context.

Question 7

This question had the lowest facility, meaning that students found it to be the most difficult multiple-choice question. According to the subject outline, cells are either prokaryotic or eukaryotic, and the cell is the smallest independent unit of life. According to the cell theory, living things are made up of one or more cells.

Question 8

Fewer than half of the students answered this question correctly, however, students in the top 6 deciles showed a clear preference for the correct alternative.

Question 9

Approximately half of the students answered this question correctly. The most popular incorrect choice (L) indicates that many students knew the direction of travel of nerve impulses but were unable to correctly identify the type of neuron from the diagrams.

Question 10

Just under two-thirds of the students answered this question correctly.

Question 11

Just over one-third of the students answered this question correctly, with only the top decile of students showing a preference for the correct alternative. The most popular choice was alternative L, but dopamine molecules in the synaptic cleft will have no effect unless they bind to a receptor.

The responses to questions 8, 9, and 11 indicate that the nervous system is not well understood by many students.

Question 12

Just under two-thirds of the students answered this question correctly.

Question 13

Approximately half of the students answered this question correctly.

Question 14

This was the question with the highest facility.

Question 15

Fewer than half of the students answered this question correctly. The concepts of precision, accuracy, reliability, and validity of data appear to be poorly understood by the majority of students.

Section 2:

The mean mark for Section 2 was 45.7%. 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

Question 16 had the lowest mean mark of all questions in Section 2.

(a) Generally answered well.

The less successful responses stated that the probe was complementary, but did not state that it needed a complementary base sequence to part of the GHSP26 gene. Some stated that the probe was short, which wasn’t enough detail.

(b) The less successful responses did not mention that the probe would not be able to bind to the Bt toxin gene, even though they may have noted that its base sequence would not be complementary.

(c) The less successful responses:

· did not describe the steps in sequential order

· stated that the plasmid was inserted into the cotton plant

· did not give an example to explain how the GHSP26 gene was incorporated into the cotton plant

· described CRISPR.

(d) The less successful responses did not state that the genetic code is universal.

(e) The less successful responses discussed the process of transcription (sometimes as well as translation). Some explained the process of photosynthesis.

(f) The less successful responses did not recognise the reduced competition for the new pest.

(g) The more successful responses (about half) linked their answer to an unintended environmental consequence.

Question 17

(a) The less successful responses commonly stated primers 5 and 8, or primers 5 and 3.

(b) The less successful responses did not state that heat-resistant enzymes are needed in PCR to prevent denaturation when high temperatures are used.

(c) (i) Most students answered this question correctly, with the less successful responses not stating that the size of fragments affects their rate of movement.

(ii) The more successful responses mentioned multiple primer binding sites.

The less successful responses mentioned restriction enzymes.

(iii) Most students answered this question correctly.

(d) The more successful responses mentioned the idea of comparison.

Question 18

(a) Most students answered this question correctly.

The less successful responses named meiosis.

(b) Many students answered this question correctly, making an appropriate comparison.

The less successful responses stated that the number of chromosomes remains the same.

(c) The more successful responses recognised that crossing over occurs between non-sister chromatids of homologous chromosomes.

The less successful described independent assortment.

(d) The less successful responses used the term ‘active site’, and/or did not mention the importance of complementary shapes.

(e) The more successful responses stated that fertilisation restores the diploid number.

The less successful responses mentioned diversity and reproduction.

(f) (i) The more successful responses linked a reduced number of mitochondria with less energy available and identified mitochondria as the main source of ATP.

The less successful responses did not link energy release to mitochondria, and/or did not state that movement requires energy.

(ii) Most students answered this question well.

The more successful responses mention two membranes, cristae, and increased surface area.

The less successful responses mentioned processes instead of structural features.

Question 19

Question 19 had the highest mean mark of all questions in Section 2.

(a) Most students answered this question correctly.

The less successful responses stated ‘adrenaline’ or ‘protein’.

(b) Most students answered this question correctly.

The less successful responses described transport via neurons and the nervous system.

(c) Most students answered this question well.

The less successful responses described ‘fight or flight’, ignoring the role of adrenaline.

Question 20

(a) Most students answered this question correctly.

The less successful responses commonly included ‘chloroplast’ or ‘mitochondria’.

(b) Some students confused the terms ‘substrate’ and ‘product’.

(b) (i) The less successful responses included ‘oxygen’.

(ii) The less successful responses commonly included ‘ATP’ or ‘energy’.

(c) The less successful responses restated the equation, without any numbers.

(d) Most students recognised that fermentation requires no oxygen.

The less successful responses were unable to link this to the RQ value, and did not state that the number of carbon dioxide molecules produced in fermentation is different from the number produced in aerobic respiration.

(e) The less successful responses discussed aerobic respiration in unnecessary detail, without explaining how the process contributes to the production of ATP, or mentioning the reactants required.

Question 21

(a) Most students answered this question correctly.

The less successful responses stated ‘time’ without the units, or stated the units of the dependent variable.

(b) Less successful responses commonly identified Person 2.

(c) The less successful responses did not discuss the role of glucagon, or used the terms ‘glycogen’ and ‘glucagon’ incorrectly.

(d) Less successful responses did not link the features of the endocrine system with the need for glucose levels to continuously remain within tolerance limits.

(e) Most students were able to correctly identify SHE concepts.

The more successful responses made clear links with the interaction between science and society and the impact on people with diabetes.

Question 22

(a) Most students answered this question correctly.

(b) Many students were able to identify two sources of genetic variation.

The less successful responses did not provide adequate descriptions.

(c) Many students provided reasonable descriptions of natural selection.

The less successful responses referred to individuals ‘adapting’, or ignored the reference in the question to speciation.

(d) The less successful responses described pre-zygotic methods.

(e) (i) Most students were able to identify an appropriate technique.

The less successful responses included ‘DNA profiling’ and PCR (which is used for amplifying, not for comparing, DNA).

(ii) Less successful responses simply stated that there would be a difference in the DNA sequences, but did not state there would need to be three groups with distinct DNA sequences.

(f) Most students were able correctly identify a difference in mating behaviour or communication would make them a different species.

The less successful responses referred to factors that are not behavioural.

Question 23

(a) The less successful responses did not recognise that this was a ‘control’, allowing for comparisons to be made.

(b) Most students were able to correctly identify that gln was required for growth.

The less successful responses did not provide an appropriate justification and did not refer to the evidence provided by the results in test tube 1.

(c) Most students were able to state two relevant factors.

(d) (i) The less successful responses identified ‘random error’.

(ii) The less successful responses did not mention that a different result (after repeating the investigation) would indicate a systematic error.