Biology subject report

2022 cohort

February 2023

Queensland Government

QCAA
Queensland Curriculum & Assessment Authority

230033

For all Queensland schools

ISBN

Electronic version: 978-1-74378-235-4

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Introduction

Throughout 2022, schools and the QCAA worked together to further consolidate the new Queensland Certificate of Education (QCE) system. The familiar challenges of flood disruption and pandemic restrictions were managed, and the system continued to mature regardless.

We have now accumulated three years of assessment information, and our growing experience of the new system is helping us to deliver more authentic learning experiences for students. An independent evaluation will commence in 2023 so that we can better understand how well the system is achieving its goals and, as required, make strategic improvements. The subject reports are a good example of what is available for the evaluators to use in their research.

This report analyses the summative assessment cycle for the past year — from endorsing internal assessment instruments to confirming internal assessment marks, and marking external assessment. It also gives readers information about:

- how schools have applied syllabus objectives in the design and marking of internal assessments
- how syllabus objectives have been applied in the marking of external assessments
- patterns of student achievement.

The report promotes continuous improvement by:

- identifying effective practices in the design and marking of valid, accessible and reliable assessments
- recommending where and how to enhance the design and marking of valid, accessible and reliable assessment instruments
- providing examples, including those that demonstrate best practice.

Schools are encouraged to reflect on the effective practices identified for each assessment, consider the recommendations to strengthen assessment design and explore the authentic student work samples provided.

Audience and use

This report should be read by school leaders, subject leaders and teachers to:

- inform teaching and learning and assessment preparation
- assist in assessment design practice
- assist in making assessment decisions
- help prepare students for external assessment.

The report is publicly available to promote transparency and accountability. Students, parents, community members and other education stakeholders can use it to learn about the assessment practices and outcomes for General subjects (including alternative sequences (AS) and Senior External Examination (SEE) subjects, where relevant) and General (Extension) subjects.

Report preparation

The report includes analyses of data and other information from endorsement, confirmation and external assessment processes. It also includes advice from the chief confirmer, chief endorser and chief marker, developed in consultation with and support from QCAA subject matter experts.

Subject data summary

Subject completion

The following data includes students who completed the General subject or AS.

Note: All data is correct as at 31 January 2023. Where percentages are provided, these are rounded to two decimal places and, therefore, may not add up to 100%.

Number of schools that offered the subject: 441.

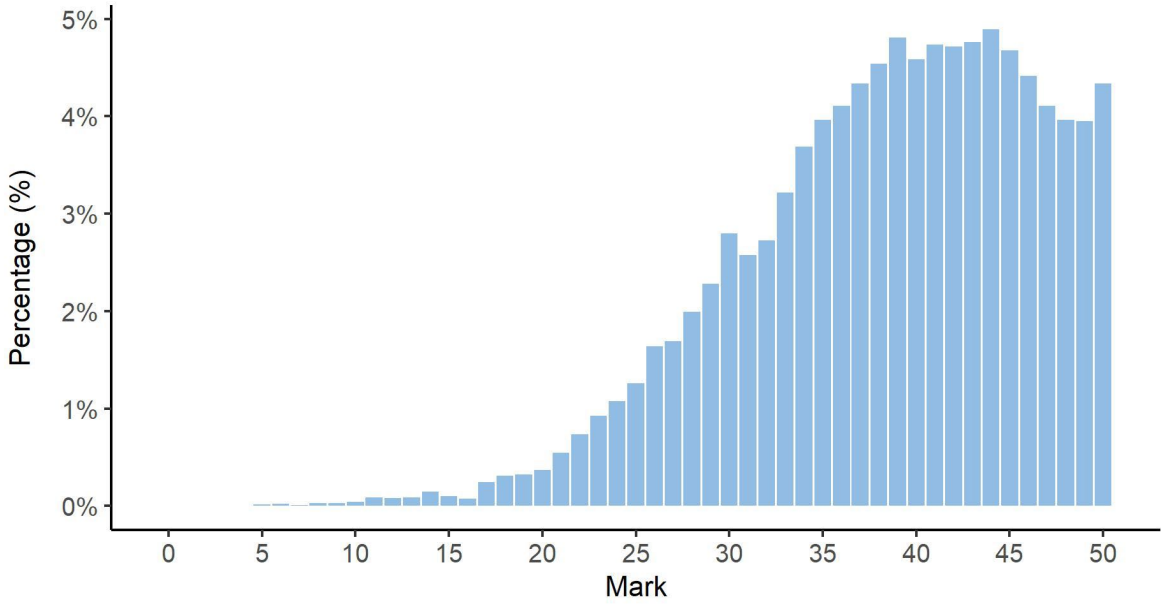
Completion of units	Unit 1	Unit 2	Units 3 and 4
Number of students completed	16 489	15 296	13 490

Units 1 and 2 results

Number of students	Satisfactory	Unsatisfactory
Unit 1	15 370	1119
Unit 2	13 812	1484

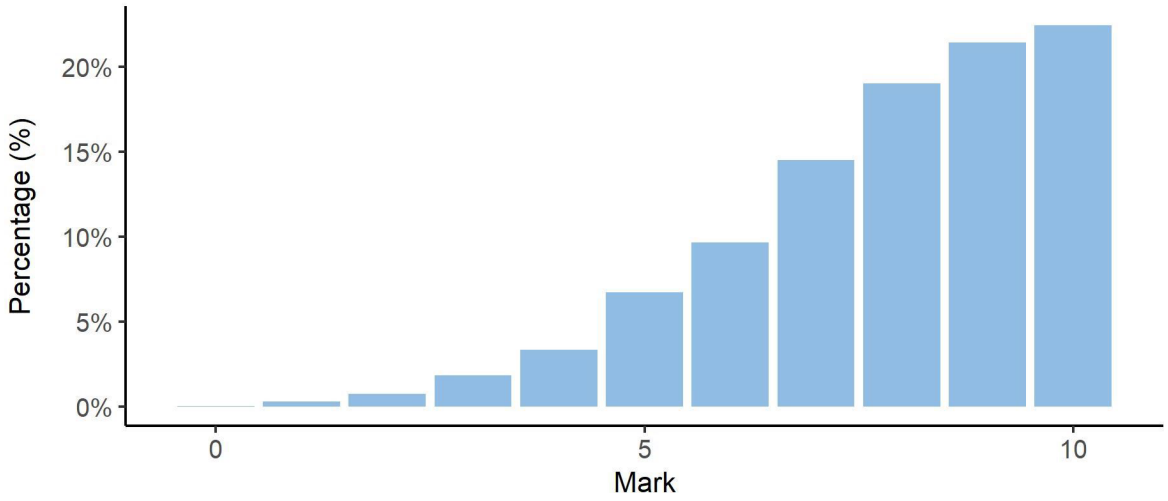
Units 3 and 4 internal assessment (IA) results

Total marks for IA

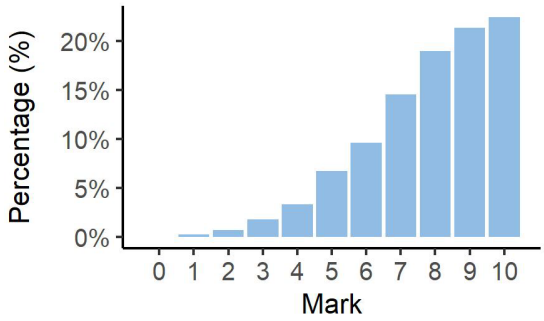


IA1 marks

IA1 total

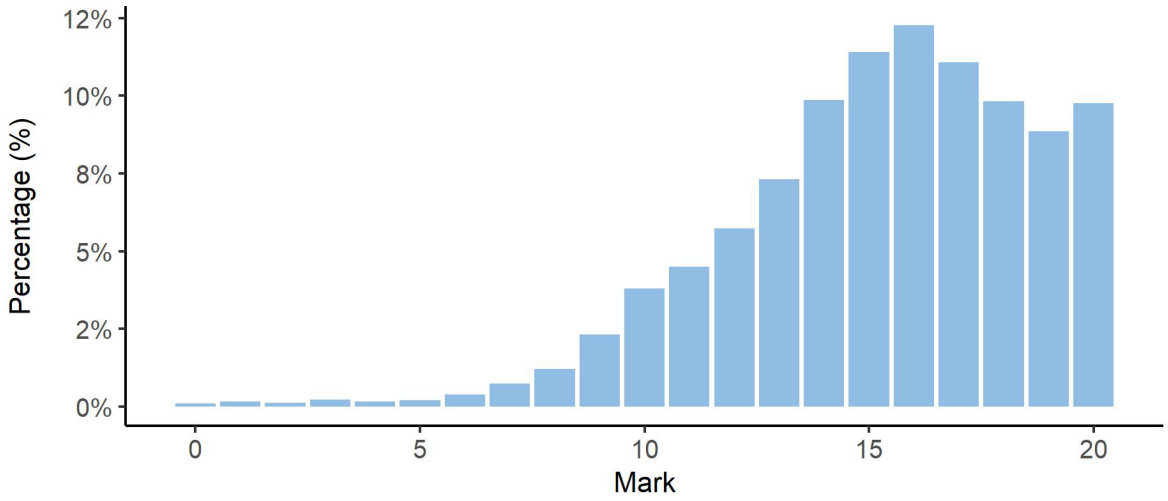


IA1 Criterion: Data test

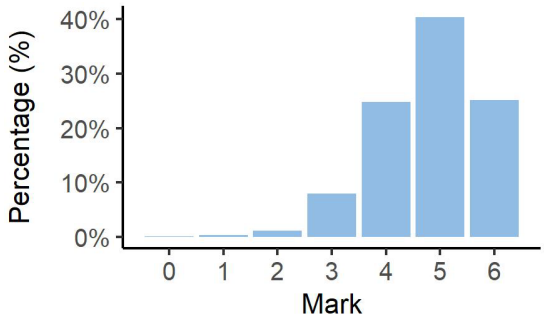


IA2 marks

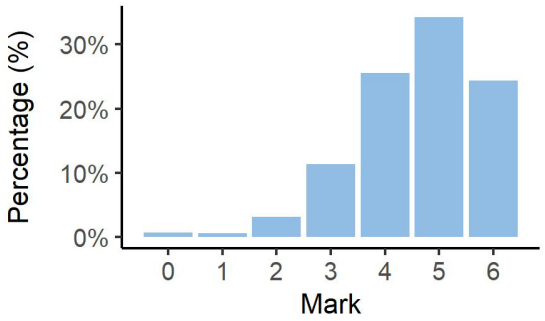
IA2 total



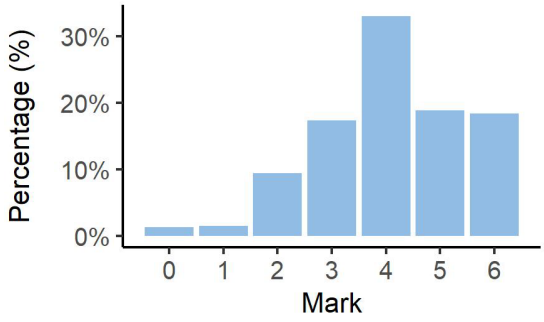
IA2 Criterion: Research and planning



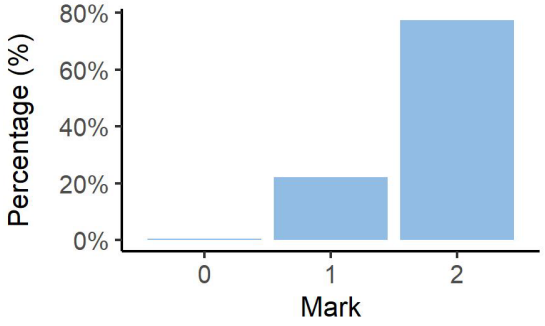
IA2 Criterion: Analysis of evidence



IA2 Criterion: Interpretation and evaluation

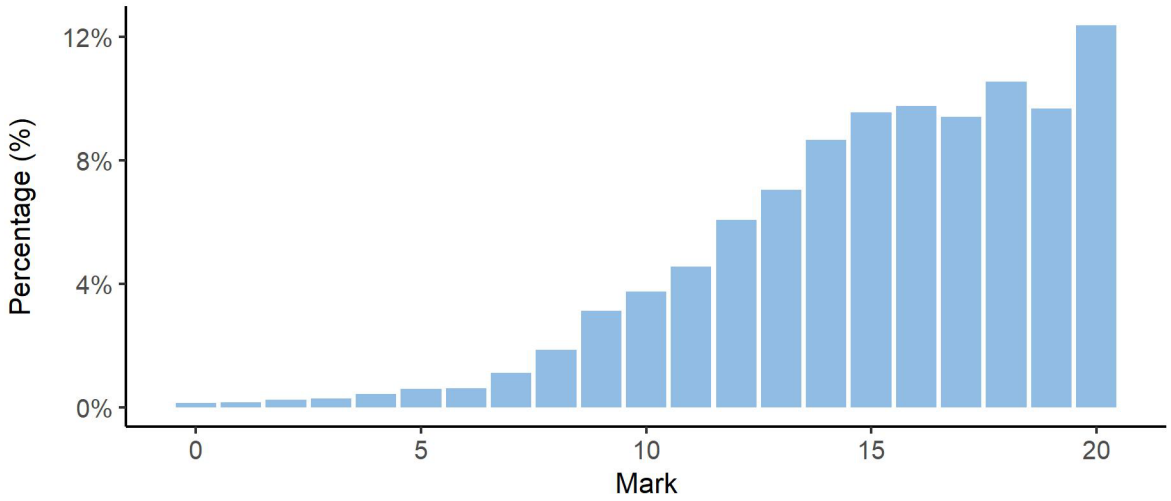


IA2 Criterion: Communication

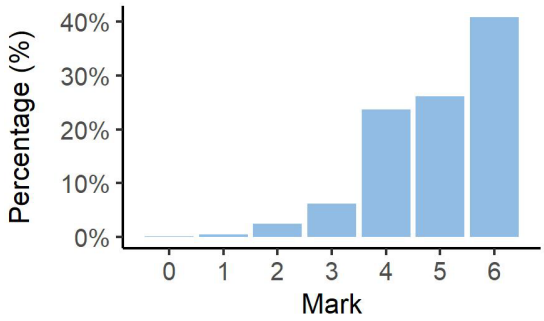


IA3 marks

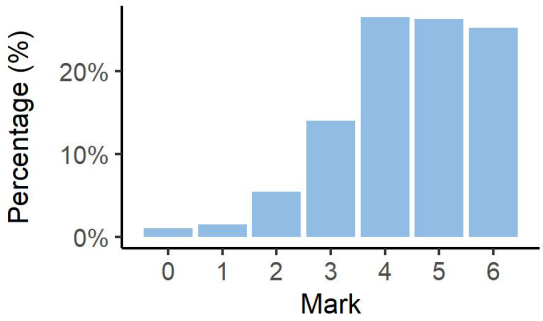
IA3 total



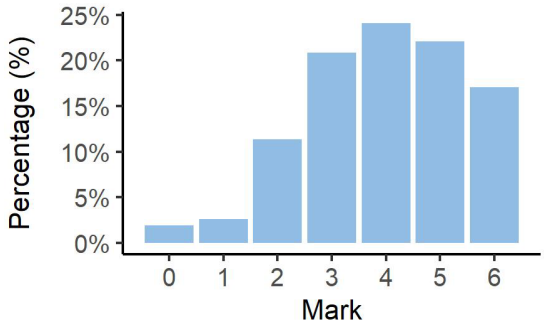
IA3 Criterion: Research and planning



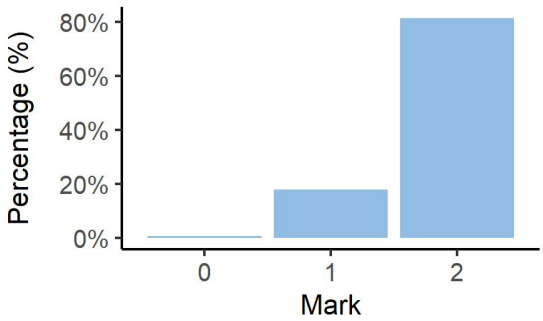
IA3 Criterion: Analysis and interpretation



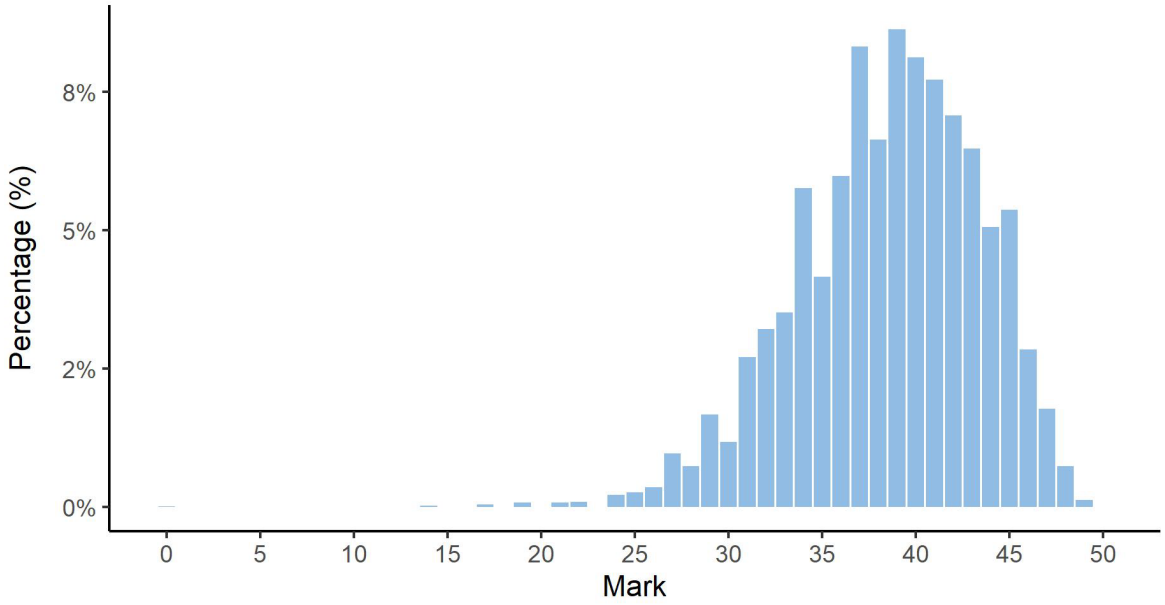
IA3 Criterion: Conclusion and evaluation



IA3 Criterion: Communication

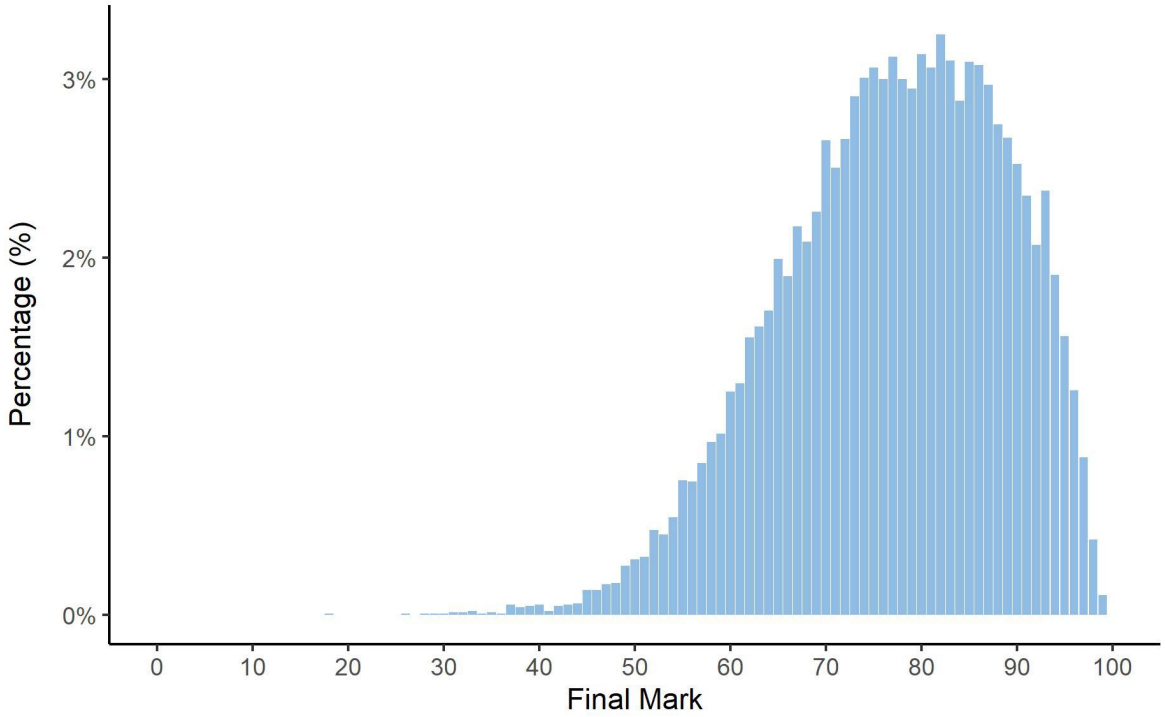


External assessment (EA) marks



Final subject results

Final marks for IA and EA



Grade boundaries

The grade boundaries are determined using a process to compare results on a numeric scale to the reporting standards.

Standard	A	B	C	D	E
Marks achieved	100–85	84–69	68–48	47–18	17–0

Distribution of standards

The number of students who achieved each standard across the state is as follows.

Standard	A	B	C	D	E
Number of students	4052	6279	3026	133	0

Internal assessment

The following information and advice relate to the assessment design and assessment decisions for each IA in Units 3 and 4. These instruments have undergone quality assurance processes informed by the attributes of quality assessment (validity, accessibility and reliability).

Endorsement

Endorsement is the quality assurance process based on the attributes of validity and accessibility. These attributes are categorised further as priorities for assessment, and each priority can be further broken down into assessment practices.

Data presented in the Assessment design section identifies the reasons why IA instruments were not endorsed at Application 1, by the priority for assessments. An IA may have been identified more than once for a priority for assessment, e.g. it may have demonstrated a misalignment to both the subject matter and the assessment objective/s.

Refer to *QCE and QCIA policy and procedures handbook v4.0*, Section 9.5.

Percentage of instruments endorsed in Application 1

Number of instruments submitted	IA1	IA2	IA3
Total number of instruments	441	441	441
Percentage endorsed in Application 1	40%	82%	76%

Confirmation

Confirmation is the quality assurance process based on the attribute of reliability. The QCAA uses provisional criterion marks determined by teachers to identify the samples of student responses that schools are required to submit for confirmation.

Confirmation samples are representative of the school's decisions about the quality of student work in relation to the instrument-specific marking guide (ISMG), and are used to make decisions about the cohort's results.

Refer to *QCE and QCIA policy and procedures handbook v4.0*, Section 9.6.

The following table includes the percentage agreement between the provisional marks and confirmed marks by assessment instrument. The Assessment decisions section of this report for each assessment instrument identifies the agreement trends between provisional and confirmed marks by criterion.

Number of samples reviewed and percentage agreement

IA	Number of schools	Number of samples requested	Number of additional samples requested	Percentage agreement with provisional marks
1	439	3126	0	98.41%
2	437	3151	305	78.49%
3	437	3112	296	83.07%

Internal assessment 1 (IA1)

Data test (10%)

This assessment focuses on the application of a range of cognitions to multiple provided items.

Student responses must be completed individually, under supervised conditions, and in a set timeframe.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	162
Authentication	0
Authenticity	6
Item construction	47
Scope and scale	81

*Each priority might contain up to four assessment practices.

Total number of submissions: 441.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- appropriately aligned the cognitive verb to the objective being assessed
- used cues and information in the task to direct students to the specific data or relationship being addressed
- required students to apply a variety of skills and cognitive processes, i.e. similar skills (e.g. calculating) were not repeated across the task.

Practices to strengthen

It is recommended that assessment instruments:

- match the cognitive verb to the nature of the response and the relevant objective
- assess specific cognitions only once, e.g. avoid repeated calculations
- ensure that the number of marks assigned is represented in the expected student response

- avoid questions that assess objective 1, i.e. questions that use the cognitive verbs ‘describe’ or ‘explain’.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	23
Language	164
Layout	29
Transparency	50

*Each priority might contain up to four assessment practices.

Total number of submissions: 441.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- provided clear instructions that ensured students would be able to address the task
- provided stimulus relevant to the task, and did not contain extra information that was distracting or irrelevant
- included images that were clear, and large enough to be accessible to students.

Practices to strengthen

It is recommended that assessment instruments:

- use correct scientific binomial nomenclature for species names
- are checked for spelling, grammatical errors and textual features within questions and datasets, e.g. tables in datasets are labelled as ‘tables’ rather than ‘figures’
- give clear instructions that are phrased so it is clear to students how to respond, e.g. ‘Justify your response’.

Additional advice

- Schools should use the QCAA IA1 quality assurance tool to support their internal moderation processes.
- Questions using Specht’s table to draw conclusions about the classification of an ecosystem should be aligned to objective 4.
- Questions that address the analysis of limitations of evidence must relate to the evidence in the data provided, not the methods of data collection.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Data test	98.41%	0.68%	0.68%	0.23%

Effective practices

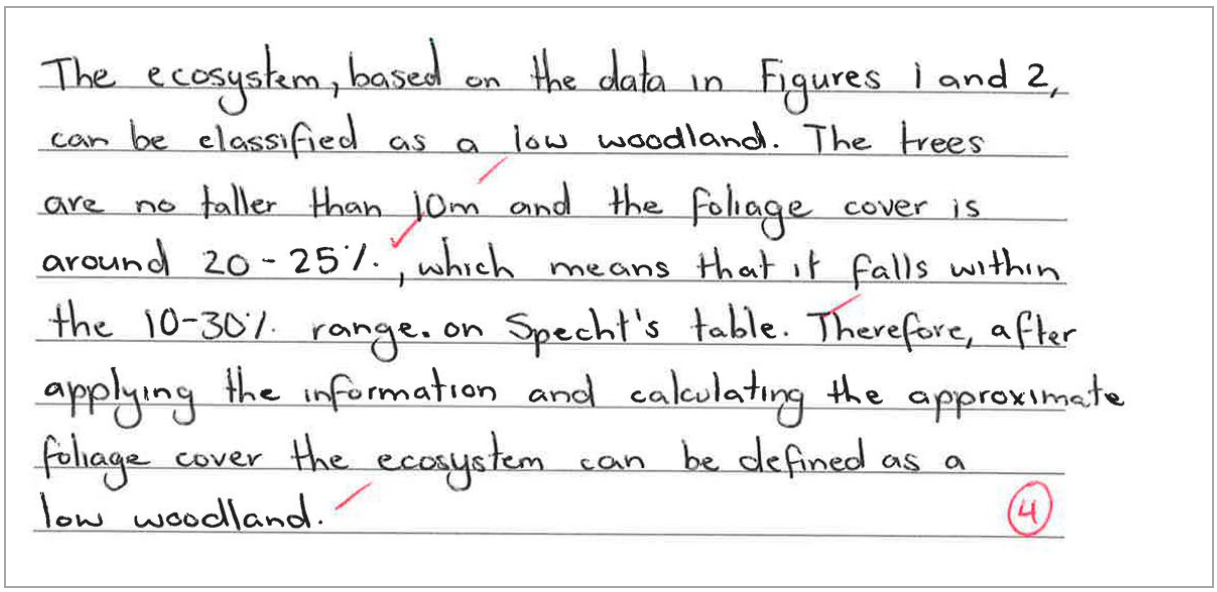
Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- marking schemes were complete, accurate and clearly matched the endorsed assessment instrument
- marking schemes clearly showed the breakdown and allocation of marks for each question, including how alternative responses were marked
- marking schemes were applied accurately and consistently across the cohort
- schools used annotations on student work (e.g. ticks and crosses) to indicate where evidence matched the marking scheme.

Samples of effective practices

The following excerpt has been included to demonstrate the use of annotations on a student response to indicate where evidence matches the marking scheme in an objective 4 item that required students to draw a conclusion about an ecosystem.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.


The ecosystem, based on the data in Figures 1 and 2, can be classified as a low woodland. The trees are no taller than 10m and the foliage cover is around 20 - 25%, which means that it falls within the 10-30% range on Specht's table. Therefore, after applying the information and calculating the approximate foliage cover the ecosystem can be defined as a low woodland. (4)

Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- schools avoid using part-marks
- teachers ensure that marks are correctly totalled, percentages are accurately determined, and cut-offs from the ISMG are correctly applied to determine provisional marks, e.g. 12/20 is 60%, not >60%, so should be awarded a 6.

Additional advice

- Comparable assessments should allow students to use the same knowledge and skills required for the endorsed instrument and include a separate marking scheme. All comparable instruments must be developed in the Endorsement application or uploaded as a PDF in the Confirmation application.
- Schools should check their marking scheme using a small sample of student responses before applying it to the entire cohort. If the marking scheme requires refinements (e.g. an alternative response is added, or an incorrect calculation is fixed), the school should provide a new PDF copy of the marking scheme, with changes indicated, when submitting required samples for confirmation.

Internal assessment 2 (IA2)

Student experiment (20%)

This assessment requires students to research a question or hypothesis through collection, analysis and synthesis of primary data. A student experiment uses investigative practices to assess a range of cognitions in a particular context. Investigative practices include locating and using information beyond students' own knowledge and the data they have been given.

Research conventions must be adhered to. This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	23
Authentication	17
Authenticity	1
Item construction	28
Scope and scale	0

*Each priority might contain up to four assessment practices.

Total number of submissions: 441.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- provided an appropriate level of scaffolding, consistent with syllabus requirements
- clearly identified the aspects of the task that were to be completed as a group and as individuals and included suitable authentication strategies to reflect this.

Practices to strengthen

It is recommended that assessment instruments:

- ensure the topics identified in the task conditions match the practicals identified in the context section of the task sheet
- include information directing students to address all aspects of the task listed in the syllabus specifications (Syllabus section 4.5.2).

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	0
Language	15
Layout	1
Transparency	9

*Each priority might contain up to four assessment practices.

Total number of submissions: 441.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- used school quality assurance processes to ensure the task was free of clerical errors in formatting, spelling and grammar.

Practices to strengthen

It is recommended that assessment instruments:

- use correct scientific binomial nomenclature for species names throughout the task
- are checked for spelling, grammatical errors and textual features (e.g. ‘rational’ instead of ‘rationale’) using school quality assurance processes.

Additional advice

- Schools should use in-school quality assurance processes to thoroughly check assessments before they are submitted for endorsement.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Research and planning	86.04%	11.9%	1.14%	0.92%
2	Analysis of evidence	89.7%	9.61%	0.46%	0.23%
3	Interpretation and evaluation	87.87%	10.98%	0.92%	0.23%
4	Communication	97.25%	0.92%	1.83%	0%

Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Analysis of evidence criterion
  - analytical techniques were appropriate for the research question and allowed *relevant* trends, patterns, relationships and uncertainty to be identified
  - visual representations, tables and graphs were appropriate for the type of data being analysed, e.g. bar graphs for comparisons, line graphs to show trends and scatterplots to identify relationships
  - *relevant processing of data* was demonstrated by only including sample calculations for algorithms appropriate for the research question
  - *thorough and appropriate identification* of the uncertainty and limitations had direct bearing on the research question and was supported by data and/or reasoning
- in the Interpretation and evaluation criterion
  - *justified discussion* of validity and reliability used reasoning and evidence (e.g. pattens in uncertainty data) to consider how specific aspects of the experimental design or data collection process impacted, or improved, the extent to which the experiment measured what was intended (validity) or the likelihood that another experimenter would obtain the same results (reliability)
  - *suggested improvements and extensions were logically derived from the analysis of evidence*, such as uncertainty data, and explained how specific aspects of the experimental process could be refined, redirected or extended to improve the validity or reliability of evidence
  - a *justified conclusion* used evidence to support a conclusion that directly responded to the research question.

Samples of effective practices

The following excerpt demonstrates a considered rationale by connecting the research question to Unit 3 subject matter, establishing a logical basis for the experiment and identifying the relevance of the independent and dependent variables.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

The disappearance of species however, correlates to a direct reduction in biodiversity, and consequently, alters the ecosystem. Factors that can induce this decrease include "habitat loss, invasive species, overexploitation and pollution" (Britannica, 2022). Introduced species – which often become invasive species – are one of these factors, as they create competition in the ecosystem for resources and often remove the native species from its niche habitat. When the introduced species is an herbivorous animal, however, the symbiotic relationship of predation is observed, and the population of native flora is either reduced or eradicated due to constant grazing. A species that demonstrates this relationship with native flora is alpacas and consequently, the effect of alpaca grazing on the biodiversity of an ecosystem will be investigated.

Research question

Does alpaca grazing in an area affect the biodiversity of groundcover flora in a sub-tropical ecosystem, as measured by species richness, species abundance and percentage cover?

The following excerpt demonstrates correct and relevant processing of data by presenting visual representations appropriate for the type of data analysed and allowing for thorough identification of trends, patterns, relationships and uncertainty relevant to the research question.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

2.1 Research question

'Does the texture of the bark of a tree (smooth or rough) affect the abundance of lichen (crustose, foliose and fruticose)?'

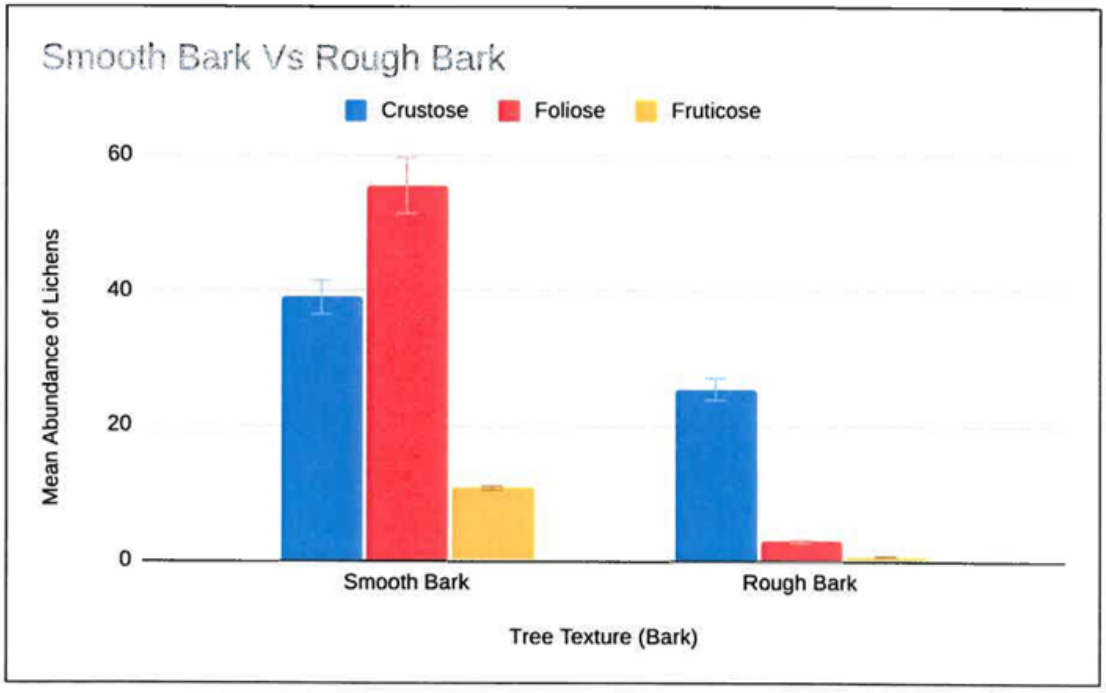


Table 5: Two-tail p-value t-test (two-sample assuming unequal variances) between smooth bark and rough bark for the three types of lichen

	P-value t-test	Crustose	Foliose	Fruticose
Smooth Vs Rough	**Two-tail**	0.2757	0.0354	0.1373

The following excerpt demonstrates a justified conclusion linked to the research question by using evidence to support a conclusion that directly responds to the research question.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

Conclusion

The experiment confirmed that the exposure of sunlight on camphor trees did impact the percent cover of foliose lichen on the north and south side of the branches and trunks to a great extent. This is evident as the areas of the trees that was greatly exposed to sunlight, had greater amounts of lichen on them (4.022% ±2.262% trunks, 17.048 ± 5.579% branches), compared to the shaded sides of the trees (0.376% ±0.197%. trunks, 0.790 ± 0.79%. branches). It was also observed that there were no trees with higher percent cover on the south side than the north. Also, the trunks and branches of trees with greater amounts of lichen, showed large clumps of lichen rather than small, dispersed clumps on the shaded (south) sides.

Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- in the Research and planning criterion
  - a *considered* rationale clearly connects the research question to Unit 3 subject matter, establishes a logical basis for the experiment and identifies the relevance of the independent and dependent variables
  - *justified* modifications to the methodology identify how each modification will improve the reliability or validity of evidence
  - a *specific* research question clearly identifies an independent variable, dependent variable and, if appropriate, relevant parameters.

Additional advice

- Teachers should provide students with opportunities to engage with a variety of inquiry skills and analytical processes as part of the teaching and learning process. This could include
  - identifying and using data processing techniques appropriate for different types of research questions, e.g. regression analysis for correlational studies
  - understanding how descriptive (e.g. mean, standard deviation) and inferential (e.g. standard error) statistics can be used to summarise and make sense of data
  - selecting and using graphs that are appropriate for the type of data being presented
  - understanding how the reliability and validity of the experimental process is related to the uncertainty and limitations of data.
- Appendixes should only include supplementary material that will not be directly used as evidence when marking the response (*QCE and QCIA policy and procedures handbook v4.0*, Section 8.2.6). If raw data is included in an appendix, there must be evidence of collection of sufficient and relevant raw data in other areas of the response, e.g. methodology, sample calculations and data presentation.
- Schools must use appropriate strategies to manage response length and promote academic integrity (*QCE and QCIA policy and procedures handbook v4.0*, Sections 8.1 and 8.4).
- Schools should review advice about how to determine provisional marks using the best-fit model. Refer to the Making judgments webinar in the QCAA Portal.

Internal assessment 3 (IA3)

Research investigation (20%)

This assessment requires students to evaluate a claim. They will do this by researching, analysing and interpreting secondary evidence from scientific texts to form the basis for a justified conclusion about the claim. A research investigation uses research practices to assess a range of cognitions in a particular context. Research practices include locating and using information beyond students' own knowledge and the data they have been given.

Research conventions must be adhered to. This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	27
Authentication	23
Authenticity	0
Item construction	25
Scope and scale	13

*Each priority might contain up to four assessment practices.

Total number of submissions: 441.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- directed students to address all aspects of the task, as outlined in the syllabus specifications (Syllabus section 5.5.1)
- ensured the topics identified in the task conditions matched the subject matter addressed in the claims
- contained claims that would allow students to generate multiple research questions, e.g. 'Gene therapy is a viable and effective treatment for human disease'.

Practices to strengthen

It is recommended that assessment instruments:

- align with the assessment specifications and do not allow students to work in groups to develop a response.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	3
Language	31
Layout	1
Transparency	5

*Each priority might contain up to four assessment practices.

Total number of submissions: 441.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- ensured that examples provided in scaffolding could not be used by students as a basis for their inquiry
- used correct scientific binomial nomenclature throughout the task.

Practices to strengthen

It is recommended that assessment instruments:

- are free from formatting, spelling and other clerical errors.

Additional advice

- Schools should permit only one complete (or near complete) draft for feedback (*QCE and QCIA policy and procedures handbook v4.0*, Section 8.2.5).

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Research and planning	92.22%	6.41%	1.14%	0.23%
2	Analysis and interpretation	90.39%	8.7%	0.69%	0.23%
3	Conclusion and evaluation	89.47%	9.84%	0.46%	0.23%
4	Communication	97.25%	0.69%	1.83%	0.23%

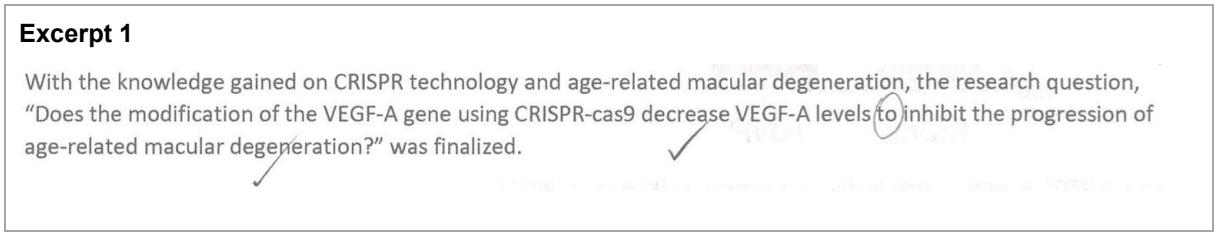
- in the Research and planning criterion
  - a *considered* rationale demonstrated informed application of Unit 4 concepts to clearly show how the research question was developed from the claim
  - a *specific* and *relevant* research question was clearly defined, linked to the claim and allowed for effective and efficient investigation of phenomena associated with DNA, genes and the continuity of life or Continuity of life on Earth
  - sources used throughout the response were credible and provided enough background information and secondary evidence to respond to the research question
- in the Analysis and interpretation criterion
  - *thorough* identification of trends, patterns or relationships was based on analysis of the evidence, rather than restating conclusions from the source material
  - *thorough* and *appropriate* identification of limitations was specific to the research question and identified how or why each limitation made the evidence less effective
  - *justified* scientific arguments were supported by evidence and linked to the research question.

Samples of effective practices

The following excerpts demonstrate a specific and relevant research question and insightful discussion of the quality of evidence. The student was responding to the claim ‘CRISPR technology can change human lives’.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

Excerpt 1


With the knowledge gained on CRISPR technology and age-related macular degeneration, the research question, “Does the modification of the VEGF-A gene using CRISPR-cas9 decrease VEGF-A levels to inhibit the progression of age-related macular degeneration?” was finalized.

Excerpt 2

There were some notable limitations identified in the studies which have compromised reliability and validity. To begin with, the purpose of the study from Yiu et al. (2016) was to, "suppress ocular angiogenesis by genomic disruption of VEGF-A in human RPE cells". Although it was successful in decreasing VEGF, it was also found that it can be produced elsewhere in the body with Stewert (2012) stating, "VEGF is produced by retinal pigment epithelial cells, neurons, glial cells, endothelial cells, ganglion cells, Müller cells, and smooth muscle cells". Therefore, this source affects reliability as the suppression of ocular angiogenesis is not certain with data demonstrating decreased protein levels in only one type of cell that produces VEGF.

Additionally, the study behind figure 2 was done in-vivo. Although it was stated that target sites used for the mouse VEGF-A gene were corroborated to be the same as the human VEGF-A gene, a discrepancy regarding if the decreased protein levels can also have an effect on humans to teat AMD is evident. Similar to this, the study done by Ameri et al. (2020) was performed in-vitro on human RPE and muller cells. With the effect of CRISPR technology being studied on cell lines, reliability is altered as it is unknown if the effects will have the same success if implemented directly in humans. This is because other factors that cause AMD such as, "smoking, obesity and diet" (Mayo Clinic, 2021) could interfere with results. Finally, in relation to the claim, only one aspect of CRISPR technology was utilised throughout each of the studies, using deletion to reduce VEGF protein levels in cells associated with humans. This is a limitation as it neglects the method of introducing genes using CRISPR to treat AMD.

Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- in the Conclusion and evaluation criterion
  - *insightful discussion* of the quality of evidence focuses on how well the evidence answers the research question and the extent to which limitations identified in the analysis of evidence influence the validity of the conclusion
  - *considered and relevant* improvements and extensions focus on ways the research investigation could be refined or extended to obtain more valid evidence applicable to the claim
  - *justified* conclusions are backed by evidence and based on scientific arguments developed throughout the response.

Additional advice

- Teachers should use resources and teaching strategies that enable students to understand the specific requirements of a research investigation (IA3 effective processes and practices resource).
- Teachers should align their understanding of ISMG qualifiers with the syllabus glossary when making judgments about student work.
- Marked ISMGs submitted for confirmation must clearly indicate the characteristics evident in the student response and the mark awarded for each criterion (*QCE and QCIA policy and procedures handbook v4.0*, Section 9.6.3).

External assessment

External assessment (EA) is developed and marked by the QCAA. The external assessment for a subject is common to all schools and administered under the same conditions, at the same time, on the same day.

Examination (50%)

Assessment design

The assessment instrument was designed using the specifications, conditions and assessment objectives described in the summative external assessment section of the syllabus. The examination consisted of two papers:

- Paper 1, Section 1 consisted of multiple choice questions (20 marks)
- Paper 1, Section 2 consisted of short response questions (22 marks)
- Paper 2, Section 1 consisted of short response questions (45 marks).

The examination assessed subject matter from Units 3 and 4. Questions were derived from the context of Describing biodiversity, Ecosystem dynamics, DNA genes and the continuity of life and Continuity of life on Earth.

The assessment required students to respond to multiple choice and short response questions.

Assessment decisions

Assessment decisions are made by markers by matching student responses to the external assessment marking guide (EAMG). The external assessment papers and the EAMG are published in the year after they are administered.

Multiple choice question responses

There were 20 multiple choice questions in Paper 1.

Percentage of student responses to each option

Note:

- The correct answer is **bold** and in a blue shaded table cell.
- Some students may not have responded to every question.

Question	A	B	C	D
1	**58.28**	19.18	8.7	13.6
2	8.84	**74.96**	8.97	7.01
3	1.25	2.43	13.24	**82.8**
4	2.39	13.33	**66.72**	17.33
5	12.55	**82.55**	3.26	1.39
6	10.6	4.15	**79.89**	5.16
7	19.25	**39.31**	17.62	23.53
8	16.1	**41.99**	39.85	1.89
9	26.46	15.17	**43.11**	15.02
10	14.29	33.25	12.68	**39.47**
11	2.83	0.71	0.94	**95.32**
12	13.01	56.33	6.26	**24.04**
13	**24.89**	19.7	7.36	47.77
14	11.93	38.75	25.1	**23.97**
15	31.17	19.21	11.46	**37.71**
16	12.48	7.63	**64.58**	15.04
17	6.13	30.75	16.59	**46.16**
18	**71.98**	14.96	7.13	5.69
19	**49.03**	9.38	19.19	22.04
20	14.42	**55.93**	12.62	16.68

Effective practices

Overall, students responded well to:

- questions requiring analysis and interpretation of data from a stimulus
- questions requiring calculation of an unknown value.

Samples of effective practices

Short response

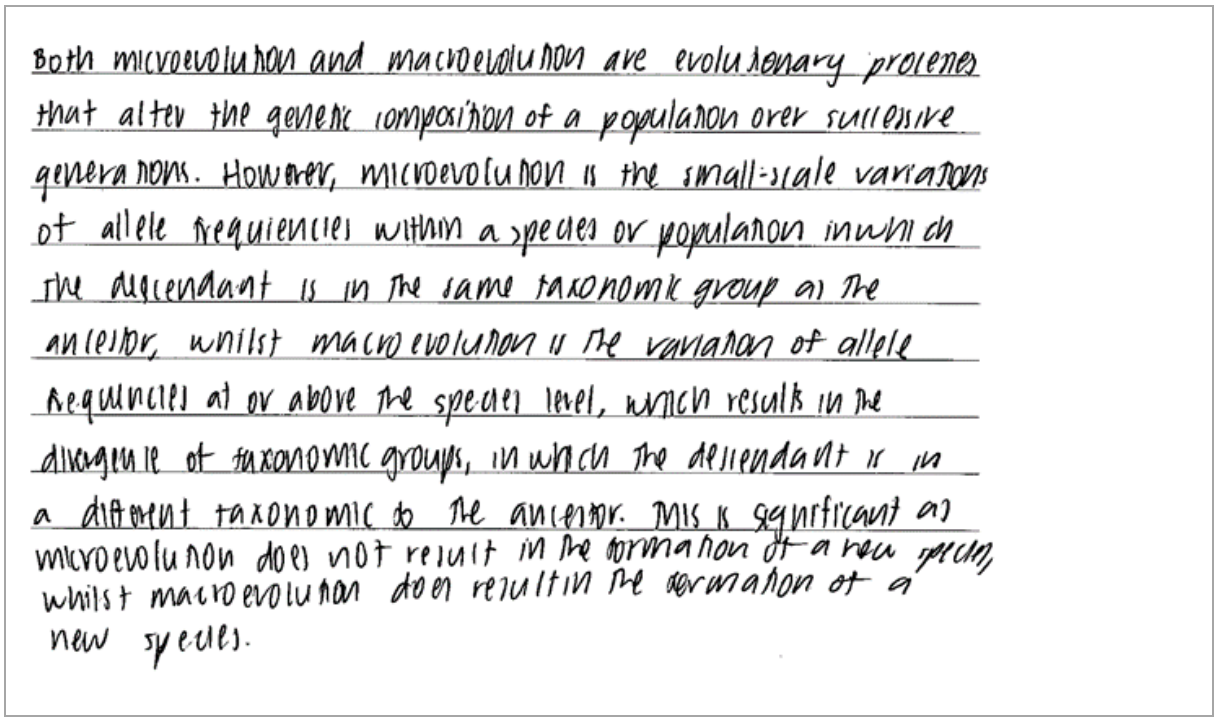
The following excerpt is from Question 23 from Paper 1. It required students to compare microevolution and macroevolution.

Effective student responses:

- provided a similarity
- provided a difference
- stated the significance of these.

This excerpt has been included:

- to demonstrate how the student has used their knowledge of syllabus definitions to identify a similarity, a difference and their significance.


Both microevolution and macroevolution are evolutionary processes that alter the genetic composition of a population over successive generations. However, microevolution is the small-scale variations of allele frequencies within a species or population in which the descendant is in the same taxonomic group as the ancestor, whilst macroevolution is the variation of allele frequencies at or above the species level, which results in the divergence of taxonomic groups, in which the descendant is in a different taxonomic to the ancestor. This is significant as microevolution does not result in the formation of a new species, whilst macroevolution does result in the formation of a new species.

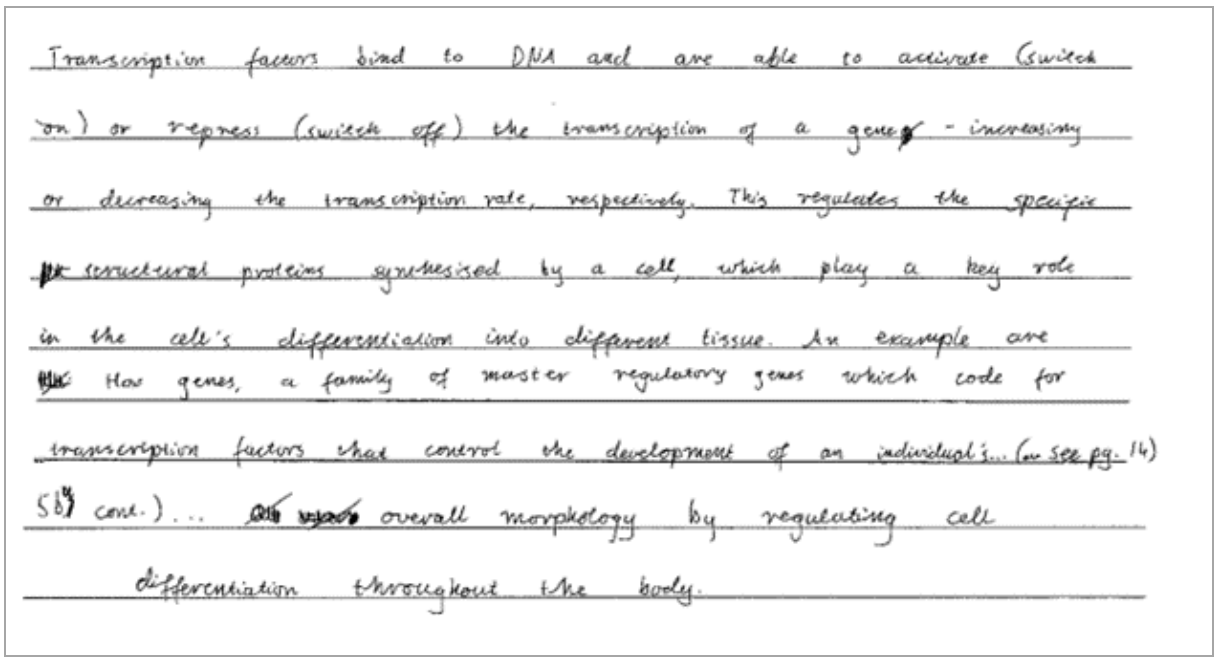
The following excerpt is from Question 5b from Paper 2. It required students to explain how transcription factors control cell differentiation using an example.

Effective student responses:

- recognised that transcription factors regulate gene expression by binding to specific DNA sequences
- explained that this allows for differential gene expression
- provided an example.

This excerpt has been included:

- to demonstrate how the student has integrated their knowledge and understanding of *Gene expression* subject matter to develop a response.


Transcription factors bind to DNA and are able to activate (switch on) or repress (switch off) the transcription of a gene - increasing or decreasing the transcription rate, respectively. This regulates the specific structural proteins synthesised by a cell, which play a key role in the cell's differentiation into different tissue. An example are Hox genes, a family of master regulatory genes which code for transcription factors that control the development of an individual's... (see pg. 14) 5b) cont.) ... overall morphology by regulating cell differentiation throughout the body.

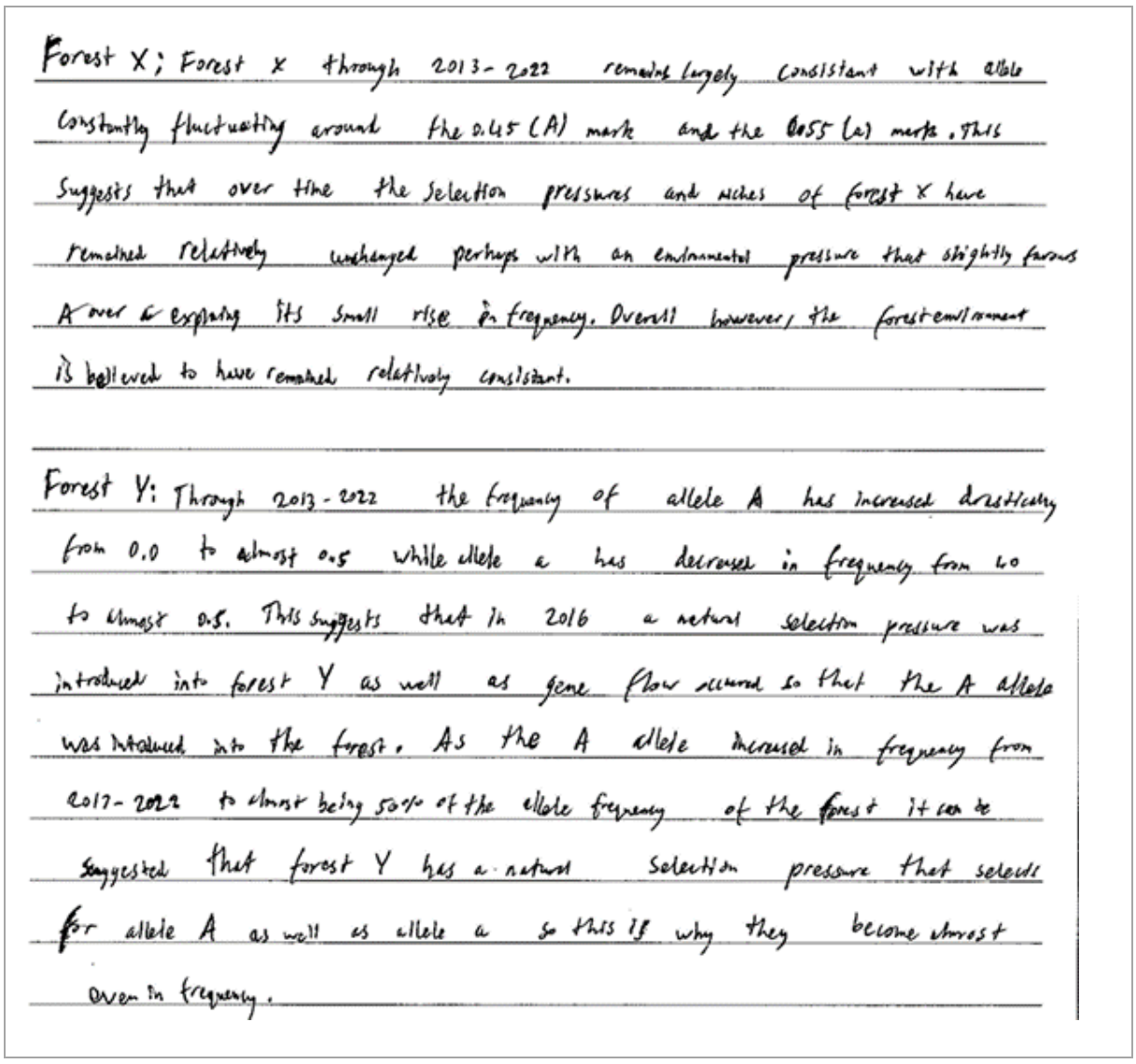
The following excerpt is from Question 11b from Paper 2. It required students to identify temporal trends in allele frequency and infer reasons for the observed differences.

Effective student responses:

- identified allele frequencies remain relatively constant in forest X over time
- inferred a reason for the temporal change in forest X
- identified allele A first appeared in forest Y in 2016
- inferred that this was due to migration or mutation
- identified the frequency of allele A increased over time in forest Y
- inferred allele A provided a selective advantage to mice in forest Y.

This excerpt has been included:

- to demonstrate how the student has integrated their knowledge and understanding of *Natural selection and microevolution* subject matter to develop a response.


Forest X; Forest X through 2013-2022 remained largely consistant with allele constantly fluctuating around the 0.45 (A) mark and the 0.55 (a) mark. This suggests that over time the selection pressures and niches of forest X have remained relatively unchanged perhaps with an environmental pressure that slightly favours A over a explaing its small rise in frequency. Overall however, the forest environment is believed to have remained relatively consistant.

Forest Y: Through 2013-2022 the frequency of allele A has increased drastically from 0.0 to almost 0.5 while allele a has decreased in frequency from 1.0 to almost 0.5. This suggests that in 2016 a natural selection pressure was introduced into forest Y as well as gene flow occured so that the A allele was introduced into the forest. As the A allele increased in frequency from 2017-2022 to almost being 50% of the allele frequency of the forest it can be suggested that forest Y has a natural selection pressure that selects for allele A as well as allele a so this is why they become almost even in frequency.

Practices to strengthen

It is recommended that when preparing students for external assessment, teachers consider:

- providing opportunities for students to practice integrating knowledge and understanding of the syllabus subject matter in order to explain phenomena, e.g. applying understanding of natural selection and microevolution concepts to explain differential trends in allele frequencies over time
- encouraging students to read the questions carefully, paying attention to the cognitive verb and other cues about how to respond
- engaging with the resources in the *Cognitive verb toolkit* (available via the Noticeboard tile in the QCAA Portal) to ensure students understand the different cognitive verbs and how to break down a question
- using the syllabus glossary for subject-specific definitions.