

Earth & Environmental Science General Senior Syllabus 2019 v1.3

Subject report 2020

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Queensland Curriculum & Assessment Authority
PO Box 307 Spring Hill QLD 4004 Australia
154 Melbourne Street, South Brisbane

Phone: (07) 3864 0299

Email: office@qcaa.qld.edu.au

Website: www.qcaa.qld.edu.au

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Introduction

The first summative year for the new Queensland Certificate of Education (QCE) system was unexpectedly challenging. The demands of delivering new assessment requirements and processes were amplified by disruptions to senior schooling arising from the COVID-19 pandemic. This meant the new system was forced to adapt before it had been introduced — the number of summative internal assessments was reduced from three to two in all General subjects. Schools and the QCAA worked together to implement the new assessment processes and the 2020 Year 12 cohort received accurate and reliable subject results.

Queensland's innovative new senior assessment system combines the flexibility and authenticity of school-based assessment, developed and marked by classroom teachers, with the rigour and consistency of external assessment set and marked by QCAA-trained assessment writers and markers. The system does not privilege one form of assessment over another, and both teachers and QCAA assessors share the role of making high-stakes judgments about the achievement of students. Our commitment to rigorous external quality assurance guarantees the reliability of both internal and external assessment outcomes.

Using evidence of student learning to make judgments on student achievement is just one purpose of assessment. In a sophisticated assessment system, it is also used by teachers to inform pedagogy and by students to monitor and reflect on their progress.

This post-cycle report on the summative assessment program is not simply being produced as a matter of record. It is intended that it will play an active role in future assessment cycles by providing observations and findings in a way that is meaningful and helpful to support the teaching and learning process, provide future students with guidance to support their preparations for summative assessment, and promote transparency and accountability in the broader education community. Reflection and research are necessary for the new system to achieve stability and to continue to evolve. The annual subject report is a key medium for making it accessible to schools and others.

Background

Purpose

The annual subject report is an analysis of the previous year's full summative assessment cycle. This includes endorsement of summative internal assessment instruments, confirmation of internal assessment marks and external assessment.

The report provides an overview of the key outcomes of one full teaching, learning and assessment cycle for each subject, including:

- information about the application of the syllabus objectives through the design and marking of internal and external assessments
- information about the patterns of student achievement in each subject for the assessment cycle.

It also provides advice to schools to promote continuous improvement, including:

- identification of effective practices in the design and marking of valid, accessible and reliable assessments
- identification of areas for improvement and recommendations to enhance the design and marking of valid, accessible and reliable assessment instruments
- provision of tangible examples of best practice where relevant, possible and appropriate.

Audience and use

This report should be read by school leaders, subject leaders and teachers to inform teaching and learning and assessment preparation. The report is to be used by schools and teachers to assist in assessment design practice, in making assessment decisions and in preparing students for external assessment.

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

Report preparation

The report includes analyses of data and other information from the processes of endorsement, confirmation and external assessment, and 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 enrolments

Number of schools offering the subject: 22.

Completion of units	Unit 1	Unit 2	Units 3 and 4*
Number of students completed	286	315	323

*Units 3 and 4 figure includes students who were not rated.

Units 1 and 2 results

Number of students	Satisfactory	Unsatisfactory	Not rated
Unit 1	273	13	0
Unit 2	284	31	0

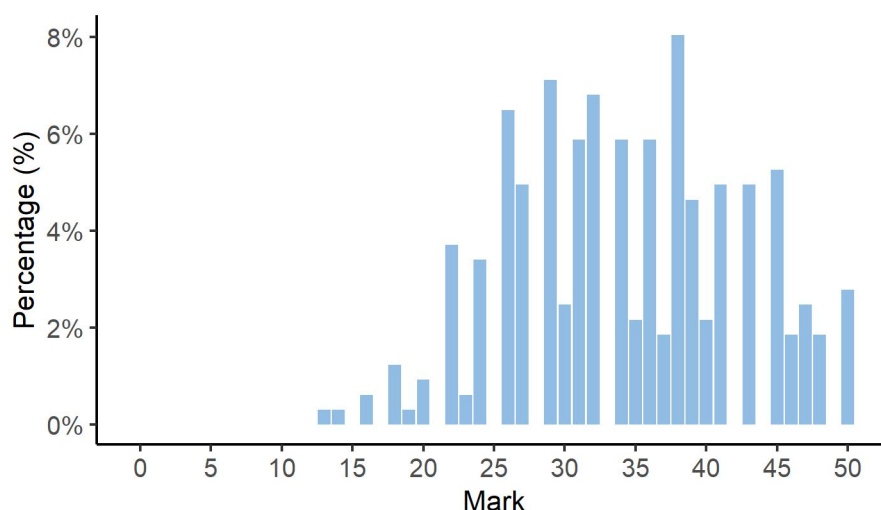
Units 3 and 4 internal assessment results

2020 COVID-19 adjustments

To support Queensland schools, teachers and students to manage learning and assessment during the evolving COVID-19 pandemic in 2020, the QCAA Board approved the removal of one internal assessment for students completing Units 3 and 4 in General and Applied subjects.

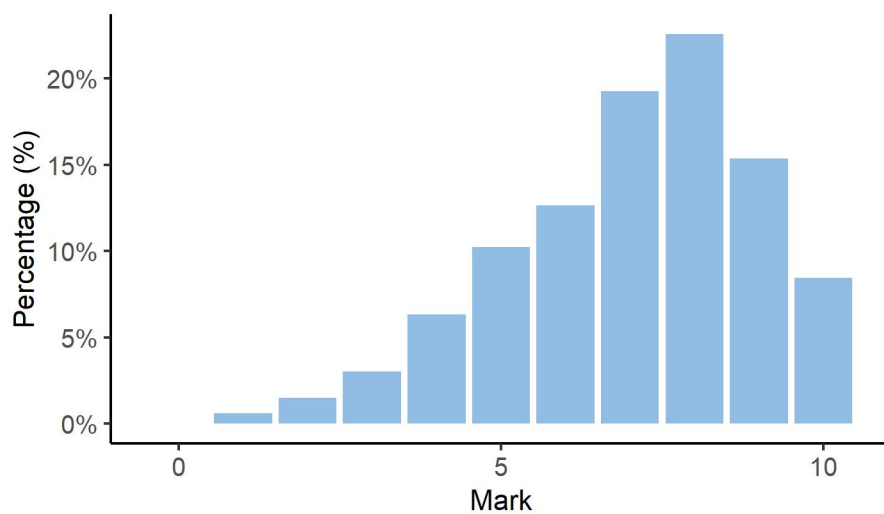
In General subjects, students completed two internal assessments and an external assessment. Schools made decisions based on QCAA advice and their school context. Therefore, across the state some instruments were completed by most schools, some completed by fewer schools and others completed by few or no schools. In the case of the latter, the data and information for these instruments has not been included.

Total results for internal assessment

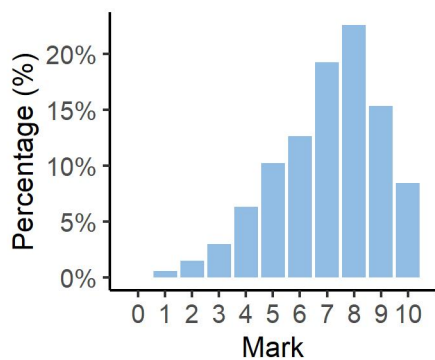


IA1 results

IA1 total

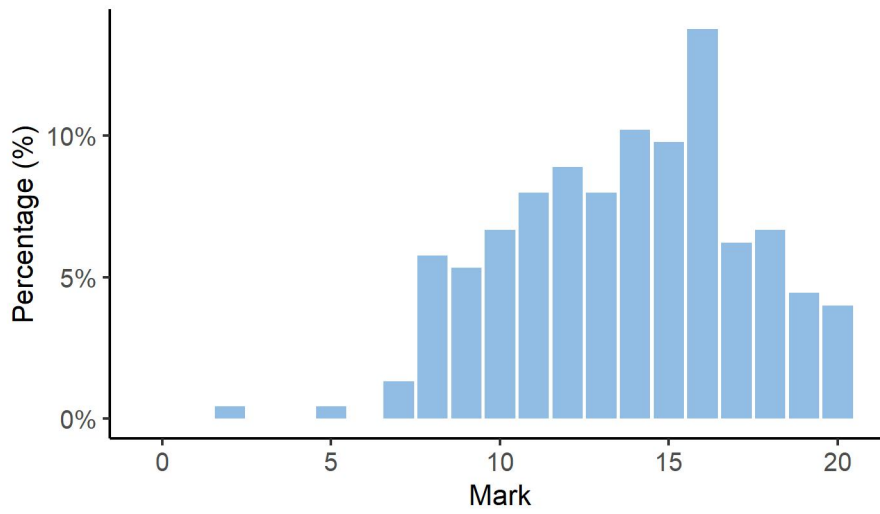


IA1 Criterion 1

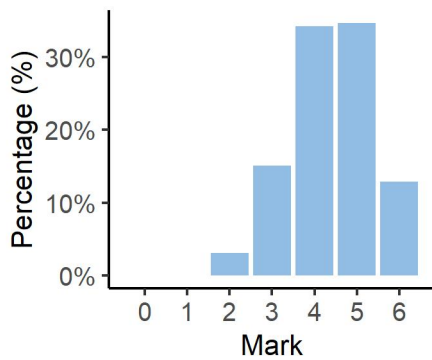


IA2 results

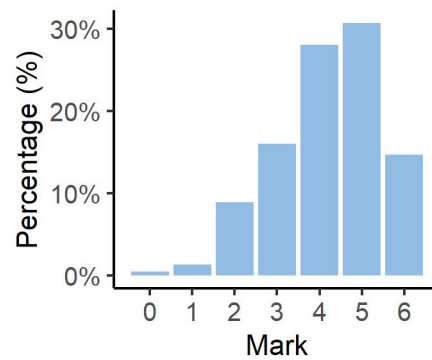
IA2 total



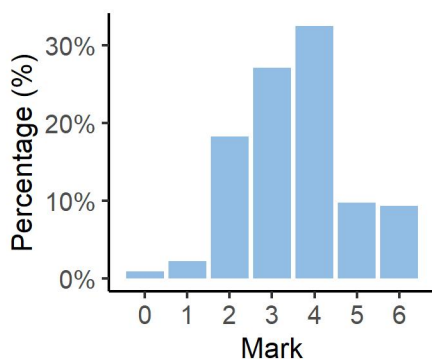
IA2 Criterion 1



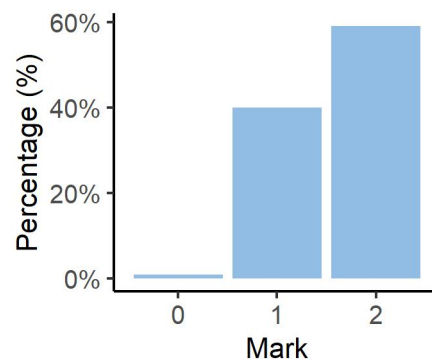
IA2 Criterion 2



IA2 Criterion 3

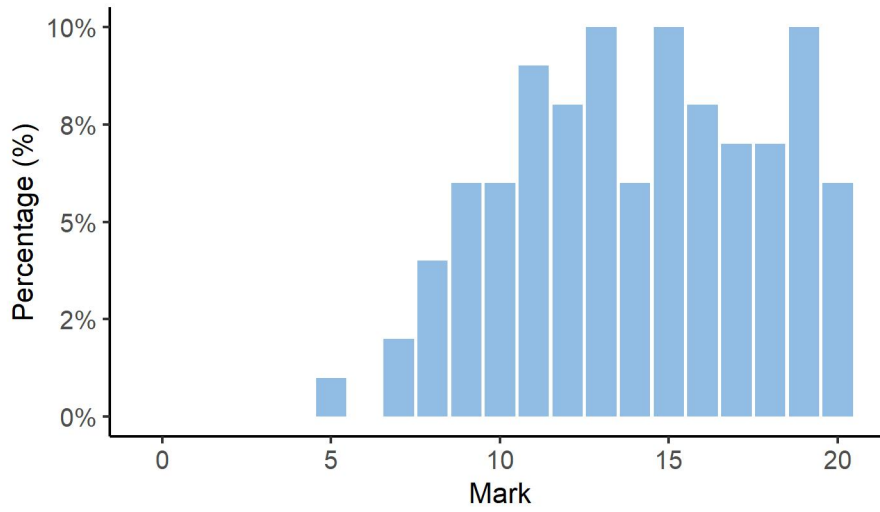


IA2 Criterion 4

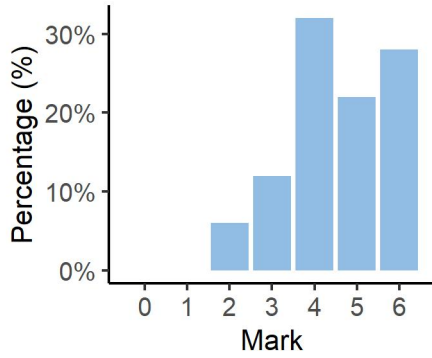


IA3 results

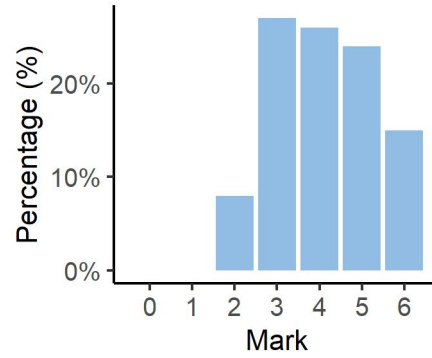
IA3 total



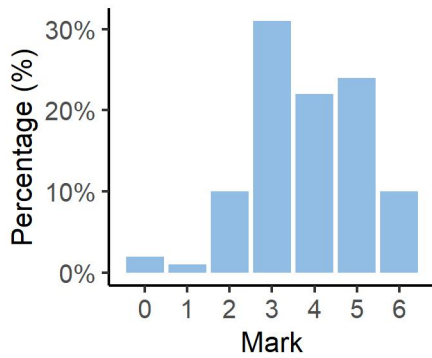
IA3 Criterion 1



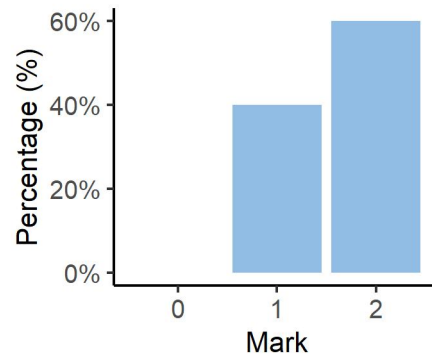
IA3 Criterion 2



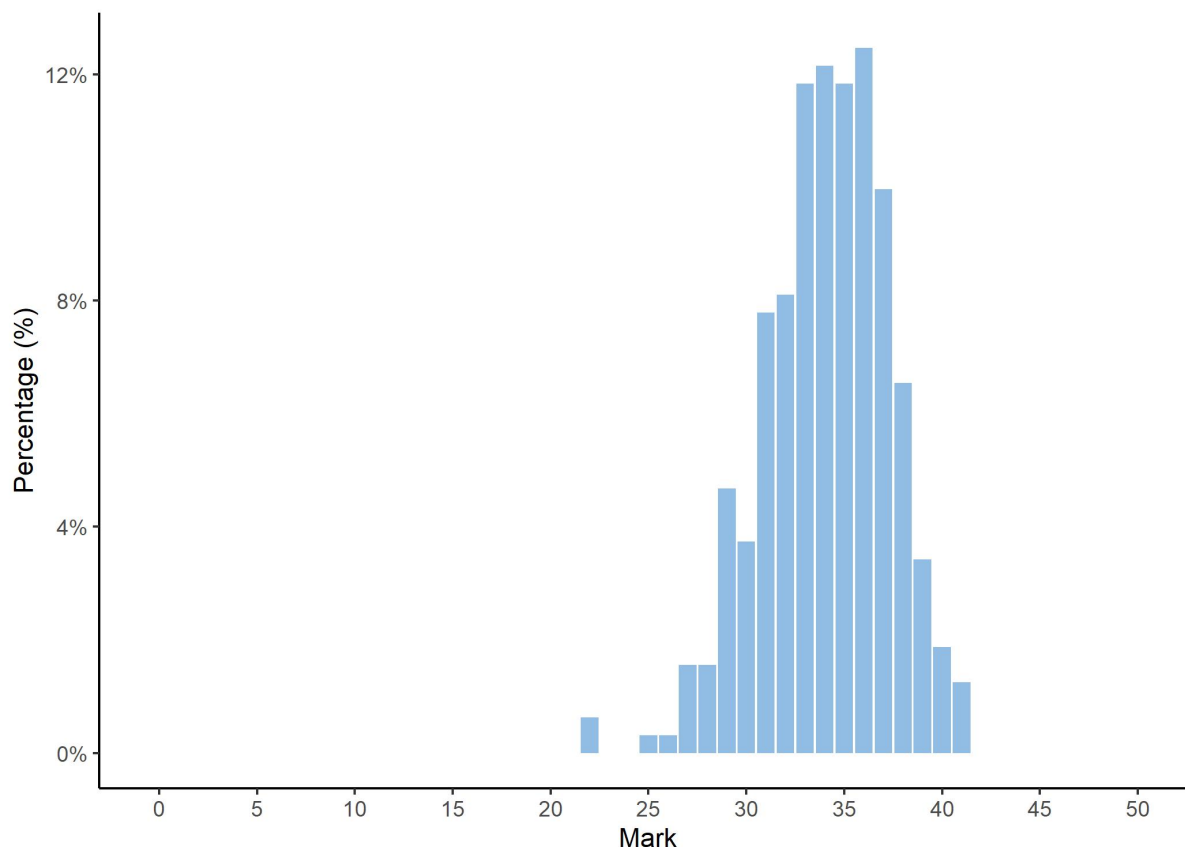
IA3 Criterion 3



IA3 Criterion 4



External assessment results



Final standards allocation

The number of students awarded each standard across the state are as follows.

Standard	A	B	C	D	E
Number of students	54	168	96	3	0

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	100–80	79–64	63–44	43–16	15–0

Internal assessment

The following information and advice pertain 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 sections 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 subject matter and to the assessment objective. Refer to the quality assurance tools for detailed information about the assessment practices for each assessment instrument.

Total number of items endorsed in Application 1

Number of items submitted each event	IA1	IA2	IA3
Total number of instruments	23	23	23
Percentage endorsed in Application 1	26	87	74

Confirmation

Confirmation is the quality assurance process based on the attribute of reliability. Teachers make judgments about the evidence in students' responses using the instrument-specific marking guide (ISMG) to indicate the alignment of students' work with performance-level descriptors and determine a mark for each criterion. These are provisional criterion marks. The QCAA makes the final decision about student results through the confirmation processes. Data presented in the assessment decisions section identifies the level of agreement between provisional and final results.

Number of samples reviewed at initial, supplementary and extraordinary review

IA	Number of schools	Number of samples requested	Supplementary samples requested	Extraordinary review	School review	Percentage agreement with provisional
1	22	113	0	0	0	100
2	13	68	5	0	0	100
3	9	45	6	0	0	99.25

Internal assessment 1 (IA1)

Data test (10%)

The IA1 data test requires students to apply a range of cognitions to multiple provided items. Students respond to items using qualitative and/or quantitative data derived from practicals, activities or case studies on topics from Unit 3. The task requires students to identify unknown scientific quantities or features; identify trends, patterns, relationships, limitations or uncertainty in datasets; and draw conclusions based on the analysis of data.

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 practices

Validity priority	Number of times priority was identified in decisions*
Alignment	9
Authentication	0
Authenticity	5
Item construction	1
Scope and scale	3

*Total number of submissions: 23. Each priority might contain up to four assessment practices.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that featured:

- a variety of datasets clearly derived from Unit 3 subject matter, e.g. mandatory or suggested practicals
- items that demonstrated clear alignment with the objectives being assessed by using the cognitive verbs listed in the mark allocation table in the syllabus, e.g. objective 2 items that used the following verbs: calculate, determine, identify, recognise and use
- appropriate amounts of data within each dataset, allowing students to read through the data and answer the questions within the allocated time.

Practices to strengthen

It is recommended that assessment instruments:

- include unseen datasets that are appropriately different from QCAA sample assessments
- include a sequence of items that is appropriately different from QCAA sample assessments
- include items where the expected student response and the classified objective clearly align
- include a balance of items across the apply, analyse and interpret objectives as per the syllabus instrument mark allocation table
- contain an appropriate number of questions and marks, so students can respond within 60 minutes.

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 practices

Accessibility priority	Number of times priority was identified in decisions*
Transparency	3
Language	3
Layout	4
Bias avoidance	7

*Total number of submissions: 23. Each priority might contain up to four assessment practices.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that featured:

- clear links between the questions and the data required to answer the question, e.g. see figure 1 in dataset 1
- consistent language between datasets and questions
- clearly legible datasets, including legends, axes, units, and figure labels.

Practices to strengthen

It is recommended that assessment instruments:

- clearly link questions to the dataset required to answer them
- avoid jargon and acronyms in the datasets
- are checked for typographical, spelling and grammatical errors within items and datasets
- are formatted using the page break tool in the Endorsement application to ensure that datasets, figure labels and questions are not separated across pages. The print preview function should be used to ensure the layout of the task is appropriate.

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 final results

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional
1	Data test	100	0	0

Effective practices

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

- school-developed marking schemes clearly matched each mark to a valued feature of the expected response
- school-developed marking schemes identified how alternative responses were marked.

Samples of effective practices

There are no student response excerpts because either the student/s did not provide permission or there were third-party copyright issues in the response/s.

Practices to strengthen

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

- schools check that mark totals and percentages have been determined correctly
- schools update the original marking scheme (that was submitted at endorsement) to indicate how unexpected responses were marked.

Internal assessment 2 (IA2)

Student experiment (20%)

The IA2 student experiment requires students to modify (i.e. refine, extend or redirect) an experiment to address their own hypothesis or question related to topics from Unit 3. Students may use a practical performed in class as the basis for their methodology. They develop a research question, collect and process primary data, analyse and interpret evidence, and evaluate the reliability and validity of their experimental process.

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 practices

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

*Total number of submissions: 23. Each priority might contain up to four assessment practices.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that featured:

- mandatory or suggested practicals from Unit 3 as experiments for students to use as the basis for their methodology and research question
- clear scaffolding that modelled processes and directed students to address all components of the task without leading students to a pre-determined response.

Practices to strengthen

It is recommended that assessment instruments:

- include only experiments clearly related to Unit 3 subject matter (i.e. use of non-renewable Earth resources and use of renewable Earth resources) for students to modify.

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 practices

Accessibility priority	Number of times priority was identified in decisions*
Transparency	2
Language	0
Layout	0
Bias avoidance	0

*Total number of submissions: 23. Each priority might contain up to four assessment practices.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that featured:

- clear instructions that aligned to the specifications within the syllabus, the assessment objectives and the ISMG
- appropriate drafting and authentication strategies, e.g. collecting progressive samples of student work, interviews with students, using plagiarism-detection software
- communication that avoided jargon, specialist and colloquial language.

Practices to strengthen

It is recommended that assessment instruments:

- include scaffolding that clearly directs students to address all aspects of the task, including the rationale.

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 final results

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional
1	Research and planning	100	0	0
2	Analysis of evidence	100	0	0
3	Interpretation and evaluation	100	0	0
4	Communication	100	0	0

Effective practices

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

- in the Research and planning criterion
 - a *considered* rationale clearly connected the research question to Unit 3 subject matter
 - a *specific* research question was explicit enough to be answered within the required response length

- *justified* modifications to the methodology ensured that the experiment collected sufficient data to draw valid conclusions, e.g. at least five data points to establish a trend
- in the Analysis of evidence criterion
 - the following analysis techniques were used to demonstrate *thorough* identification of trends, patterns or relationships:
 - measures of central tendency, e.g. mean and median
 - measures of dispersion, e.g. standard deviation
 - measures of correlation, e.g. Pearson’s correlation coefficient, *r*
 - context-specific measures, e.g. ecological footprint
 - the standard error was used to demonstrate *thorough and appropriate* identification of uncertainty and limitations of evidence.

Samples of effective practices

There are no student response excerpts because either the student/s did not provide permission or there were third-party copyright issues in the response/s.

Practices to strengthen

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

- in the Interpretation and evaluation criterion, the uncertainty and limitations identified in the analysis of the evidence should be used to
 - justify the discussion of the reliability and validity of the experimental process
 - logically derive the suggested improvements and extensions to the experiment.

Additional advice

- Schools should use the ISMG from the syllabus without making any changes to wording or formatting.
- It is not necessary for schools to remove teacher feedback from student responses before uploading them for confirmation, particularly if the feedback is expressed in the language of the ISMG.
- Experimental methodologies should be based on experiments that consider only one dependent variable (e.g. mandatory or suggested practicals from the syllabus) rather than complicated experiments that consider more than one dependent variable or involve complex systems in which external variables are difficult to control.
- As part of the teaching and learning process, teachers should demonstrate the relevant data processing techniques that can be used to identify trends/patterns/relationships and uncertainty/limitations of data in practicals before students use these practicals as a basis for their experiments.
- Teachers should use the strategies identified in the *QCE and QCIA policy and procedures handbook* to
 - manage response length to ensure that student responses meet the conditions of the syllabus
 - promote academic integrity to ensure that student responses clearly demonstrate their students’ own achievement.
- Risk assessments and other sections of the response that are considered as evidence for marking should not be put in the appendix.

Internal assessment 3 (IA3)

Research investigation (20%)

The IA3 research investigation requires students to gather secondary evidence related to a research question in order to evaluate a claim about topics from Unit 4. Students develop a research question, collect and analyse secondary data, interpret evidence to form a justified conclusion, discuss the quality of the evidence and extrapolate the findings of the research to the claim.

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 practices

Validity priority	Number of times priority was identified in decisions*
Alignment	2
Authentication	0
Authenticity	0
Item construction	0
Scope and scale	0

*Total number of submissions: 23. Each priority might contain up to four assessment practices.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that featured:

- claims that could generate multiple research questions, e.g. prolonged drought will change species distribution across Australia
- claims that could be narrowed down into specific and relevant research questions, e.g. damage from natural disasters in Australia can be reduced with better preparedness strategies
- claims that have sufficient data available for students to research, e.g. climate change will cause sea levels to rise
- sufficient claims for the size of the cohort, allowing students to form unique responses to the task
- scaffolding that directed students to address all components of the task
- appropriate drafting and authentication strategies, e.g. collecting progressive samples of student work, interviews with students, using plagiarism-detection software.

Practices to strengthen

It is recommended that assessment instruments:

- contain simple and direct claims that are clearly derived from Unit 4 subject matter, i.e. the cause and impact of Earth hazards and the cause and impact of global climate change
- use claims that are assertions without evidence. Science as a Human Endeavour (SHE) statements from the syllabus can be used as a starting place to develop claims; however, these statements are not necessarily suitable to be directly used as claims.

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 practices

Accessibility priority	Number of times priority was identified in decisions*
Transparency	2
Language	1
Layout	0
Bias avoidance	0

*Total number of submissions: 23. Each priority might contain up to four assessment practices.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that featured:

- clear instructions that aligned to the specifications within the syllabus, the assessment objectives and the ISMG
- a lack of jargon, specialist or colloquial language.

Practices to strengthen

It is recommended that assessment instruments:

- are clearly written with the necessary information a student requires to complete the task to the specifications
- are free from typographical, spelling and grammatical errors.

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 final results

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional
1	Research and planning	97	3	0
2	Analysis and interpretation	100	0	0
3	Conclusion and evaluation	100	0	0
4	Communication	100	0	0

Effective practices

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

- in the Analysis and interpretation criterion
 - limitations of evidence were *thoroughly and appropriately* identified with respect to the research question
 - scientific arguments were *justified* using concepts from Unit 4 subject matter
 - identification of sufficient and relevant evidence drew on qualitative and quantitative data from scientifically credible sources, e.g. peer-reviewed research papers
- in the Conclusion and evaluation criterion, the limitations identified in the analysis of the evidence were used as a basis for the *insightful discussion* of the quality of the evidence.

Samples of effective practices

The following is an excerpt from a response that illustrates the characteristics for the criteria at the performance level indicated. The sample may provide evidence of more than one criterion. The characteristics highlighted may not be the only time the characteristics have occurred throughout the response.

<p>Conclusion and evaluation (5–6 marks) Justified conclusion/s linked to the research question</p> <p>The response uses sound reasoning and valid and reliable evidence to support conclusions that directly respond to the research question.</p>	<p>Analysis</p> <p>Combining the first 3 figures, the proportion of severe tropical cyclones are increasing. For Figure 1, the proportion of category 3 or above tropical cyclones increase at a rate of 0.270% per year (10% for 37 years). For Figure 3, the proportion of category 3 or above cyclones increased at a rate of 0.275% per year (11% for 39 years), while the proportion of category 4 or above cyclones increased at a rate of 0.333% per year (13% for 39 years). In general, all data shows an increasing proportion of severe tropical cyclones in the last few decades and is projected to continue increasing in the future (Dunne, 2020).</p> <p>Figure 4 shows that the mortality rate of coral covers increased gradually in the Great Barrier Reef since 1984, with a dramatic increase in the southern Great Barrier Reef. The hard-coral cover had been decreasing in a similar trend as the mortality rate. From 1984 to 1991, the mortality rate doubled from 1% to more than 2%, while the coral cover dropped from 27% to 22%. The mortality rate due to severe cyclones decreased from 2% in 1991 to 0% in 1994, while the hard-coral cover from 22% to 25%. Since 1995, the mortality rate increased to 4% while the coral cover decreased from 25 to 13.8%. Therefore, the mortality rate had been increasing and coral cover had been decreasing, being inversely proportional to each other.</p> <p>Combining the first 3 figures with Figure 4, the number of severe tropical cyclones increased as both the mortality rate increased and coral cover decreased. They are directly correlated as the number of severe tropical cyclones is directly proportional to the hard-coral mortality rate and inversely proportional to the hard-coral cover.</p>
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Conclusion and evaluation (5–6 marks)
Insightful discussion of the quality of the evidence

The discussion shows understanding of the features of the evidence that affect its ability to respond to the research question.

Evaluation

The inability to completely support the claim revolves around the data itself and selected time frame. Papers from the PNAS only tracked the mortality rate and percentage of hard-coral cover between 1984 and 2012. The absence of data between 2012 and 2020 shows no correlation between severe cyclones and hard-coral.

Hard-coral cover in the Great Barrier Reef shows a decreasing trend as time progresses. Yet, the line of maximum for hard-coral cover in the north Great Barrier Reef increased 27% in 1883 to 30% in 2012. The reason is unclear and further studies are needed.

Therefore, there is no reliable evidence to show the existence of a correlation between the frequency of severe tropical cyclones and the hard-coral's cover percentage and mortality rate between 1970 and 1983, and between 2012 to 2020, fails to definitely answer the research question.

In contrast, evidence of both variables shows a strong correlation between 1984 to 2012, especially between 2006 to 2011, as the only three category 5 tropical cyclones between this period and the percentage cover showed a dramatic decrease from 20% in 2005 to 13% in 2012.

Data on hard-coral cover and mortality rate were surveyed around the perimeter of the reefs with manta-tow technique by the AIMS Long-Term Monitoring Program between 1985 and 2012 instead of model projection. The frequency of severe tropical cyclones was derived from the number of cyclones which were recorded easily by various sources, and in this report, by PNAS both variables' data has high accuracy as they were actual data recorded. Hence, the report can conclude with high validity.

The report measures the frequency of cyclone by decade instead of by year. This can minimise the imprecision caused by nature's variant in weather patterns and the impact from natural climate patterns such as El Niño and La Niña.

Further experiments like recording the sea level temperature during cyclones can be conducted to better understand the cause and intensity of severe tropical cyclones. Refining the report by investigating how water temperature affects hard-coral's mortality rate.

Practices to strengthen

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

- in the Research and planning criterion
 - a *considered* rationale should clearly connect the research question to Unit 4 subject matter
 - a *specific* research question should be explicit enough to be answered within the required response length
 - selection of *sufficient and relevant* sources should provide enough evidence to answer the research question.

Additional advice

- Schools should use the ISMG from the syllabus without making any changes to wording or formatting.
- It is not necessary for schools to remove teacher feedback from student responses before uploading them for confirmation, particularly if the feedback is expressed in the language of the ISMG.
- Teachers should develop resources and teaching/learning strategies that reflect the specific requirements of a research investigation (e.g. a rationale that develops the research question from a claim, extrapolation of findings of the research to the claim) rather than using approaches from previous syllabuses (e.g. extended response task) or other contexts (e.g. literature review).
- Teachers should use the strategies identified in the *QCE and QCIA policy and procedures handbook* to

- manage response length to ensure that student responses meet the conditions of the syllabus
- promote academic integrity to ensure that student responses clearly demonstrate their students' own achievement.
- Risk assessments and other sections of the response that are considered as evidence for marking should not be put in the appendix.

External assessment

Summative external assessment (EA) — Examination (50%)

Assessment design

Assessment specifications and conditions

Description

The assessment instrument consisted of two papers. Questions were derived from the context of Units 3 and 4. Each paper consisted of different types of possible items:

- multiple choice
- short response items requiring single-word, sentence or paragraph responses
- calculating using algorithms
- interpreting graphs, tables or diagrams
- responding to unseen data and/or stimulus
- extended response (300–350 words or equivalent).

Conditions

Paper 1

- Time: 90 minutes plus 10 minutes perusal.
- Other: QCAA-approved graphics calculator permitted.

Paper 2

- Time: 90 minutes plus 10 minutes perusal.
- Other: QCAA-approved graphics calculator permitted.

This assessment was used to determine student achievement in the following assessment objectives:

1. describe and explain the use of renewable and non-renewable resources and the cause and impact of Earth hazards and global climate change
2. apply understanding of use of renewable and non-renewable resources and the cause and impact of Earth hazards and global climate change
3. analyse evidence about the use of renewable and non-renewable resources and the cause and impact of Earth hazards and global climate change to identify trends, patterns, relationships, limitations or uncertainty
4. interpret evidence about use of renewable and non-renewable resources and the cause and impact of Earth hazards and global climate change to draw conclusions based on analysis.

Paper 1 Section 1 was 15 multiple choice questions (15 marks).

Paper 1 Section 2 was 5 short response questions (35 marks).

Paper 2 Section 1 was 5 short response questions (38 marks).

Paper 2 Section 2 was 1 extended response question (15 marks).

Assessment decisions

Overall, students responded well to the following assessment aspects:

- Unit 3: Living on Earth — extracting, using and managing Earth resources; Topic 2: Use of renewable Earth resources
- Unit 4: The changing Earth — the cause and impact of Earth hazards, Topics 1 and 2.

Effective practices

The following samples were selected to illustrate highly effective student responses in some of the assessment objectives of the syllabus.

Multiple choice item response

Assessment objective: Objective 2 — Apply understanding

Item: Paper 1, Question 1

This question required students to identify the most likely reason for the location of volcanoes down the western side of South America (a figure of South America that included volcano location and the tectonic plate boundaries was included).

The options were:

(A) two tectonic plates diverging, resulting in exposing the asthenosphere

(B) two tectonic plates colliding, causing the Earth to crack along the continental coast

(C) the heavier oceanic plate subducting under the lighter continental plate, resulting in a volcanic arc forming along the continental coast

(D) the continental plate cracking due to pressure and moving under the oceanic plate, making the continent grow larger through the formation of volcanoes

Option	Validity statements
A	Diverging plates initially produce rifts, which eventually become rift valleys.
B	Colliding plates form a subduction zone where the subduction zone is destroyed and mountains are formed.
C	Key
D	Cracking of the continental plate would be less likely to form a uniform arc of volcanoes in the pattern described.

Assessment objective: Objective 1 — Describe and explain

Item: Paper 1, Question 7

QUESTION 7

What is the minimum requirement for maintaining a sustainable flow of water in a river system?

- (A) maintaining the level of water extraction below annual recharge
- (B) stabilising the riparian vegetation along the river system
- (C) constructing flood levees to control water flow
- (D) maintaining biodiversity in the river ecosystem

This question required students to apply their understanding of sustainability to water flow in a river system.

Option	Validity statements
A	Key
B	This would not significantly affect flow.
C	This would stop the flow.
D	This would not significantly affect flow.

Short response

Assessment objective: Objective 1 — Describe and explain

Item: Paper 2, Question 1

Effective student responses:

- stated an introduced pest species
- stated two reasons the introduced pest species is classified as a pest
- stated three positive influences of an anthropogenic activity
- stated three negative influences of an anthropogenic activity.

Student sample of an effective response

<p>Describe and explain (9 marks)</p>	<p>QUESTION 1 (9 marks)</p> <p>a) Identify an introduced animal or plant species and explain two reasons why this species is classified as a pest. [3 marks]</p> <p>Introduced species: <u>cane toad</u></p> <p><u>The cane toad is a pest as it competes with native species for food such as bugs, and disrupts food chains as they poison the predators that eat them.</u></p> <p>b) Using a case study about an anthropogenic activity other than introducing a pest species, discuss three positive and three negative human influences on the sustainability of an ecosystem on a local scale. [6 marks]</p> <p>Anthropogenic activity: <u>fishing</u> ^{local}</p> <p><u>A positive influence of fishing on a local scale is that fishing is able have a slight to apply slight control over a population of fish. This benefits the ecosystem as it allows other species to flourish, increasing biodiversity. Another is that the local community is able to be educated about fishing sustainability, possibly resulting in local regulation of fishing. Another influence positive influence would be the development of sustainable fisheries which will reduce the impact on the natural fish population. Negative influences may include overfishing, or which would disrupt the local food chain. Another negative influence would be pollution such as fishing lines and nets, reducing marine biodiversity. A third negative impact would be the destruction of marine habitats by using damaging fishing techniques such as explosives.</u></p>
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This excerpt has been included to show a typical response that received full marks.

Assessment objective: Objective 4 — Interpret evidence

Item: Paper 1, Question 18

Effective student responses:

- stated grass species 1 and 2 are negatively affected
- identified supporting evidence from the stimulus.

Student sample of an effective response

Interpret evidence (5 marks)	<p>QUESTION 18 (5 marks)</p> <p>This question refers to Stimulus 2 and 3 in the stimulus book.</p> <p>A mine that opened in 2014 was surrounded by semi-open woodland. As part of the mine's environmental plan, soil pH was monitored at four sites around the mine. The distribution of three native grass species, a woody weed species and an annual weed species was also monitored and recorded.</p> <p>a) Draw a conclusion about which plant species were negatively affected by the operation of the mine. Use data from the stimulus to support your response. [2 marks]</p> <p><i>Plant species</i> Grass species 1 and grass species 2 were negatively affected by the mine. This is because according to Stimulus 3, these two plant species were the only two to decrease in distribution from 2014 to 2019. Grass species 1 changed from 15% to 11%, and grass species 2 changed from 21% to 13%.</p>
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This sample has been included to show a typical response that received full marks.

Extended response

Assessment objective: Objective 4 — Interpret evidence

Item: Paper 2, Question 6

This question had stimulus that included a map of Puerto Rico showing the location of three towns and historical data about earthquake activity and depth over the last few centuries. Other stimulus included a description of the Richter scale.

Effective student responses:

- drew upon information from the stimulus table map and graph to present a fully synthesised and supported response based on evidence and reasoning.

Student sample of an effective response

Interpret evidence (15 marks)	<p>QUESTION 6 (15 marks)</p> <p>This question refers to Stimulus 5 and 6 in the stimulus book.</p> <p>a) Justify the decision of the Puerto Rican government to move the Department of Civil Defense to Ponce instead of Mayagüez, referring to both stimulus to support your response. [8 marks]</p> <p>Mayagüez is situated along the western coastline where a major earthquake measuring 7.5 on the Richter Scale ^(Stimulus 6) occurred killing 147 people. A similarly sized earthquake would near a populated area would put the Department of Civil Defense at risk of having buildings destroyed and lives lost during the earthquake and subsequent tsunami (Stimulus 5). Mayagüez is in close proximity to a concentration of earthquakes in the A-D and 6-8 areas whereas Ponce has is close to 2 earthquakes in the last 2 years in D9 and E9 although its epicentre is 300km deep (Stimulus 5) reducing its overall effect. Ponce is also close to recent earthquake epicentres in I8 and J6 however the potential for tsunamis is low due to the land southeast of Ponce blocking potential waves from the area. Another 7.5 earthquake rated at 7.5 on the Richter scale in or around B6 would not could caused landslides, destruction of buildings including the m. including the Department of Civil Defence building if built with timber and masonry construction (Stimulus 6). Regardless, the building would face considerable damage. The earth past earthquake epicentre in D7 was just 34-70 km deep (Stimulus 5) which increases it increases its likely hood of causing not causing major damage from tsunamis and earthquakes.</p>
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This sample has been included to show part of a response that received full marks despite using alternative wording to the expected response.

Practices to strengthen

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

- that numeracy skills (e.g. calculating percentage change) should be reviewed and maintained over the length of the course
- the cognitive verb as a guide to determining the expected response, e.g. 'explain' is used when students are required to make an idea or situation plain or clear by describing it in more detail or revealing relevant facts
- referencing the stimulus in responses to questions.