# Scientific Studies Subject Assessment Advice

## Overview

Subject assessment advice, based on the previous year’s 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

Investigation Folios provide opportunity for students to undertake practical investigations, design tasks and an issues investigation task. In the investigations folio, it is appropriate to assess the specific features of Investigation, Analysis and Evaluation, Application and Knowledge and Understanding.

Typically, it is most effective to have students complete the School Assessment component using a theme to enable students to demonstrate knowledge across a range of concepts.

The more successful responses commonly:

* provided opportunity for students to individually design, report quantitative data, and then analyse the data with respect to scientific concepts, errors, accuracy, and improvements before drawing a conclusion
* used standard features of scientific reports, such as the presentation of tables with appropriate headings and units, and correctly formatted graphs effectively and accurately
* used terms such as ‘random and systematic errors’, ‘accuracy’, and ‘reliability’ appropriately
* designed at least one practical investigation individually
* were provided with teacher feedback regarding topic selection when choosing an issue to investigate
* chose a topic for their issues investigation that enabled critical evaluation of the relevant science related to the issue
* posed their evidence as an argument, to ensure adequate exploration from a variety of viewpoints. Most students who performed in the A band posed their topic as a question that clearly enabled the discussion of different viewpoints.
* evaluated their sources for bias, accuracy, and suitability
* critically selected material from a range of sources, including peer-reviewed articles, government websites, and scientific journals, along with other credible primary sources
* included have in-text referencing and an appropriately formatted reference list.

The less successful responses commonly:

* were based on practical tasks where students simply answered questions related to the concepts, thus often limiting the ability of students to analyse the data or evaluate procedures
* collected subjective or qualitative data, or failed to collect a large enough sample size for appropriate analysis
* did not address an appropriate issue, or did not argue alternative points of view and just did an information report
* completed issues investigation tasks without appropriate referencing of research.

Assessment Type 2: Skills and Applications Tasks

The broad range of options afforded to schools when designing skills and applications tasks allowed for the theme(s) used in the investigations folio to be carried through this assessment component. Examples included environmental science, human biology, the physical world, and aviation. A growing trend among schools was the idea of sports science or human movement.

A variety of assessment tasks were used within this assessment type, and teachers are encouraged to use tasks that best meet the learning needs of the students in their classes and that enable the specific features associated with all of the assessment design criteria to be assessed.

The more successful responses commonly:

* enabled students opportunity to evaluate, explain and interpret information from a range of concepts in a variety of formats
* showed depth of knowledge and understanding across a range of concepts
* provided logical answers to questions across all formats, demonstrating an ability to apply their knowledge
* in research tasks and oral presentations were detailed, and provided evidence of comprehensive research to answer questions that required a range of skills, not just recall
* made logical connections between a range of concepts, data and scientific issues across all the tasks.

The less successful responses commonly:

* involved tasks that only required students to recall information from a selection of simple concepts
* did not involve assessment that required students to demonstrate analysis and evaluation
* showed basic understanding in simple recall questions
* consistently provided limited answers to problem solving type questions
* when presenting information for research tasks or oral presentations, provided limited evidence of deeper understanding. Often the evidence was a PowerPoint that listed some basic concepts, but provided no evidence of analysis or connection to data or an issue, as an example.

# External Assessment

Assessment Type 3: Practical Investigation

Students do an individual practical investigation on a topic of choice. The report includes evidence of a proposal, method design, data collection, analysis and evaluation and an understanding of the science underlying the investigation performed. The assessment design criteria that are assessed include

* investigation — I1 and I4
* analysis and evaluation — AE1 and AE2
* application — A2
* knowledge and understanding — KU1 and KU3.

It is important for the success of the student, that teachers assist them to choose an investigation that enables students to design their own method, have sufficient time to do the experiment to collect an appropriate amount of data and that the investigation enables evaluation of the outcomes.

The more successful responses commonly:

* featured student work that had been edited after the completion of the initial design process with a discussion of topic choice and the science behind the investigation
* included a method that was detailed and well-considered which related to the stated aim of the experiment
* had a method design that included an appropriate sample size to enable valid conclusions to be suggested based on a fair investigation
* stated an hypothesis that clearly indicated a prediction for the effect of the independent variables on the dependent variable
* clearly and logically made connections between the data obtained and the relevant scientific concepts involved
* discussed the potential effect of random and systematic errors on their data and how these may have affected the reliability or accuracy of the results obtained
* considered relevant and specific improvements to their method to improve the outcomes of the experiment.

The less successful responses commonly:

* occurred where teachers narrowed the choices of investigation topics available to their students to a particular theme (e.g. vitamin C, fermentation, or catalase)
* occurred when students conducted the same practical but with a different independent variable. This must be discouraged in Scientific Studies as it is very hard to assess a proposal when identical methods are used
* were evident when a recipe investigation or one that is better suited as a formative investigation was used. Students must focus on the science behind their topic in order to illustrate their understanding through analysis of data
* used simulation practicals which do not fit within the concept of practical investigations, as prescribed in the subject outline for Scientific Studies. Simulations deliver predetermined values derived through the use of a computer program
* featured psychology-based investigations that are reliant upon quantitative subjective data, i.e. the data is based on the opinion of subjects involved. Scientific Studies, however, expects the data to be quantitative objective data, i.e. measured data, rather than data based on opinion
* displayed common faults in the design aspects, such as simple results being obtained, lack of replication, inadequate sample size, and limited analysis of the data collected in relation to the relevant scientific principles
* used an inadequate sample size and did not reproduce the data to allow for discussion of averages, scatter, or anomalies in their report
* conducted an experiment in pairs or groups rather than individually, or modified a class practical which had been done earlier as a trial. These actions made it difficult for the markers to discriminate between what was undertaken by individual students
* wasted word-count on elaborate background information or an abstract
* had a confused understanding of key terms for the analysis and evaluation of the investigation e.g. precision, reliability, accuracy etc
* included a generic discussion relating to how their investigation could be improved.

Some of the components of the report are discussed in more detail below.

**Proposal**

The more successful responses commonly:

* featured clear teacher feedback on the original design proposal that was clearly used to develop the resubmitted and edited version
* a proposal that was detailed and included all components expected when designing an investigation: clear aim, hypothesis, variables, materials and a detailed step by step method.

The less successful responses commonly:

* indicated no change to the original student design, although it is expected that changes should be evident after consultation with the teacher
* contained flaws in the original proposal, some of them major; however, little or no attempt had been made by students to correct them in the final report
* included only one copy of the design component, therefore it was unclear whether it was the student’s original design proposal or the edited version
* copied their method from a source such as the Internet and did not design their own investigation.

**Results**

The more successful responses commonly:

* used appropriate calculations (e.g. means) for their data and presented this information as summary data (e.g. tables and/or graphs) in their report, along with any mathematical equations, and maintained a consistent number of significant figures in all data
* placed all raw data in tables as appendices
* presented their summary data in tables with clearly stated and appropriate titles, headings, and appropriate units
* presented their summary data in graphs with consideration given to appropriate graph format, which is determined by the nature of the investigation. That is, if the data is continuous (such as a range of concentrations, times, or pHs), then the data must be plotted as a line graph (showing the points with a line of best fit), whereas non-continuous data (different age groups, or genders) must be plotted as a histogram
* ensured that in the case where multiple graphs were used, the same scale was used on the y-axis in each graph so as to best represent the data.

The less successful responses commonly:

* included copious tables and graphs, rather than combining their data into a summary of their findings
* provided graphs drawn with programs such as Excel, where the x-axis is drawn incorrectly, arising from choosing the wrong format for line or scatter plots
* used an incorrect line of best fit; for instance, chose a straight line of best fit rather than a curved line of best fit, which then inappropriately represented the data
* presented qualitative results only. For example, some experiments involving micro-organisms were just ‘qualitatively’ analysed by photographs, rather than zones of inhibition of bacterial growth; or other experiments had subjects rate their feelings of taste or hardness or texture, which provides only subjective data.

**Analysis and Evaluation**

The more successful responses commonly:

* linked the data collected to scientific theory, with an understanding that specific feature AE1 requires students to demonstrate their ability to find patterns in the data and link data with concepts. Topic choice is significant, as an investigation with links to scientific concepts allows students to critically and systematically discuss their findings
* discussed outliers, where they existed within their data, and what the implication of outliers might have on the analysis of their data
* displayed a strong understanding that random and systematic errors differentiated between types of errors, and provided explicit examples of where errors may have skewed or influenced the results
* discussed the effect of sample size and repetition on random error or anomalies in the data to help verify results obtained within the investigation
* articulated an understanding of the terms ‘accuracy’, ‘precision’, ‘scatter’, and ‘reliability’ within their report.

The less successful responses commonly:

* were clearly heavily scaffolded, as the layout and phrases, and often sentences, were identical across the class, making it impossible to discern student work from teacher assistance
* focused on regurgitation of raw data, without making any links to the science behind the emerging patterns in the data
* indicated that there were no errors in the investigation or did not accurately discern between random and systematic error
* revealed that many students were not fluent with appropriate scientific terminology and either neglected to address all designated specific features being assessed or misused terminology
* failed to adequately discuss their findings due to limited data, because a small sample size was tested or lack of repetition occurred
* discussed superficial improvements to the investigation, particularly where the method was not followed and students restated a component of the method. A discussion of ‘appropriate improvements’ needs to be more than a list of errors.