**Assessing Specific Features in Scientific Studies**

When assessing student work against the specific features described in the Scientific Studies subject outline, the following pointers may assist in making judgements about the quality of the evidence provided.

relates to scientific method / relates to engineering design

| Specific Feature | Evidence assessed | Higher quality evidence | Lower quality evidence |
| --- | --- | --- | --- |
| **IAE1** Investigation design | * Deconstruction of a problem
* Hypothesis and variables, or an investigable question
* Materials/apparatus
* Method that outlines the trials and steps to be taken
* Controlled and uncontrolled factors
* Identification and management of safety and/or ethical risks
* Justification for the design
 | * Detailed deconstruction exploring a range of aspects of a problem with critical thinking, such as:
* identifying factors or variables that impact the problem
* explaining how these factors or variables impact the problem
* Detailed design of a scientific investigation for which outcome is uncertain (scientific method below in blue / engineering design process in red)
* Hypothesis expressed with single independent variable in conventional format / identification of success criteria to determine viability of prototype
* Method is a valid test of the hypothesis proposed / success criteria
* Method has sufficient detail to be implemented without further information (e.g. specific apparatus/equipment, primary data to be collected)
* Method could be realistically implemented
* Detailed justification for aspects such as:
* selection of method
* variables
* quantities
* mode of measurement
* Explanation of how and why to control range of variables
* A suitable range of values/variations of the independent variables tested
* Suitable sample size for repeated measurements of the dependent variable
* Blank data table to show primary data to be collected and recorded
* Description of expected results or findings
* Discussion of relevant safety or ethics
 | * No evidence of deconstruction of a problem
* Outcome is known before the investigation is designed
* Hypothesis missing/unsuitable/inappropriately expressed, or addresses multiple independent variables / Success criteria of prototype to determine viability is missing or inappropriate
* Method is a commonly used procedure with minimal or no individual changes
* Method lacking detail (e.g. specific apparatus/equipment, data to be collected) or would be difficult to actually implement
* No justification for any aspect of the design
* Minimal discussion of variables
* Lacking consideration of how/why to control range of variables
* Unclear what data is to be collected
* No discussion of specific safety or ethics
 |
| **IAE2** Representation of data | * Tables with headings and units
* Significant figures
* Graphs formatted appropriately with axes labelled
* Line of best fit
 | * Tables clearly structured and labeled
* Graphs appropriate for the data, correctly labelled, suitable scale, easy to interpret
* Appropriate line of best fit
* Appropriate conventions for data e.g. averages, sig figs
 | * Tables difficult to interpret
* Huge amounts of raw data are tabulated without averages
* Graphs are difficult to interpret
* Incorrect type of graph/line of best fit was constructed
* Conventions such as sig figs, labels, units of measurement not/incorrectly used
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| **IAE3** Analysis | * Interpretation of data
* Trends, patterns, relationships
* Conclusion with justification
* Limitations of conclusion
 | * Trends in data described
* Effect of outlier(s) or aberrant values considered
* Thorough, accurate interpretation of data relevant to the investigation
* Data related to relevant science concepts
* Sample calculation of processed data included
* Possible explanations for causes of unexpected results explained
* Uses findings from data analysis to form a relevant conclusion
* Justification of conclusion by referring to results
* Discussion of limitations of conclusion(s) e.g. how widely they could be applied
 | * No reference to data in interpretation/justification
* Limited/no justification for the conclusion
* Little understanding of limitations of the conclusion
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| **IAE4** Evaluation | * Control of sources of uncertainty
* Effects of errors on reliability, accuracy, validity of data
 | * Accurate identification and discussion of specific systematic and random errors
* Relevant links between errors and method
* Explanation of how each of the errors affect precision and accuracy of results and reliability of conclusion.
* clarity in discussion of precision, accuracy, reliability and validity
* evaluates the appropriateness of the method to meet the aim of the investigation
 | * Random errors simply listed/defined
* Mistakes confused with errors
* Confusion between random and systematic error (or between precision and accuracy)
* Very limited discussion or understanding of how significant the effects of errors are on the results
* Generic explanation of the effect on data, not related to the specific investigation
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| **IAE5**Collaboration | * Evaluation of communication, leadership, contribution within group
* Impact on group outcome (e.g. ensuring the reliability of data obtained)
 | * Accurate and fair evaluation of group dynamics that consider a range of contributing factors relating to:
* Building a shared understanding of the inquiry, e.g.:
	+ effective communication within the group
	+ roles and responsibilities are negotiated and allocated appropriately
	+ timelines and ways of working are agreed
	+ all resources and information is shared with all group members and used effectively
* Contributing collectively to their agreed responsibilities, e.g.:
	+ active and purposeful participation, especially when facing challenges/problems
	+ the perspectives/contributions of others are acknowledged and understood
	+ tasks and responsibilities are carried out according to the agreed plan and the engagement of others is monitored
* Regulating behaviours and actions to maintain shared understanding, e.g.:
	+ the constructive contribution and progress of self and others is shared and monitored
	+ conflict or differences are resolved productively, with sensitivity
	+ actions and contributions of team members adapt to suit individuals in their group
* Identifying effect(s) of group members’ behaviour/activities on achieving ‘successful’ results outcomes, e.g., applies scientific procedures consistently across group to promote the reliability of results/outcomes
* Specific, suitable examples provided to illustrate aspects of evaluation and effects on success.
 | * *Describing* rather than *evaluating* the collaboration
* General comments e.g. ‘Everyone worked well.’
* Very limited recognition of how members worked together
* Unfairly biased perspective of how the group worked together
* Little recognition of how group members’ behaviour/actions affected the outcome of the inquiry
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| **KA1** Knowledge | * Depth and understanding of concepts
 | * Explanations of concepts show depth and detail (in specified tasks or sections)
* Only occasional inaccuracies
 | * Explanations of concepts lack depth and detail (in specified tasks or sections)
* Understanding of concepts (particular ones specified) very weak
* Questions often not attempted/partially answered
* Significant misunderstanding of concepts
* Mostly only recall of simple concepts correct
* Absence of more complex explanations
* Inaccuracies common
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| **KA2** Application | * Use of knowledge in new and familiar contexts
 | * Understanding of concepts (particular ones specified) demonstrated in application in both familiar and unfamiliar contexts
* Ability to solve problems, clearly communicating problem solving method
* Evidence of research in more complex explanations
 | * Weak problem-solving skills
* Difficulty applying understanding in an unfamiliar context
* Confused explanations
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| **KA3** SHE | * Interaction of science and society
* Examples of the key SHE concepts
 | * Answers to questions (in SATs) clearly show the interaction between science and society
* SHE concept(s) specifically addressed
* SHE concepts identified then further discussed
* SHE concepts linked to the topic
* Interaction between science and society integral to the discussion
* Selection of a focus for the SHE report linked to the focus of the program, allowing relevant science to be included
* SHE report focusses on exploring the interaction between science and society but with appropriate attention to the relevant science
 | * Selected focus of SHE report not linked to the focus of the program or has content that is too simple or too complex
* Interaction between science and society not discussed
* SHE concepts not specifically addressed or hidden in the report
* SHE concepts only stated and not specifically discussed
* SHE concepts not linked to any aspects of the topic
* An information report prepared rather than a SHE investigation report
* The focus of the SHE report limits the amount of science that could be included
* SHE report focusses on the science theory rather than exploring the interaction between science and society
* Lack of understanding/explanation of connection between science and society
* Very little science in the SHE report
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| **KA4** Communication | * Representations such as formulae, equations, diagrams
* Scientific terminology and conventions
* Language skills
 | * Easy to read and interpret
* Conventions using formulae or equations, drawing and labelling diagrams clear and accurate
* Conventions for acknowledging sources (in-text, reference list) regularly applied
* Appropriate scientific terminology correctly used
* Reports are coherent
* Structure of practical report appropriate, including all parts specified in subject outline
* Concise explanations
* Remaining within word limit
 | * Sentences are very difficult to read and interpret
* Conventions using formulae or equations, drawing and labelling diagrams frequently inaccurate
* Conventions for acknowledging sources (in-text, reference list) not/irregularly applied
* Appropriate scientific terminology rarely/incorrectly used
* Reports lack coherence
* Repetition
* Elements of practical report missing
* Exceeding word limit
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| **General comments for teachers** | * Inquiry Folio – Science Inquiry Skills tasks
 | * Open ended tasks allow students to investigate problems *rather than* tweak existing methods
* Task allows for exploration of situation with uncertain outcome
* Opportunities to ponder, discuss, and research problems leading to creative deconstructions.
* Tasks focused on science inquiry skills
* Sufficient balance of descriptions and explanations in tasks
* Tasks give the opportunity to analyse graphs and other data
* Tasks provide opportunity to apply knowledge and understanding in unfamiliar contexts
 | * The scaffolding in investigation(s) limit the ability of the student to show a high level of capability/analysis/evaluation.
* Very prescriptive tasks not allowing students to provide evidence of their deconstruction and investigation design skills.
* Tasks focused on only recall and/or science understanding with little opportunity to show understanding application
* Tasks focus too heavily on the routine and on recall
* Set of tasks provide little opportunity to explain concepts in depth/ apply understanding in new contexts
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| * Inquiry Folio – Science as a Human Endeavour task
 | * Task clearly directs students towards a SHE investigation *rather than* a research topic
* Highlighting that the focus of the SHE task is the interaction between science and society
 | * Task directs students towards an issues investigation rather than a SHE investigation
* Focus is not contemporary
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| * Inquiry Folio – Inquiry Design Proposal
 | * Task provides opportunity for innovation
* Inquiry allows for exploration of situation with uncertain outcome
* Investigation has a real-life context
 | * Task sets up students to simply tweak an existing method
* Inquiry is not related to the focus of the program
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| * Collaborative Inquiry
 | * Task provides opportunity for wide-ranging ways of investigating or solving the problem
* Groups organised to maximize success
* Solutions to the investigation do not necessarily depend on expensive or extensive equipment.
 | * Solution to the problem is too elementary or too complex
* Outcome of the investigation is already ‘known’.
* Task is not clear about the requirements for the pitch.
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| * Individual Inquiry
 | * Feedback on the proposal enables the investigation to be put into practice with a reasonable expectation of obtaining results.
 | * Method implemented by the students has a flawed procedure preventing them from obtaining useful/relevant data because of insufficient feedback.
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