IB Biology Internal Assessment (IA)

Primary Data Investigations (Student-Collected Data)

Complete Section-by-Section Guide to score 24/24

Based on: IB Assessment Criteria (first assessment 2025) | TSM (Unpacking the IA) | May 2025, Nov 2025 and May 2026 Subject Reports

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Version 2

HOW TO USE THIS GUIDE

This guide is organized by IA section, in the order they must appear in your report. Sections contain:

- A description of what belongs in each section
- A detailed checklist of required elements
- The IB band descriptor that separates a 3–4 from a 5–6 (explained vs. described)
- Suggested formatting for tables/graphs
- Common mistakes to avoid

⚠ AVOID / COMMON MISTAKE

THE CAP RULE – Read this first!

Strands are NOT averaged within a criterion → The LOWEST strand caps the entire criterion score.

For example, if Strand 1 = 5–6, but Strand 2 = 3–4, your maximum for that criterion is 4 marks – regardless of the strength of the other strands.

The single most important language shift: moving from DESCRIBED (3–4) to EXPLAINED/JUSTIFIED (5–6). Students who describe their choices land in the 3–4 band. Students who explain WHY land in the 5–6 band.

CRITERION A – RESEARCH DESIGN (6 marks)

This criterion assesses how effectively you communicate the methodology – both its purpose and its practice – used to address your research question. All three strands must reach the 5–6 band.

1. Research Question

The RQ is the title of your IA. It must be specific, focused, and describes exactly what is being investigated.

Required elements (for 5–6 band)

- **IV stated with full range and units**
- **DV stated with unit and measurement period** (where applicable)
- **Study organism named** – common name (*Species name*)
- **Measurement method hinted** – either named in the RQ or made immediately clear in the context
- **Location and time of year/season** – for field studies
- **Consistent wording** – copy-paste the RQ; needs to be written *identically* everywhere in the IA

✅ **FOR 5–6 BAND:** RQ explicitly states IV (with range and units), DV (with unit and measurement method and time period), and study organism. The question directly implies WHY measuring this DV answers the RQ.

⚠ AVOID / COMMON MISTAKE

Do NOT write the RQ as a yes/no question – use sentence starters like 'how does' or 'to what extent'. Do NOT omit the range of IV. Do NOT use vague terms like 'amount' – use proper SI units. Do NOT use 'biomass' or 'weight' when you mean mass. Do NOT state a *vague* derived DV (e.g. "rate of growth") that hides the raw measurement. A rate is acceptable only if the raw measurement and time base are explicit.

2. Background

The background provides all theory and context a reader needs to understand and follow the investigation. It must justify (not just introduce) the link between your IV and DV using correctly cited academic sources.

Required elements (for 5–6 band)

- **Specific context** – describe the exact biological system in which the RQ is embedded (not just the broad topic)
- **Detailed biological explanation** – explain the main biological process(es) directly involved in your investigation with enough depth to interpret future results
- **IV–DV relationship explained** – use theory to establish WHY changing the IV will affect the DV in a biologically meaningful way
- **Study organism justified** – explain why *this* organism was chosen (availability, relevance to the biological process, ethical considerations, practicality in data collection, etc.)
- **Prior peer-reviewed studies cited** – describe what is already known and identify the specific gap this IA addresses
- **Figures where helpful** – include a diagram or image (with Figure caption and in-text reference) if it helps explain a process or the experimental system.
  - ➔ Adapt figures from textbooks/published papers (adapted from…) or create using bioicons + **draw.io** extension

✅ **FOR 5–6 BAND:** Background focuses on the EXACT variables being tested - not a general topic overview. Sources are peer-reviewed and are cited correctly. The reader understands clearly why this measurement answers the specific question.

⚠ AVOID / COMMON MISTAKE

A broad overview of a topic is insufficient. You must connect the theory directly to YOUR specific IV and DV. Background sources cited here must also be revisited in the Conclusion. Do NOT include a section explaining why you chose this topic (i.e. personal engagement) as this is no longer assessed and wastes word count. **Academic sources only** – peer-reviewed journal articles, textbooks, and trusted institutional sources; NOT general websites like blogs, Wikipedia or biology revision sites

3. Hypothesis

Technically optional but strongly recommended. A hypothesis provides a specific, falsifiable prediction and helps situate the RQ within biological theory. Do NOT write in null/alternative form unless you plan to use formal significance testing – in that case, null/alternative hypotheses belong in the Statistical Analyses section.

Required elements

- **Specific directional prediction** – state how each IV group will affect the DV
- **Biological justification** – explain WHY you predict this outcome using theory from the background/past studies
- **Predictive graph (recommended)** – a hand-drawn or simple graph showing the hypothesised line/curve of best fit; label axes with units

4. Independent Variable (IV)

Describe what you are manipulating, how you are manipulating it, and WHY you chose this range and these specific increments.

Required elements (for 5–6 band)

- **Variable stated clearly** – named with full SI units
- **Experimental groups listed** – 5 groups (4+ treatment groups plus a control) is recommended for robust data. For continuous IVs aiming at correlation, prioritize more IV levels across the range
- **Control identified and justified** – explain what the control is and WHY it is the appropriate baseline (if relevant)
- **Control experiment (if relevant)** – if your IV could affect the substrate or the measurement rather than the biological process itself (e.g. high temperatures melting gelatine in a protease investigation), include a treatment without the enzyme/organism to show the effect is real
- **Range justified** – explain WHY this range is biologically meaningful (use a pre-trial or published literature as support for the chosen range)
- **Increments justified** – explain WHY these intervals were selected (equal spacing, log scale, published optima, etc.)
- **How IV is applied** – describe exactly how each IV level is prepared/applied – if explained in detail here, this can be cited later in the methodology or vice-versa

✅ **FOR 5–6 BAND:** Both range AND increments are justified using biological reasoning supported by citations or pre-trial data. The justification explains the biological significance of the chosen boundaries

⚠ AVOID / COMMON MISTAKE

'I chose these concentrations to get a range of data' is a generic justification and places you in the 3–4 band. EXPLAIN the biological relevance of your range limits. If pre-trialling was done, include a brief description of what was done and why and the decisions made as a result.

5. Dependent Variable (DV)

Describe exactly what is being measured, how it is measured, when it is measured, and WHY this measurement is appropriate for addressing the RQ.

Required elements (for 5–6 band)

- **Variable named with SI units and time period**
- **Measurement method described** – explain the procedure clearly with apparatus named
- **Apparatus diagram/image included** – either here or in the Methodology section; include a Figure caption and reference it in text
- **DV selection justified** – explain WHY this measurement best answers the RQ (why not another proxy? why this time period? why these units?) – use a pre-trial or published literature as support
- **Number of repeats per group** – state the number of trials per group and justify why this is sufficient for the planned statistical test (minimum of 5 trials per group is required as the IB minimum for a reliable SD). If you plan a t-test, aim for at least 10 trials per group (the TSM states that "for an effective t-test, at least 10 replicates are needed"); with 5–9 per group, use Mann-Whitney U and explain why

⚠ AVOID / COMMON MISTAKE

5 trials is the absolute minimum number of trials per experimental group and is considered 'very small' for statistical test purposes. Prioritise sufficient trials over multiple IVs or an overambitious range. If more than 5 per group is possible, do so.
* If germination success is the DV, lots of 10 seeds per trial (n=10 x 5 per IV group) or more should be done

6. Control Variables

Control variables are factors (other than the IV) that could affect the DV and that you will actively hold constant. For each one, explain the biological impact, describe how it is controlled, and justify the value chosen.

TABLE FORMAT REQUIRED

Present control variables in a table with three columns: (1) Variable name, (2) Biological impact on DV – explained with a citation, (3) Method of control – including specific values, apparatus, and justification.

Controlled Variable	Biological Impact	Method of Control

For EACH control variable – required elements (for 5–6 band)

- **Variable named**
- **Biological impact explained** – WHY would this variable affect the DV if left uncontrolled? (cite a source)
- **Method of control described** – HOW is it kept constant? Include specific apparatus and values
- **Value justified** – WHY was this particular value chosen as the constant?

✓ **FOR 5–6 BAND:** Each control variable has a clear chain: variable → biological impact on DV (explained with citation) → specific method of control (with apparatus and values) → justification of the chosen value.

⚠ AVOID / COMMON MISTAKE

Simply 'keeping everything in the same room' is NOT sufficient control. You must describe HOW you monitored/maintained each variable. Control variables should be relevant to the investigation and not generic (e.g. "gravity" or "atmospheric pressure").

7. Uncontrolled Variables

Uncontrolled (confounding) variables are factors that could affect the DV but cannot be held constant – only monitored. Distinguish these clearly from control variables.

TABLE FORMAT REQUIRED

Present uncontrolled variables in a table with three columns: (1) Variable name, (2) Biological impact on DV – explained with a citation, (3) How it will be monitored throughout the investigation and how this monitoring will allow you to determine whether it influenced results.

Uncontrolled Variable	Biological Impact	Method of Monitoring

8. Materials & Apparatus

Provide everything the investigator needs to conduct the investigation, in as much detail as possible.

List Materials and Apparatus separately for added clarity.

Materials	Apparatus
• Each item listed with: – Quantity (e.g., x5) – Amount with unit (e.g., 200 mL, 5 g) – For chemicals: concentration (e.g., M, %) and volume/amount – For containers: dimensions/size – Brand/model if used as the variable (e.g., specific fertilizer brand)	• Each item listed with: – Units and precision (±) – Brand and/or model if known

9. Safety Considerations

Identify all hazards in the investigation and explain how each will be mitigated. If there are genuinely no hazards, provide a justified statement explaining this.

TABLE FORMAT REQUIRED

Present in a table with three columns: (1) Hazard name (chemical, organism, apparatus, or procedure), (2) Nature of the potential harm – supported by a reference (e.g., MSDS/SDS data sheet), (3) Mitigation measure – specific action taken to minimise or eliminate the risk – also supported by a reference.

Hazard	Nature of Hazard	Method of Mitigation

Additional requirements

- **Bacteria/microorganisms** – state the source and confirm non-pathogenic status with a citation and source; state the incubation temperature and justify it – never incubate at body temperature (37 °C); cultures are grown only in the school lab, never at home
- **Waste disposal** – addressed here AND in Environmental Considerations (if disposal poses hazard risk)
- **Mitigation, not just identification** – stating a hazard is not the same as mitigating it; each hazard needs a specific action that was actually taken

10. Environmental Considerations

Explain and justify how ALL materials, organisms, and chemicals will be properly disposed of at the conclusion of the investigation. Support every disposal method with a reference (MSDS, institutional protocol, peer-reviewed source, etc.)

11. Ethical Considerations

Include only if relevant. If no ethical considerations apply, you may omit this section entirely.

When to include and what to address

- **Animals used** – follow IB guidelines; explain what measures were taken to minimise harm and distress
- **Human participants or secondary data** – explain how consent was obtained, how data will be used and stored during and after the investigation, and how anonymity is protected. Human bodily samples (e.g. saliva, urine) are normally not permitted; if your teacher approves an exception, documented consent and a stated handling and disposal method are required
- **Plants/yeast/microorganisms** – address ethical treatment where relevant; this may overlap with Environmental Considerations

12. Methodology

A detailed, step-by-step procedure that allows any reader to fully replicate the investigation. This is a RECORD of the method actually used to collect data.

Required elements (for 5–6 band – Criterion A, Strand 3)

- **Separated into subsections** – use subheadings to organise the procedure into logical parts (e.g., Creating Chemical Solutions, Setup, Data Collection, etc.)
- **Every step includes apparatus and quantities** – refer to items by their exact name from the Materials/Apparatus list; include volumes, masses, concentrations, and times
- **Diagrams or photographs** – include annotated diagrams or photos of the experimental setup AND key steps (including a photo showing how the DV was measured, e.g. ruler position on a stem or an inhibition zone); assign Figure numbers and captions; reference in text
- **Number of trials and repeats clear** – explicitly state how many trials are run per IV group
- **Control and uncontrolled variable management referenced** – do not repeat the control/uncontrolled table; simply reference them at the relevant step
- **Precise SI units throughout** – never write 'amount'; always use g, mL, mol L^{-1}, etc.
- **No unnecessary repetition** – if information is already written elsewhere (e.g., IV, DV, control table), reference it rather than repeating it
- **Pre-trialling accounted for** – mention any modifications made following pre-trial work

✅ **FOR 5–6 BAND:** A reader with no prior knowledge of the investigation could fully reproduce it using only the Methodology section (supplemented by referenced tables and figures). No ambiguous steps, no missing quantities or conditions.

⚠ AVOID / COMMON MISTAKE

Do NOT write the method in future tense ('I will...'). Write in third-person passive past tense ('Leaves were rinsed...'). Do NOT use personal pronouns. Do NOT forget to reference controlled/uncontrolled variables and how qualitative data was obtained.

CRITERION B – DATA ANALYSIS (6 marks)

This criterion assesses how you have recorded, processed, and presented your data in ways relevant to the research question. All three strands must reach the 5–6 band.

13. Qualitative Data

Record all non-numerical observations made during the investigation. This section is frequently omitted but is assessed under Criterion B. This data may be of great use later to help distinguish groups which do not demonstrate statistical differences in order to highlight potential IV effects and contextualize statistical findings.

TABLE FORMAT RECOMMENDED

Present in a table with three columns: (1) IV group (trial), (2) Concise, descriptive observations, (3) Image

IV group (trial)	Observations	Images

Required elements

- **Images included** – photographs with Figure caption (Figure number + description + relevant details)
- **Anomalous observations noted** – flag anything unexpected (e.g., unusual colour, unexpected precipitate, insects, damage/odd texture, etc.)
- **If no visual differences** – provide a brief justified statement explaining why qualitative data was not meaningfully different across groups

14. Raw Quantitative Data

All unmodified, unprocessed numerical data collected during the investigation.

Required elements (for 5–6 band – Criterion B, Strand 1)

- **Detailed table caption** – format: 'Table X – [what was measured] of [Study species] measured after [time frame] for [IV groups].' Include definitions of any abbreviations used
- **Column headers** – include: variable name, unit, and uncertainty (e.g., Temperature (°C ± 0.5))
- **Consistent decimal places** – match the precision of the measurement apparatus throughout
- **All raw data included** – individual trial values; if dataset is too large, include a representative sample in the main body and the full dataset in an appendix (with a justifying statement)
- **Anomalies highlighted** – flag outliers visually (e.g., with an asterisk or highlight the cell a different colour) and a note in the caption as to how they were identified (*see Statistical Analyses*).

EXAMPLE CAPTION FORMAT

Example caption: 'Table 1 – Leaf disc flotation time (min ± 0.5) of *Spinacia oleracea* measured after exposure to varying light intensities (lux ± 50). Asterisk (*) denotes an outlier identified in Statistical Analyses.'

EXAMPLE TABLE FORMAT

Present in a table clearly showing all data for each IV group for each trial

e.g. format for data collection once per trial per IV group:

Independent variable (± unit)	Dependent variable (± unit)				
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
IV group A					

e.g. format for data collection twice (beginning and end) per trial per IV group:

Independent variable (± unit)	Dependent variable (± unit)									
	Trial 1		Trial 2		Trial 3		Trial 4		Trial 5	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
IV group A										

e.g. format for data collection over several time points per trial per IV group:

Independent variable (± unit)	Trials	Dependent variable (± unit)			
		Day 1	Day 2	Day 3	Day 4
IV group A	1				
	2				
	3				
	4				
	5				

15. Processed Data

Show all calculations performed on the raw data, explain why and HOW each calculation was done, and present the results in a clearly formatted table.

Required elements (for 5–6 band – Criterion B, Strands 1 & 3)

- **Description and justification of each calculation** – for each calculation (mean, standard deviation, coefficient of variation, rate, % change, etc.) explain WHAT it shows and WHY it was performed
- **Method stated** – specify software and version e.g., 'Data were analyzed using Microsoft Excel for Mac (Version 16.107)' OR show a sample calculation with correct formula and working
- **Instrument uncertainty** – state the instrument uncertainties relating to the IV and DV (*note: propagation of uncertainties is optional and not required in IB Biology)*
- **Processed data table** – with detailed caption; columns for IV, mean DV (with unit), and standard deviation; include uncertainty in IV column header

EXAMPLE CAPTION FORMAT

Example caption: 'Table 3 – Mean, standard deviation, and coefficient of variation (CV) for germination success (%) of *Lactuca sativa* after 96 hours in groups imbibed with varying concentrations of GA3 solutions'

EXAMPLE TABLE FORMAT

Example processed data table column headers: (1) IV groups, (2) Mean DV measure (3) SD for DV measure

e.g. format:

Independent variable (± unit)	Dependent variable (unit)		
	Mean	Standard Deviation	Coefficient of Variation

⚠ AVOID / COMMON MISTAKE

DV columns (Mean, SD, CV) show the unit only. Do NOT copy the ± instrument uncertainty from the raw data table; a mean's variability is shown by its SD. The IV column keeps its uncertainty. Report means and SDs to the same number of decimal places as the raw data, or at most one more, and ALWAYS to the same number of places as each other.

16. Statistical Analyses

Select and apply statistical tests that are appropriate for your data type and sample size. Justify every test choice.

LINKED RESOURCE

Consult STATS FLOWCHART – RAW DATA to help choose appropriate test and links to online calculators

Required elements (for 5–6 band – Criterion B, Strands 2 & 3)

- **Outlier test** – to check for any statistical outliers in the raw data using Q_1, Q_3 and IQR. Do not remove outliers without justification; indicate them in the raw data table using * or highlight.
- **Shapiro-Wilk test** – to check normality of each IV group's data (prerequisite for parametric tests)
- **Levene's test** – to check homogeneity of variance (prerequisite for ANOVA and the t-test; if variances are unequal, use Welch's t-test)
- **Choice of main test justified** – based on Shapiro-Wilk and Levene's results. For 3+ groups: if both passed → one-way ANOVA; if either failed → Kruskal-Wallis. For 2 groups: t-test (Welch's t-test if variances are unequal) or Mann-Whitney U if not normal."
- **t-test/Mann-Whitney or One-way ANOVA/Kruskal-Wallis** – run the appropriate test; present results in a table showing H_o, H_a, *p-value*, and inference
- **Post-hoc test if $p < \alpha$** – Tukey's HSD (following ANOVA) or Dunn's test (following Kruskal-Wallis); present pairwise comparisons in a table
- **Pearson's or Spearman's correlation** – if IV is continuous; include H_o, H_a, r, R^2, *p-value*, and inference in a table
- **Null and alternative hypotheses stated** – for <u>each</u> statistical test
- **Online calculator acknowledged** – if used, state the calculator name/URL; this does NOT replace justification

EXAMPLE TABLE FORMAT

e.g. format for statistical tests (also include table caption with additional information and selected α)

	Hypotheses	*p-value*	Inferences
Test name	H_0 - H_a -		

⚠ AVOID / COMMON MISTAKE

Use SD for n = 5–30 (with fewer than 5 values, report the range instead). SEM is more appropriate for n > 30. ANOVA without a post-hoc test when $p < \alpha$ is incomplete. Correlation coefficient must be accompanied by a significance test – r^2/r_s alone is not sufficient. Outlier(s) must NOT be simply removed without justification – could present results both with and without the outlier(s). Note: r is the correlation coefficient; R^2 is the coefficient of determination – do not use them interchangeably.

17. Graph(s)

Graphs must plot processed data (means, not raw trial data). Choose the graph type that matches your IV type. Quality over quantity – include only the graph(s) essential to answering the RQ.

Graph caption – required elements

- **Graph number and title**
- **Study species (*Genus species*)**
- **What is being measured and over what time period**
- **Source of error bars** (e.g., 'Vertical error bars show ±1 standard deviation')
- **Statistical information** – R^2, r (or r_s) and p-value from correlation test; or letters indicating post-hoc significance (if applicable)

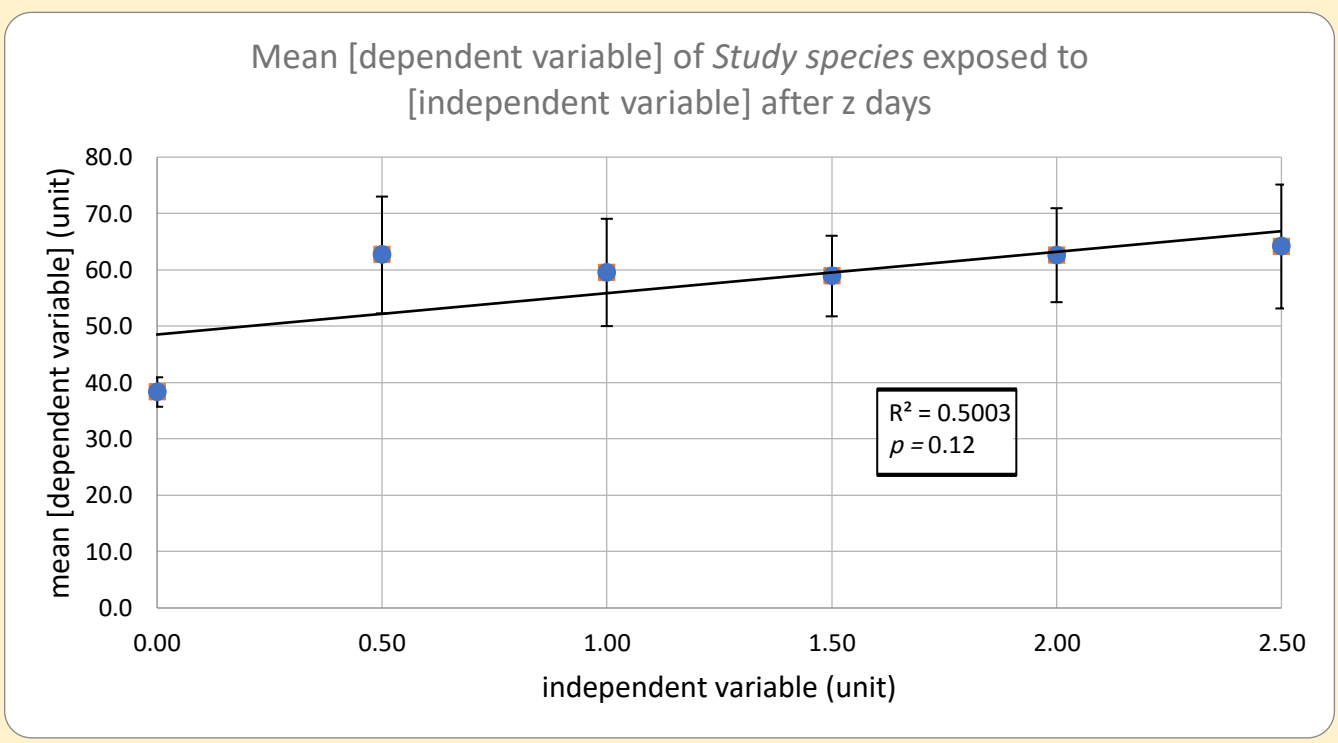
Scatter plot (continuous IV)	Bar chart (categorical/discontinuous IV)
• X axis: IV with name and units • Y axis: Mean DV with name and units • LOBF: solid line; display R^2, r (or r_s) and p-value from test • Vertical error bars: ±1 SD (SEM if n > 30) * can also include post-hoc letters above points, as in bar chart	• X axis: IV group descriptor (no units needed) • Y axis: Mean DV with name and units • Vertical error bars: ±1 SD (SEM if n > 30) • Letters above bars: indicate post-hoc significance groupings (e.g., Tukey p < 0.05)

⚠ AVOID / COMMON MISTAKE

Do NOT screenshot graphs from Excel – copy and paste from Excel as an image for full resolution. Do NOT plot raw trial data on the graph. The Y axis should always show 'Mean [DV]'. Make graph large and easy to read.

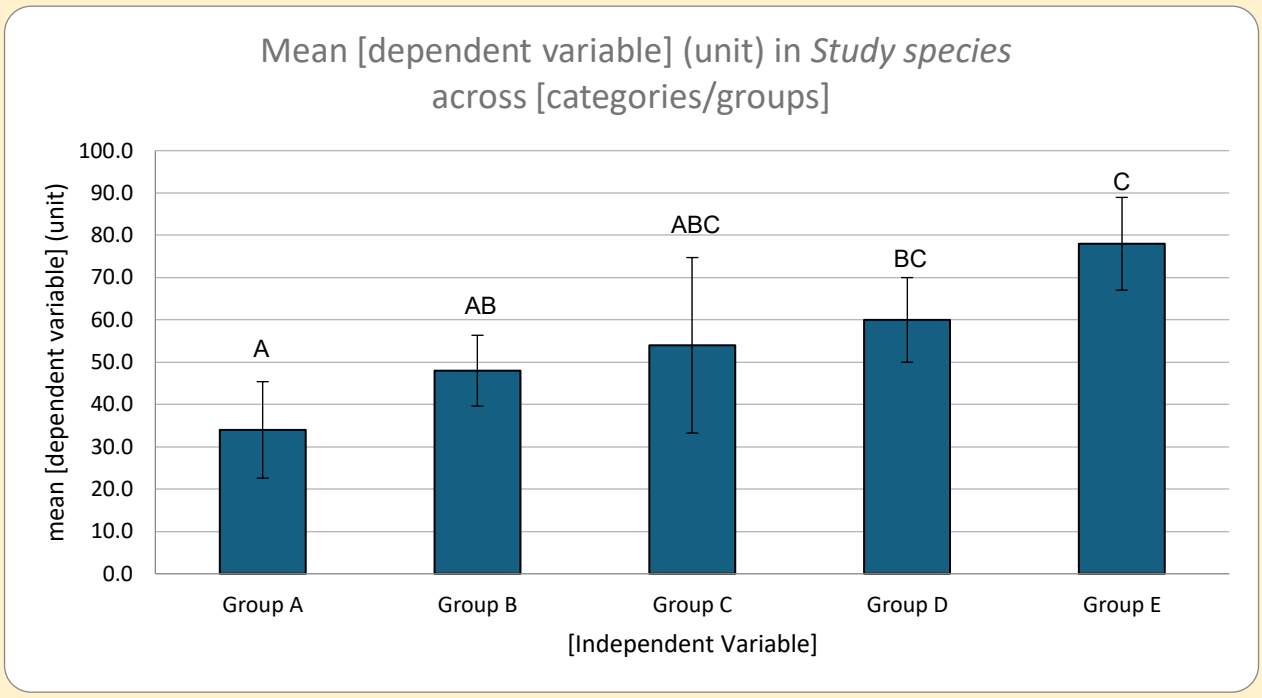
EXAMPLE GRAPH FORMAT (SCATTER PLOT)

Graph 1 – Scatter plot of mean [dependent variable] (unit) of *Study species* exposed to [independent variable] (unit) for z days. Each point shows the mean of n = 5 trials; vertical error bars show ±1 standard deviation (see Processed Data, Table x). Trendline shown with coefficient of determination (R^2); p-value from Pearson correlation test displayed beneath.



EXAMPLE GRAPH FORMAT (BAR CHART)

Graph 2 – Bar chart of mean [dependent variable] (unit) of *Study species* exposed to [independent variable groups] for z days. Each bar shows the mean of n = 5 trials; vertical error bars show ±1 standard deviation (see Processed Data, Table x). One-way ANOVA: p = [value]. Bars that do not share a letter differ significantly (Tukey's HSD post-hoc test, p < 0.05).



CRITERION C – CONCLUSION (6 marks)

Criterion C is written as a single narrative that moves from interpreting your processed data to explaining your findings in scientific context. It flows through three phases: (1) description of data (2) interpretation of data (3) biological explanation of data. This criterion assesses how successfully you answer the RQ using your data analysis in the context of accepted scientific knowledge. Both strands must reach the 5–6 band.

18. Analysis

Describe and interpret your processed data. Do not explain causally here – that occurs later (phase 3).

Required elements (for 5–6 band – Criterion C, Strand 1)

- **Qualitative data** – describe patterns, anomalies, and any unexpected observations; reference specific images (Fig.X) or observations from qualitative data section.
- **Overall trends** – describe the overall relationship between IV and DV with reference to specific data points and values
- **Variability within groups** – discuss SD values and error bar size; identify and address outliers statistically (IQR method) with justification for any exclusions
- **Variability between groups** – discuss error bar overlap as an indication of whether groups may differ, but note that overlap (or no overlap) of SD error bars is NOT evidence of statistical significance; judge significance using p-values from ANOVA/Kruskal-Wallis and post-hoc tests with reference to the 0.05 significance threshold
- **Correlation results** – if IV is continuous, interpret r and R^2 values and their significance
- **Reference all figures and tables** – every table and graph must be cited in the Analysis (e.g., 'See Graph 1...')

19. Conclusion

Draw your conclusion explicitly, grounded in the evidence established in Analysis. Reference your earlier analysis – do not restate it in full. Then use course biology and published literature to explain your findings causally (i.e. the biological *why* behind the patterns described and the conclusion drawn earlier).

Required elements (for 5–6 band – Criterion C, Strand 1)

- **Answer the RQ directly** – state your conclusion explicitly and unambiguously at the start
- **Fully consistent with data** – refer back to specific data values, trends, and processed results from Analysis
- **Uncertainties interpreted** – discuss what the SD, error bar overlap (an indication only – significance comes from p-values), outliers, and p-values *collectively mean* for the reliability and validity of your conclusion
- **Statistical results explained** – interpret *p-values* relative to the 0.05 threshold (alpha); explain what 'statistically significant' or 'not statistically significant' means for the conclusion
- **Hypothesis evaluated** – state explicitly whether the data supports or refutes your hypothesis and WHY
- **Correlation vs. causation** – if your investigation produces a correlation, explicitly discuss whether a causal relationship can be inferred and why
- **Relevant biological terms used** – e.g. optima, maxima/plateau, thresholds, intercepts, rate changes – where applicable

Required elements (for 5–6 band – Criterion C, Strand 2)

- **Biological explanation** – use course biology and cited literature to explain WHY the results turned out the way they did; this is mechanistic explanation, not re-description of trends
- **Prior studies revisited** – return to the studies cited in the Background (Criterion A) – compare your findings to theirs; explain both agreements AND discrepancies using the literature
- **Unexpected results addressed** – if results were not as predicted, explain possible biological or methodological reasons using the literature; do not force conclusions the data do not support

✅ **FOR 5–6 BAND:** Background theory is actively REVISITED to explain findings – not just confirmed. Literature is used to explain unexpected results, not just expected ones. Specific data points are cited throughout the conclusion.

⚠ AVOID / COMMON MISTAKE

A common Criterion C weakness is citing sources in the Background but NEVER returning to them in the Conclusion. Every key source should appear in both sections. Do NOT introduce new data or processing here – this is interpretation and explanation. Each statistical result or data point should appear *once* – no need for repetition.

CRITERION D – EVALUATION (6 marks)

This criterion assesses the evaluation of the methodology which includes (1) weaknesses/limitations and (2) suggested improvements. Note: STRENGTHS are no longer required in the new criteria. Both strands must reach the 5–6 band.

20. Evaluation

TABLE FORMAT REQUIRED

Present evaluation in a two-column table: Left column – Weakness/Limitation with its relative impact on data quality and the chain of reasoning; Right column – Specific, realistic improvement that directly addresses the weakness, with explanation of expected benefit.

Weaknesses/Limitations	Suggestions for Improvement

Note: Points should clearly identify if it is a weakness or limitation – they are not synonymous:

- **Weakness**: An issue in the methodology or procedure that affected data quality – and that COULD be fixed if the investigation were repeated.
- **Limitation**: An inherent bound on what the experiment can answer, even if perfectly executed. Cannot be eliminated, only reduced.

For EACH weakness/limitation – required elements (for 5–6 band)

- **Relative impact assessed** – is this weakness/limitation minor or major? Explain qualitatively WHY it matters more or less than others by reasoning through its effect on data quality and conclusions. *List the weaknesses/limitations in order from most to least impact and indicate this priority in the table caption*
- **Specific to this investigation** – not generic (avoid: 'more trials', 'better equipment', 'human error')
- **Impact explained** – explain HOW this weakness/limitation affected the data: what kind of error does it introduce (random or systematic)? How does this affect the conclusion?
- **Evidence from own data** – support identified weaknesses with observations from YOUR results (e.g., unusually large SD in one group, unexpected trend, specific outliers, qualitative data, etc.)
- **Clear chain**: weakness → effect on data quality → effect on conclusion

For EACH Improvement – required elements (for 5–6 band)

- **Specific improvement** – describe exactly HOW you would fix the issue in a future investigation (include specific values, apparatus, or protocol changes)
- **Improvement linked to weakness** – explain WHY this specific improvement would address the identified weakness/limitation and what benefit it would provide
- **Realistic in school context** – improvements should be feasible for a high school student
- **Clear chain**: weakness → impact → specific improvement → expected benefit

✅ **FOR 5–6 BAND:** Almost no student reaches the 5–6 band for evaluation because they skip relative impact and do not EXPLAIN WHY these weaknesses/limitations and improvements are valid and relevant to the investigation. You must explain whether each weakness is minor or major and explicitly connect this to data quality and your conclusion clearly and in detail.

⚠ AVOID / COMMON MISTAKE

Don't confuse improvements with extensions – improvements must refine the original methodology, not propose an entirely new investigation (e.g. a different organism, a different IV, or a fundamentally different experimental approach).

Generic weaknesses that will NOT score above 3–4:

- 'Should have done more trials/sample size too small' (without specifying how many or why current n was insufficient)
- 'Human error could have affected results' (not a methodological weakness)
- 'Should have used more precise equipment' (without specifying what, why, and how this would improve data)
- Weaknesses involving procedural mistake during the investigation (these are careless errors, not methodological weaknesses)

REFERENCE LIST

21. Reference List

Required elements

- **APA format throughout** – all references formatted correctly and consistently → Citation generator
- **Alphabetical order** – by first author's surname
- **Every in-text citation has a corresponding entry** – and vice versa; no orphan citations or unused references
- **Retrieval dates for online sources** – required for traceability
- **Appropriate sources only** – peer-reviewed journal articles, academic textbooks, and trusted institutional websites; NOT Wikipedia, revision sites, or general web pages

⚠ AVOID / COMMON MISTAKE

Any IA that lacks references and a reference list will be submitted as 'no grade' due to doubts of authenticity.
Citation generators are a useful starting point, but they often make errors (e.g. missing authors or dates, wrong capitalisation, incorrect journal details or DOIs). Check every entry against the original source before submitting.

APPENDICES

22. Appendices

This section is optional. Include only supplementary evidence that supports the transparency and reproducibility of the investigation but is not assessed.

Included elements

- **Large raw datasets** – If a very large amount of data was collected (e.g. daily measurements for each trial over many weeks) a representative sample or summary belongs in the main body (Section 14), and the full dataset can go in the appendix with a clear statement like "Full raw data available in Appendix A".
- **Additional qualitative data** – additional supplementary photographs can be included if many were taken
- **Full pre-trial methodology** – detailed step-by-step method for the pre-trial can be included and referenced in the main body
- **Raw statistical output** – screenshots of raw output data tables produced by online calculators

⚠ AVOID / COMMON MISTAKE

Appendices are NOT read by examiners – anything you want credited must be in the main body, and the appendix is NOT a word-count overflow section. Reference each appendix in the main body (e.g. “see Appendix A”). Your teacher will add a comment confirming they have seen your full raw data. Appendices are still needed for supporting material such as that listed above, or consent forms.

FORMATTING REQUIREMENTS

Formatting Checklist

Word count

- **3,000 words MAXIMUM** – the following are excluded from the word count: charts, diagrams, graphs, data tables, equations, calculations, in-text citations, reference list, headers, appendix, figure/table captions

⚠ AVOID / COMMON MISTAKE

Any content that goes beyond 3000 words is NOT READ and therefore NOT COUNTED in the grading. While data tables are not included, tables that include descriptive text are (e.g. controls, qualitative data, evaluation).

Layout

- **1.5–2× line spacing throughout**
- **Normal margins** (moderate at most)
- **Font size 12 minimum** for ALL text – including figure captions, graph axis labels, and table text
- **Same font throughout** – including all captions and graphs
- **Page numbers on every page**
- **Tables do not break across pages (if this is unavoidable, make note on page and restate column headers)**
- **Headings/captions are not separated from their related content**

Figures and tables

- **Each figure has a name** (Fig.1, Fig.2…) AND a detailed caption (using APA guidelines)
- **Each figure referenced in text** – e.g., '(see Fig.1)' before or immediately after the figure
- **Figures placed near their in-text reference** – not on a separate page far from the citation
- **Images are not blurry** and stay within normal margins
- **Species names correctly formatted** – Species names correctly formatted – full name at first use, then abbreviated (e.g. *Lactuca sativa*, then *L. sativa*); italicised, Genus capitalised, species lowercase

Writing style

- **Third-person passive throughout** – avoid all personal pronouns (I, we, my, our)
- **In-text citations** – every biological or scientific claim must be supported by an in-text citation (APA format)
- **Technical terms defined** – define complex/subject-specific terms clearly when first used; avoid unexplained jargon
- **RQ written identically** – every time the RQ appears in the report, the wording is identical

APA citation

- **In-text citations** – mainly parenthetical style (although narrative can be used when referring to a specific study/investigator)
- **Reference list** – alphabetical order. *Note: this is called a 'Reference List' NOT 'Works Cited' or 'Bibliography'*

LINKED RESOURCE

Consult APA CITATION GUIDE for full details on in-text citations and reference list entries

⚠ ACADEMIC INTEGRITY AND AI USE

"Using artificial intelligence (AI) to write an essay that is then presented as your own is dishonest." Additionally, AI-generated material can be "considered as one of your resources… always acknowledged and cited appropriately."
Generally speaking, AI use should be avoided but if it is used, it must be declared and validated against other sources.