A-Level Biology

Lab Report Guide · 实验报告指南

Biology practical marks concentrate in three places that have nothing to do with the result: naming the variables precisely, justifying the control, and evaluating with the data"s own spread. This guide follows the order the examiner reads. 生物实验的分数集中在变量界定、对照设置与基于数据离散度的评价三处。

Variables – the wording that scores

Independent variable — Name it with its range and its levels: "sucrose concentration, at 0.0, 0.2, 0.4, 0.6 and 0.8 mol dm^{-3}". "Concentration" alone is not a variable statement.

Dependent variable — Name it with how it is measured and in what unit: "the change in mass of the potato cylinder, in grams, after 30 minutes". The measurement method is part of the mark.

Controlled variables — Give at least three, each with HOW it is kept constant and WHY it would affect the result. "Temperature, kept at 25 degrees in a water bath, because enzyme activity rises with temperature" is a complete statement; "temperature" is not.

Standardising the material — Same species, same age, same size, same source, cut with the same cork borer to the same length, blotted the same way. Biological material varies more than anything else in the experiment and the examiner expects that to be addressed.

Controls and replication

A control is not a controlled variable — The control is the treatment with the independent variable absent or denatured – boiled enzyme, distilled water in place of the solution. Its purpose is to show the effect is caused by the variable and not by something else, and saying that purpose is the mark.

Replicates — At least three per level, and state why: to identify anomalies and to allow a mean and a measure of spread. One reading per level cannot support any conclusion, however clean the trend looks.

Randomisation — Where organisms or quadrat positions are chosen, say how randomness was achieved – random number tables for coordinates, for instance – because "chosen at random" by eye is not random and the exam knows it.

Presenting biological data

Choosing the graph — A line graph when the independent variable is continuous; a bar chart when it is categorical. Getting this wrong loses the presentation mark before the data are read.

Tables — Quantity and unit in the heading, raw values then processed values, the same decimal places within a column, and the mean given to one more figure than the raw data only when justified.

Error bars — Plot the mean with bars showing the standard deviation or the standard error, and say which. Overlapping error bars mean the difference may not be significant – that inference is a routine question.

Statistics – choosing the right test

t-test — For comparing the MEANS of two sets of continuous, roughly normally distributed data.

Chi-squared — For comparing observed COUNTS with expected counts in categories – genetics ratios, distribution across habitats.

Correlation coefficient — Spearman's rank for a relationship between two ranked or non-normal variables; Pearson's for linear association in normal data.

Stating the conclusion — Compare the calculated value with the critical value at $p = 0.05$ and the correct degrees of freedom, then reject or fail to reject the null hypothesis, then say what that means biologically. All three steps are scored separately.

Evaluation

Use the spread, not intuition — Judge reliability from the range or standard deviation of the repeats at each level. "The repeats at 0.4 mol dm^{-3} differed by 0.08 g, so the mean there is less reliable" is evidence-based; "the results were quite reliable" is not.

Anomalies — Identify anomalous points by circling them on the graph and suggest a specific cause, then say whether they were included in the mean.

Limitations and improvements — Each limitation must name the step it affects and each improvement must be workable in a school laboratory. "Use a colorimeter instead of judging the colour by eye" is specific; "be more accurate" is not.

The write-up skeleton

Hypothesis, stated as a directional prediction with a biological reason.

Variables: independent with range, dependent with method of measurement, three controlled with how and why, and the control treatment with its purpose.

Method in numbered steps, repeatable, with apparatus precision stated and hazards with precautions.

Results table, graph with error bars, and the statistical test with its null hypothesis, calculated value, critical value and conclusion.

Discussion explaining the trend in biological terms, then evaluation of reliability and validity with specific improvements.