Internal Assessment Criteria

What They Mean & How to Score a 24

*Criteria and descriptors taken directly from ibo.org.

Personal Engagement	Exploration	Analysis	Evaluation	Communication	Total
2	6	6	6	4	24

Personal Engagement

- Assesses the extent to which the student engages with the exploration and makes it their own. Examples:
  - Addressing personal interests
  - Showing evidence of independent thinking
  - Creativity or initiative in the design, implementation, or presentation of the investigation

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1	**The evidence of personal engagement with the exploration is limited with little independent thinking, initiative or insight.** The justification given for choosing the research question and/or the topic under investigation does not demonstrate **personal significance, interest or curiosity.** There is little evidence of **personal input and initiative** in the designing, implementation or presentation of the investigation.
2	**The evidence of personal engagement with the exploration is clear with significant independent thinking, initiative or insight.** The justification given for choosing the research question and/or the topic under investigation demonstrates **personal significance, interest or curiosity.** There is evidence of **personal input and initiative** in the designing, implementation or presentation of the investigation.

Expectations:

- This is the vaguest of all the IA criteria and the most difficult to demonstrate. The focus here is on whether or not you have demonstrated independent thinking in the IA process.
- Personal interest does not mean you tell a story about how you always enjoyed insects/marine life/growing flowers with your grandma when you were young and now you just can't wait to explore it in your IA.
- Examples of how this may be demonstrated include but are not limited to
  - ✓ Adapting a common procedure to the materials you have available
  - ✓ Going above in beyond in data collection
  - ✓ Having a particularly creative or original idea (or extension of an existing idea)

Exploration

- Assesses the extent to which the student establishes the scientific context for the work, states a clear and focused research question and uses concepts and techniques appropriate to IB work.

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1-2	The topic of the investigation is identified and a research question of some relevance is **stated but it is not focused**. The background information provided for the investigation is **superficial** or of limited relevance and does not aid the understanding of the context of the investigation. The methodology of the investigation is only appropriate to address the research question to a very limited extent since it takes into consideration few of the significant factors that may influence the relevance, reliability and sufficiency of the collected data. The report shows evidence of limited awareness of the significant **safety,** ethical or environmental issues that are **relevant to the methodology of the investigation***.
3-4	The topic of the investigation is identified and a relevant but not fully focused research question is described. The background information provided for the investigation is mainly appropriate and relevant and aids the understanding of the context of the investigation. The methodology of the investigation is mainly appropriate to address the research question but has limitations since it takes into consideration only some of the significant factors that may influence the relevance, reliability and sufficiency of the collected data. The report shows evidence of some awareness of the significant **safety,** ethical or environmental issues that are **relevant to the methodology of the investigation*.**
5-6	The topic of the investigation is identified and a relevant and fully focused research question is clearly described. The background information provided for the investigation is entirely appropriate and relevant and enhances the understanding of the context of the investigation. The methodology of the investigation is highly appropriate to address the research question because it takes into consideration all, or nearly all, of the significant factors that may influence the relevance, reliability and sufficiency of the collected data. The report shows evidence of full awareness of the significant **safety,** ethical or environmental issues that are **relevant to the methodology of the investigation*.**

Expectations:

- Focused research question. For example, “How does the pH of water affect plant growth?” is vague. “How does increasing the pH from 7 to 10 at intervals of 0.5 pH affect the biomass of *Lemna minor*?” is more focused.
- Correctly identifying independent, dependent, and controlled variables. Controlled variables are most easily addressed using a table that identifies each controlled variable, why it must be controlled, and how it will be controlled. Some controlled variables may actually be beyond your control, but it still must be identified and discussed. Sometimes these uncontrollable “controlled” variables will have little actual impact on your results, in which case continuing the experiment would be acceptable. Other times, lack of control over such variables may mean you need to pick a new topic.
- A hypothesis is *not* required but may be helpful depending on the type of data processing you carry out.
- Background research must relate to the topic and should help the reader understand the experiment that follows. If other relevant experiments have been performed and/or have impacted the direction of your experiment, they should be included here.
- In addition, your rationale for the experiment should be stated. Specifically, the relevance of your topic to real world applications should be made obvious. For example, you might think watering plants with soda and diet soda would be a good idea. My question would be, why would anyone ever do this? You should be able to explain why here. If you can’t, you should probably pick a new topic.
- Whether doing a hands-on experiment or using a database, procedures should be written so clearly that anyone should be able to follow them to duplicate your results. Each step you take must be detailed, including such things as steps to regulate controlled variables, quantities of materials used, size of equipment used (ex. beaker size, pot size), time periods involved (ex. after 20 minutes/3 days), and measurement and recording of dependent variables. Do not assume that just because you know how to do something that others will as well – tell them how!
- Use only SI units.
- Experiments should strive for a minimum of 5 by 5 design, meaning five different intervals or variations of your independent variable tested at least five times.
  - ✓ Your intervals should be such that meaningful data can be gathered from your experiment. For example, if *Lemna minor* is known to thrive at a pH of 7, testing at intervals of 0.5 pH would be more useful in determining the limits of its pH range than testing a pH of 1, 4, 7, 10, and 13.
  - ✓ Five trials of each interval of your independent variable is the *minimum*. If your experiment is simple and not too time consuming, you will be expected to collect more raw data.
- Procedures must address safety, ethical and environmental issues. For example, do you need gloves/goggles/lab apron? Should you work under a fume hood? How should you dispose of your materials? Does your experiment have any ethical implications, either on humans or any other living organisms? Will your experiment negatively impact the environment? If so, how will you lessen or eliminate these impacts? Even if your experiment lacks either safety, ethical or environmental issues, you should state this explicitly so the grader knows you considered them.

Analysis

- **Assesses the extent to which the student’s report provides evidence that the student has selected, recorded, processed and interpreted the data in ways that are relevant to the RQ and can support a conclusion.**

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1-2	The report includes **insufficient relevant** raw data to support a valid conclusion to the research question. Some **basic** data processing is carried out but is either too **inaccurate or too insufficient to lead to a valid** conclusion. The report shows evidence of little consideration of the impact of measurement uncertainty on the analysis. The processed data is incorrectly or insufficiently interpreted so that the conclusion is invalid or very incomplete.
3-4	The report includes relevant but incomplete quantitative and qualitative raw data that could support a simple or partially valid conclusion to the research question. Appropriate and sufficient data processing is carried out that could lead to a broadly valid conclusion but there are significant inaccuracies and inconsistencies in the processing. The report shows evidence of some consideration of the impact of measurement uncertainty on the analysis. The processed data is interpreted so that a broadly valid but incomplete or limited conclusion to the research question can be deduced.
5-6	The report includes sufficient relevant quantitative and qualitative raw data that could raw data that could support a detailed and valid conclusion to the research question. Appropriate and sufficient data processing is carried out with **the accuracy** required to enable a conclusion to the research question to be drawn that is fully **consistent** with the experimental data. The report shows evidence of full and appropriate consideration of the impact of measurement uncertainty on the analysis. The processed data is correctly interpreted so that a completely valid and detailed conclusion to the research question can be deduced.

Expectations:

- As stated in the last criterion, 5 by 5 is the minimum design for acceptable data collection. A data table is the preferred method for communicating raw data, but there are exceptions. *If* you have large quantities of raw data that could be presented more succinctly in a graph, then graphing raw data is an acceptable alternative to a data table. If your data set is too large to be reasonable represented in either format, a representative sample of your data may be included with an explanation of the rationale for presenting only a portion of your raw data. Inclusion of raw data in an appendix is not acceptable in a biology IA.
- Each data table must meet the following criteria:
  - ✓ Be identified with a table number. For example, Table 1.
  - ✓ Have a descriptive title. Titles should be detailed enough that the reader could deduce the type of data it contained without having read the remainder of your IA. For example, "Table 1: Biomass of Pond Weed" is insufficient. "Table 1: Biomass in grams of *Lemna minor* grown in freshwater with pH ranging from 7.0 to 10.0 at 0.5 pH intervals, recorded weekly over three months" would be a more descriptive title.
  - ✓ Column and row headings are required.
  - ✓ Units of measurement (in SI units) should be identified. Units may be identified in both the title and column headings or in the column headings only, but *NOT* in the title only.
  - ✓ Measurement uncertainty must be included with your units.
- Each graph must meet the following criteria:
  - ✓ Be identified with a figure number. For example, Figure 1.
  - ✓ Have a descriptive title. Titles should be detailed enough that the reader could deduce the type of data it contained without having read the remainder of your IA. For example, "Figure 1: Average Biomass of Pond Weed" is insufficient. "Table 1: Average biomass in grams of *Lemna minor* grown in freshwater with pH ranging from 7.0 to 10.0 at 0.5 pH intervals, recorded weekly over three months" would be a more descriptive title.
  - ✓ Axes must be identified with a numbered scale or categories (depending on the data and graph type), units with uncertainty (if appropriate), and a label identifying the type of data on each axis.
  - ✓ Graph should be scaled so that data takes up the space allotted for your graph. In other words, your axis scales should be appropriate for your data so that all your data isn't bunched up in one corner.
  - ✓ A labelled key should be provided as necessary.
  - ✓ When graphing standard deviation, care must be taken to ensure that the appropriate standard deviation is graphed for each average. If your standard deviation lines are the same for each of your data points, you probably graphed it incorrectly.
- Averages and standard deviations alone are generally not sufficient processing. I expect more, such as percent change (also fairly minimal processing but sometimes the best you can do), chi squared, t-test, line of best fit with r-squared value interpreted correctly, ANOVA, etc.
- Each graph (or calculated value in the case of chi squared, t-test and ANOVA) should be followed by a short paragraph explaining/analyzing/interpreting the data contained within.
- Impact of measurement uncertainty on the processed data should be addressed. For example, if your averages are different but overlap when the measurement uncertainty is considered, then your values cannot be considered truly different due to that uncertainty in the measurement of your values.
- Formulas and sample calculations should be included for all calculations except averages. Use of an online calculator is acceptable but this should be noted and the website used for the calculations should be included.
- Use significant figures consistently.

Evaluation

- **Assesses the extent to which the student's report provides evidence of evaluation of the investigation and the results with regard to the RQ and accepted scientific context.**

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1-2	A conclusion is **outlined** which is not relevant to the research question or is not supported by the data presented. The conclusion makes superficial comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **outlined** but are restricted to an **account** of **the practical** or **procedural issues** faced. The student has **outlined** very few realistic and relevant suggestions for the improvement and extension of the investigation.
3-4	A conclusion is **described** which is relevant to the research question and supported by the data presented. A conclusion is **described** which makes some relevant comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **described** and provide evidence of some awareness of the **methodological issues*** involved in establishing the conclusion. The student has **described** some realistic and relevant suggestions for the improvement and extension of the investigation.
5-6	A detailed conclusion is **described and justified** which is entirely relevant to the research question and fully supported by the data presented. A conclusion is correctly **described and justified** through relevant comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **discussed** and provide evidence of a clear understanding of the **methodological issues*** involved in establishing the conclusion. The student has **discussed** realistic and relevant suggestions for the improvement and extension of the investigation.

Expectations:

- The expectation here is that you actually answer your research question. Do not just state your conclusion, but describe the conclusion and support it with evidence from your data processing. Include actual numbers here. DO NOT base your conclusions or provide as evidence your RAW data. If your raw data was enough on its own, then processing would be unnecessary. But raw data is NOT enough on its own to draw and support a conclusion.
- You should compare your results to those of other relevant research, explaining how it supports or refutes your conclusion. If your results are not supported by other experiments on your topic, provide an explanation as to why this may be so.
- Strengths and weaknesses of the experiment should be discussed. Weaknesses *cannot* be human error because at this level, you are expected to be able to carry out procedures proficiently. If a human error is committed, it is expected that you recognize the error and repeat the experiment to eliminate it. Procedural errors should be discussed and corrections suggested. For example, the statement "the growth rate of species X is relatively slow, and thus the experiment would have yielded better results if the experiment had been allowed to continue for an additional six months", implies that the method used was appropriate but that the procedure just needed adjusting. Errors with the overall method of the investigation, if present, should be recognized and addressed as well.

Communication

- **Assesses whether the investigation is presented and reported in a way that supports effective communication of the focus, process and outcomes.**

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1-2	**The presentation of the investigation is unclear, making it difficult to understand the focus, process and outcomes.** The report is not well structured and is unclear: the necessary information on focus, process and outcomes is missing or is presented in an incoherent or disorganized way. The understanding of the focus, process and outcomes of the investigation is obscured by the presence of inappropriate or irrelevant information. There are many errors in the use of subject-specific terminology and conventions*.
3-4	**The presentation of the investigation is clear. Any errors do not hamper understanding of the focus, process and outcomes**. The report is well structured and clear: the necessary information on focus, process and outcomes is present and presented in a coherent way. The report is relevant and concise thereby facilitating a ready understanding of the focus, process and outcomes of the investigation. The use of subject-specific terminology and conventions is appropriate and correct. Any errors do not hamper understanding.

Expectations:

- This set of criteria applies to your entire paper and means, basically, have you written in a way that makes sense?
- Your paper should be concise with no extraneous information.
- Cite your sources using a conventionally recognized method within the text and include a bibliography.
- Consistent and appropriate use of metric/international units, significant figures, and uncertainty.
- Vocabulary use is appropriate to the topic, including both on the topic and in discussion of materials and methods.
- IA is twelve or fewer pages in length.