IB Biology: Exploration IA (6)

**Background Information**

**\_\_\_** Provide some context and significance for the investigation (why are you investigating this topic?)

\_\_\_ Provide appropriate and relevant information to enhance understanding of the concept

\_\_\_ Define key terms

\_\_\_ Outline key scientific processes or concepts

\_\_\_ Outline all the chemicals, why they were selected and also their uses/safety issues

**Research Question & Hypothesis**

\_\_\_ Write a clear and fully focused research question (it must include your dependent and independent variables)

\_\_\_ Clearly state your hypothesis (prediction of what you will find)

\_\_\_ Explain your hypothesis. Why do you think this will happen?

\_\_\_ Support your hypothesis with research (including in-text MLA citations)

**Variables**

\_\_\_ State the *independent variable* (variable that was changed) – include units and ± uncertainties

\_\_\_ State how you are going to change/manipulate your independent variable

\_\_\_ If applicable, state the control for the experiment

\_\_\_ State the *dependent variable* (variable that was measured) – include units and ± uncertainties

\_\_\_ State how you are going to measure your dependent variable

\_\_\_ List **all** of the *controlled variables* in a table (see example below)

|  |  |  |
| --- | --- | --- |
| **Controlled Variable** | **How will it be controlled?** | **Why it is important to control this variable?** |
| Height of the lamp | The height of the lamp will be measured to 10.0 +/- 0.1 cm above the beaker using a 15cm ruler. | By keeping the height of the lamp controlled, the light intensity will remain constant for all trials during the photosynthesis experiment, and thus the results of the experiment will be due to the manipulation of the independent variable. |
| Volume of sodium bicarbonate solution | 125.00 ml +/- 0.01 will be measured using a 150 ml graduated cylinder for each trial. | Sodium bicarbonate is the source of CO2 for the *Elodea* plant, so the amount of solution must be equal for all trials. |
| Size of the beaker | 200 ml beakers will be used for all trials of this experiment. | The size of the beaker will ensure that the same length of the Elodea will be submerged under the solution. |

**Materials**

\_\_\_ List all of the materials needed for the experiment using bullet points

\_\_\_ The quantity and size of all of the materials is listed (5, 150 ml beakers)

**Safety**

\_\_\_ Mention any safety, ethical or environmental considerations

**Procedure**

**\_\_\_** Write a **detailed** procedure in **numbered steps** in the same order that they should be performed

\_\_\_ Every step is included even though they may be obvious (i.e. zeroing the balance)

\_\_\_ Each material has been accounted for in detail (size of beaker, volume of solution, units of electronics)

\_\_\_ State how many trials will be performed at each range/interval of data (5x5 minimum)

\_\_\_ Could someone read this procedure and easily repeat it

**\_\_\_** The data gathered enables the aim, the research question or the hypotheses to be adequately addressed.

\_\_\_ State how you will use the data (what statistical tests will you use? And why.)

IB Biology: Analysis IA (6)

**Raw Data Tables**

\_\_\_ A table with all of the **quantitative** **raw data** (data you collected) and class data (if applicable)

\_\_\_ The table has a detailed **title and headers** for each column and/or row

\_\_\_ All data has **uncertainties** (i.e. 22°C ± 1)

\_\_\_ The uncertainties are all justified.

\_\_\_ All **units** are included in the header (do NOT write the unit in each cell of your table)

\_\_\_ All data has the same **precision** (you should NOT have one measurement as 22°C and another 23.78°C)

\_\_\_ ***Highlight*** *the data that* ***you*** *collected (only for group/class data)*

\_\_\_ A table with the **qualitative data** you found (color, change in size etc.)

\_\_\_ Include images (figure #) of the equipment set-up and the experiment itself

**Processed Data Table** (Could be combined with raw data in one table)

\_\_\_ State and explain any **anomalies** (data that did not fit with the trend you see)

\_\_\_ Describe *how* you are processing the data and ***why*** you chose to do that

\_\_\_ **Process the data** correctly and **completely** (an average is insufficient)

\_\_\_ Include one complete sample calculation for each different calculation that was not completed by excel

\_\_\_ Perform additional statistical analysis (ttest, correlation, Chi-square)

\_\_\_ Processed data has the **same precision** as the raw data

\_\_\_ State all of the technology that was used (Excel, calculators etc.)

\_\_\_ Describe the trend or pattern you see in the data (**Analysis**)

\_\_\_ State in words what you found but do NOT explain it

**Presenting/Graphing Data**

\_\_\_ Plot the **processed data** in a **suitable graph (DO NOT GRAPH RAW DATA)**

\_\_\_ Ensure independent variable is on the x-axis and dependent variable is on the y-axis

\_\_\_ Title **your graph and both axes** (including the units and uncertainty)

\_\_\_ Add error bars to the graph (if applicable)

\_\_\_ Describe to reason for including error bars and wat they mean

\_\_\_ Add a trend-line to the graph (if applicable)

\_\_\_ Add a figure number and title underneath/above your graph (Fig 1. A scatter plot showing…)

\_\_\_ Describe the trend or pattern you see in the data (**Analysis**)

\_\_\_ State in words what you found but do NOT explain it

IB Biology: Evaluation IA (6)

**Conclusion**

\_\_\_ Restate your research question and hypothesis (*The purpose of this lab was to…)*

\_\_\_ State an appropriate and reasonable conclusion based on your results that answers your research question

\_\_\_ Summarize your findings using actual numbers and referring to tables and graphs

\_\_\_ Explain and justify your results using correct biological terms

\_\_\_ Include other **sources** (internet, books etc) that also support what you found

\_\_\_ Compare your results to accepted scientific concepts

\_\_\_ If your results don’t support the generally accepted truth, explain this limitation and suggest reasons why your

results differ from the norm

\_\_\_ Include MLA in-text citations here

\_\_\_ **Accept or reject** and modify your hypothesis

\_\_\_ Do NOT use the word “prove”

**Evaluation**

Problem (Sources of Error/Limitations)

\_\_\_ Mention the **main weaknesses** in the procedural design of the experiment (did you control for all your controlled

variables? Were all the materials working correctly?)

\_\_\_ Consider sources of human error, random error, instrumental error, measurement error, replicate size, trial number,

etc.( as applicable)

\_\_\_ Evaluate limitations of your data (quantity, quality, accuracy, precision)

\_\_\_ **All** significant sources of error/limitations have been recorded

Explanation of Problem (How did the source of error/limitations affect your results?)

\_\_\_ State how those weaknesses affected your results

\_\_\_ State whether or not the weaknesses and limitations were serious enough to undermine the conclusion

Improvement (How to modify/improve/extend this experiment?)

\_\_\_ Suggest how each source of error can be **specifically** modified to improve the accuracy of the results

Explanation of the improvement

\_\_\_ Explain how the improvements will be achieved. They must be **realistic and relevant.**

|  |
| --- |
| Problem 1:  Explanation of problem:  Improvement:  Explanation of the improvement: |
| Problem 2:  Explanation of problem:  Improvement:  Explanation of the improvement: |

**Strengths and Extensions** (paragraph under table)

\_\_\_ State and explain the strengths of this experiment

\_\_\_ Suggest at least one possible extension for this experiment

IB Biology: Communication (4)

**Presentation Structure and Format**

\_\_\_ Research question as the title

\_\_\_ Name on the top right corner

\_\_\_ Submitted in Times New Roman 12pt font

\_\_\_ Single spaced

\_\_\_ Page numbers on the bottom right corner

\_\_\_ Correct headers are **bolded** (the same headers as the IA checklist)

\_\_\_ Spell checked

\_\_\_ Checked for proper grammar

\_\_\_ Scientific writing is clear and concise

\_\_\_ Correct use of scientific vocabulary

\_\_\_ MAXIMUM of 12 pages (otherwise you will lose marks)

**(MLA) Works Cited**

\_\_\_ Sources are listed in alphabetical order

\_\_\_ Indentation occurs on second and third line of each source

\_\_\_ Entire works cited is double space

IB Biology: Personal Engagement (2)

**Personal Engagement**

\_\_\_ Justify your choice of research question - why did you choose this topic?

\_\_\_ Explain how research question/topic has personal significance or interest to you

\_\_\_ Explain how you took initiative during the design, implementation and presentation of this investigation