Lab Write-up Guide for Biology 10

Always include the following unless I tell you it's not necessary. All labs need to be typed (unless you have computer woes, then write it out by hand!) but all rough data need to be attached to the back. The basic objective in writing laboratory reports is to communicate your methods and conclusions as clearly as possible. All labs should be written in the **third person**. **Do NOT use I.** Do not personalize labs. Each person's lab should be unique. No two sentences in any two lab reports should be identical, even lab partners. **Attach to the lab a copy of any written directions you received .**

The following titles and subtitles (*) should be used for your lab report and given in this order within your lab report.

*Problem Question: This will be a question that includes both the independent and dependent variables. Must be focused and not in vague in any way.

*Background/Introduction: Many of the investigative procedures you do involve complicated concepts. Include here any information that helps the reader understand what you wanted to accomplish, and why. Research is needed to do a good job! Use citations for anything you didn't already know. If appropriate include other experiments and their results done on this subject. You **MUST reference** all material with citations in this section.

*Hypothesis: Predict an outcome based upon the background information. ***This must be written before you start the experiment***! Remember this is an educated guess as to what you think will happen. Whether you are right or wrong has no effect on your grade. The quality of the hypothesis however, is crucial. Whatever you decide to try to prove, you must be sure that it has a relevant biological focus that matches the experiment (it needs to be well thought out). **The independent and dependent variables should be identified in the hypothesis as well as the problem question.** The usual format is ***ÏF …***something is done and it affects the object, ***THEN…..*** Include a rationale or reason for your hypothesis which ties into your background.

*Variables Description: A valuable way to make sure you include all your variables appropriately is to make up a table like this before you write the experimental procedure .

Independent Variable (what you are changing)	**Dependent Variable (what you are measuring)**	**Controlled Variables (those factors that need to be held the same in each trial)**

*Diagram: Draw and label a diagram which best shows the major procedure you used. This could also be a photograph of lab set-up. Annotate this to show how variables were instituted.

*Materials: All materials used in the lab should be listed including sizes and quantities of each (ie. 4 100-ml beakers, NOT beakers). Diagrams of apparatus are a nice touch.

*Procedures: In point numbered format, summarize step-by-step what you will be doing to carry out the lab. These should be in your own words, and should include ALL details as these are your lab directions. The steps should be clear enough for anyone else to follow accurately. If you use a specialized apparatus, you could include a labeled diagram. Make

sure to note within the procedure or in a separate section how you will control variables that might affect your results.

***Results or Data Collection:**

*Raw Data Table: IB needs to see your rough data in the table you originally used. Write in ink. Your original data table or observations must be attached to the back of the lab. Data table design and clarity is important. A title should be given. Make sure all columns, etc. are properly headed and units are given.

*Data Processing: Explain your calculations in a brief paragraph that gives an overview of how and why you decided to process and present the data in the form given. Give a sample calculation, neatly lay out and explain one example of the manipulation that was done to the raw data to help make it more useful for interpretation.

*Presentation (of tables and/or graphs): This is typically one or more data tables (of your now processed data) and one or more graphs of this processed data. Once again, the design and clarity of data table(s) is important and the quality of graphs is also very important. Give careful consideration to the choice of graph style(s) that you choose to do. Do **not** put graphs drawings etc. at the end of the lab, include just after the data tables. **Remember, do not discuss your results in this section, just state them.** There should be quantitative and qualitative measurements in your results wherever possible. **Graphs must include descriptive titles, units, be in proper scale and should be either hand drawn or be from a graphing program.** Usually the independent variable goes on the X axis.

***Conclusion and Evaluation:** Consists of 2 parts.
***Conclusion**: Explain and discuss what the results of your experiment. What is the answer to your problem? Restate the hypothesis and compare your conclusion to it. Write a clear conclusion stating how the experiment confirms or rejects the hypothesis and explain why. Refer to scientific concepts you have learned to discuss whether the results are reliable or not. Do the data follow current scientific trends, or were there errors that leave your conclusion questionable? Include information from the literature but **USE CITATIONS**. How reliable are your results? Evaluate and explain your results, which lead straight into the evaluation, if you encountered many difficulties.

***Evaluation**: This paragraph section discusses how well your experimental design helped answer your experimental question. Discuss any difficulties. Suggestions for improvement should also be included. This is the toughest part of the lab and takes the most thought. What errors did you find or perform during the experiment? How reliable and true are your data? Are they accurate (close to the true values) and precise (measurements taken to the proper significant digit)? Are there further experiments that can be performed or did the data suggest other avenues to explore? What anomalies (unusual findings) were there and where were the errors? How did those affect the data? How could you have performed this lab better? If you want you can use this table to help you describe those errors and how to fix them:

(continues on next page)

The error or problem encountered	How that error affected the data	A suggestion for improvement
Thermometer was held upside down when taking the temperature of the H2O2	**The temperature values were outside the accepted values for the H2O2 temp**	**Hold the thermometer the other way.**

Note: do not just say "Measurements could have been more accurate…" or "there was error in measurement." Or "we could have worked harder/paid more attention to what we were doing." Those are not valid evaluation statements.

Some things to avoid:

- having the hypothesis, procedure, and conclusion be about 2 or 3 different things. These three parts should be consistent and complementary.
- taking too small a number of samples or trials. The more, the better.
- not recording data that occurs: if in doubt – record it. You can throw out outliers later.
- recording data that did not occur. **DISHONEST**!!!!
- beginning to work on the lab procedure and data table or the write-up the day before it is due. What happens if you have questions? Or the electricity goes out? Or you get sick?
- working too closely with your lab group. Even if there is a **suspicion** of copying or use of same material, you will both noted has having committed malpractice and will receive a zero.

A checklist to make sure you are performing a quality experiment:

- Are the independent and dependent variables clearly and correctly identified?
- Is the hypothesis testable? Is it suggesting an answer to the aim or question of the activity?
- Are there appropriate strategies to control other variables that might affect your results?
- Is there a clear easy-to-follow, step-by-step procedure outlined that someone else could follow?
- Does the experiment actually test whether the hypothesis is supported or disproved?
- Have you got title and column units in your data table?
- Did you show how you did any calculations?
- Did you use an appropriate system of data analysis (right sort of graph)?
- Do your graphs have descriptive titles and units on the axis?
- Does the conclusion accurately reflect the data?
- Are your procedural modifications fully and accurately discussed?
- Have you noted sources of error and how to fix those problems?
- Are anomalous results identified and explained in a reasonable manner?