How to Write a Formal Lab Report

Honors Biology

General Comments:

- Lab reports should always be word-processed. Except for the abstract section, your paper should be double-spaced. If your report includes graphs, you can either use a computer program (like Microsoft® Excel) or draw the graph by hand on graph paper.
- Label the individual sections (Abstract, Introduction) clearly and set them apart like below.
- Short, concise lab reports are always better than long, rambling ones.
- It is acceptable to write in 1st person, using "I" or "we": *We placed 3 plants in direct sunlight.*

Abstract

Formal science papers usually follow a traditional format that makes it easy for other researchers to find quickly the information they need (or in this case, for your teacher to grade the assignment). This is the abstract, a **brief** paragraph that summarizes the entire report. Although it is the first section of the lab report, it should be written last after you have finished the other sections. It should have a one-sentence summary of the purpose, a short (one or two sentence) description of the procedure, and a sentence describing the outcome (what you found and how you interpreted these data). An example:

> *Many chemicals are known to kill bacteria. We wished to determine the effectiveness of Lysol in killing bacteria normally found on human skin. The bacterium* E. coli *was grown on agar plates, some containing Lysol and the rest without. We found 83% fewer bacteria on plates with Lysol.*

When you write the lab report, especially the abstract, choose your words carefully. Be as precise as you can: try to include numbers to back up your conclusions.

Vague statement: *The seeds grew best with the least amount of water.*
Precise statement: *The seeds had the longest shoots in 5 mL of water.*

Notice how the precise statements describes exactly what made you think these shoots were the best, and what the least amount of water in your experiment actually was.

Introduction

The introduction sets up the experiments you performed. For example, if you did a series of experiments looking at enzymes, you would define and discuss enzymes in general, and then talk in detail about the particular enzyme you are studying. You should discuss and define any concept that is important to the lab. It is in this section that you demonstrate to your teacher how much you understand the topic studied. Consider it an informal exam. In some detailed labs, your introduction may be two to three pages long.

You MUST include a hypothesis in the introduction. It is often placed in the last paragraph. This tells the reader why you ran the tests. Again, be explicit: "*We hypothesize that the more water given to seeds, the faster they will germinate*" or "*We expect the findings to show that foods with high fat content have more Calories than other foods.*"

Materials & Methods

This is probably the easiest part of the lab to write. It is here where you would describe in brutal detail the equipment and procedures you followed to perform the lab. This is particularly important if you have invented a new procedure–here is where you would share it with the world. However, if you are following protocols written by your teacher and others, and you need not type them over again. You can simply cite them, as in the example below. The only time you have to write a more detailed section is if you made modifications, which you must clearly state. Remember, your instructions must be detailed enough so that another Honors Biology student could faithfully reproduce your work.

Laboratory procedures were performed as described in the Honors Biology Enzymes Lab.

-Or-

Laboratory procedures were performed as described in the Honors Biology Enzymes Lab except 35 mL of 2.6 M NaOH was substituted for 70 mL of 1.3 M NaOH.

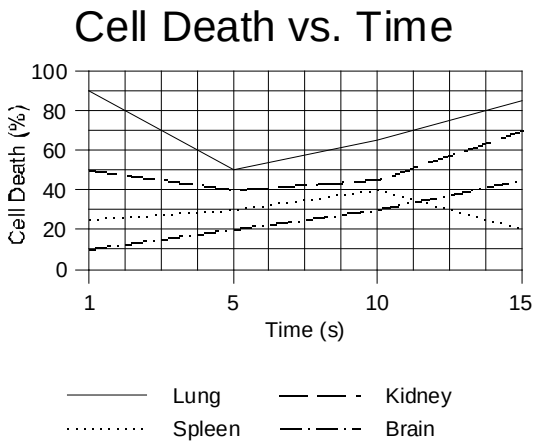
Results

Here you should clearly display your findings from the lab. They should be accurate and easy to read. Avoid analyzing your data here. Simply report it. Some advice:

- Numbers! Numbers! Numbers! Data you have measured or counted are always much better than opinions. For example, instead of saying "*the seeds in cup A grew better than the seeds in cup B*," say "*45 seeds in cup A grew, but only 10 seeds grew in cup B.*"
- Never underestimate the power of a good table or graph to illustrate your results.
- Always label your tables and graphs. A column of numbers means nothing to me. You must tell me what they measured or where they came from.
- Units! You better have units attached to all of your measurements, or else.

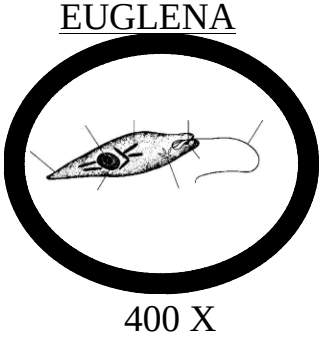
<u>If you use a graph:</u>

- It must be computer-generated or drawn on graph paper using a straight edge. No freehand lines unless you are sketching a curve.
- Label both axes, and include the units
- It should have a title explaining the data it shows
- Plan your graph so that you use most of the graph paper. Small graphs are hard to read, and are often used by unscrupulous scientists to hide bad data.



<u>If you include a drawing (particularly from a microscope):</u>

- Always label the drawing, and include the magnification if it is from a microscope or dissecting scope
- If it is important, use color. Otherwise, black and white is fine.
- It is acceptable to draw any graphs or pictures in pencil. Ink is not mandatory.
- It is perfectly acceptable to cut and paste the sketches from your original lab notes rather than redraw them.



Discussion

Analyze the results here. Start by addressing every part of the hypothesis. Clearly state your conclusion, and then list all of the evidence you amassed to support your conclusion. Finally, and most importantly describe your reasoning, or how you justify the links between your conclusions or claims and the evidence. Use accepted scientific concepts to link your claim and evidence, if possible. For example, assume that you studied the affect of either pond water or distilled water on the growth of underwater aquatic plants. You found that the plants in the distilled water reached and average height of 27 cm, and the stems supported many thick leaves. The plants in the pond water reached an average height of 13 cm, and had far fewer branches and thinner leaves. Your conclusion would look like this:

> *We found that plants grown in distilled water grew taller and thicker than those grown in pond water. Plants in distilled water averaged 14 cm in greater height and had more branches and thicker leaves. The increased growth may be due to the difference in water clarity. The distilled water was clear, whereas the pond water was very murky. The clear water allowed more light to penetrate, permitting more photosynthesis. Another possibility is the presence of a chemical in the pond water that prevented the plants from reaching a greater size.*

If the data are poor quality, offer possible sources of error. Think critically about this, especially about the limitations of the lab equipment or any difficult or problematic procedure you performed. Blaming human error will get you nothing, unless you are certain that you made a mistake in the procedures. It is better to list a particular part of the experiment that may have gone wrong.

It is important to understand that a failed hypothesis does not mean a failed experiment. In science, showing that a possible explanation is incorrect is just as important as discovering that your hypothesis is correct.

At the end of your conclusion, answer all the questions in the lab manual

Acknowledgments

It is here that you give credit where credit is due. List your lab partner. Give the name of anyone who gave you assistance on this lab, especially if you used someone else's data.

Citations

In order to write the introduction (and possibly other parts of your lab report), you are going to need to look up information from other sources. Whenever you use someone else's information, you must give them credit. You do this by citing the material you took from them in your lab report. In science, we use internal citations. After you use the material you researched, place the author's name in parentheses.

> *Catalase is an enzyme that breaks down hydrogen peroxide. It is found in all cells, and especially in the liver of animals (Audesirk). It breaks apart hydrogen peroxide into water and oxygen gas (Britannica).*

At the end of your lab report, you must list all of the references you used. You can use the same form you use in your English classes:

<u>For your text book:</u>

Audesirk, Teresa, Gerald Audesirk, and Bruce Byers. *Biology* 6th edition. Prentice Hall: Upper Saddle River, NJ. 2001.

<u>For a website:</u>

"Catalase." *Encyclopedia Britannica Online.* Encyclopedia Britannica. 15 Oct. 2004 <http://www.eb.com>

It is very important that you always cite information you looked up in other sources. If you do not, you are committing plagiarism—the most serious academic offense. If you are caught plagiarizing, you will get an F on the assignment and be referred to your grade principal. If you are unsure whether to cite something, or how to write the reference for the end of the lab report, please ask your teacher.

The Website "A Research Guide for Students" by I. Lee <http://www.aresearchguide.com> is an excellent source of information on how to use the parenthetical citations and how to write up the reference in your bibliography. The *FHS Guide to Research Papers* from the English department is also an excellent reference.