Lab Report Guidelines
AST-1022
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Your lab reports comprise a significant percentage of your final grade for this class. This guideline will provide details as to what every lab report should contain, as well as make suggestions as to how to format your lab reports. A small, sample lab report is provided at the end for your use as a template or guide when you are prepared to write your own lab report.

Lab Report Sections:
Every lab report must contain the following sections, weighted as follows:

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Introduction – The Introduction should contain a statement of purpose, first and foremost. This statement of purpose should be one or two sentences, maximum, that concisely and clearly state the objective of the experiment. In other words, what question(s) are you trying to answer by performing this experiment? The introduction should also contain a few sentences that provide important background information regarding the experiment. For instance, you can include a short, general explanation of some of the fundamental physics or astronomy involved in the lab, reference specific examples in nature that provide the motivation behind the experiment, or briefly mention previous work performed by others working in the same subject area.

Procedure – The Procedure section should explain step-by-step what was actually performed in the lab the day (or night) of the experiment. Think of writing the Procedure section in the same way you would write down a great recipe for a fantastic dish you just created. You need to list all the “ingredients” needed, write down the exact order steps were performed, and be sure to note any deviations you may have made from an older recipe you were using as a guide. In much the same way, you need to provide a detailed, step-by-step log of what you did during the experiment. Be sure to list any equipment you used at the beginning, then explain in detail each step you did during the lab. If you are ever in doubt as to whether you should mention something, write it down. It is always better to provide a detailed explanation of your experiment than to leave out a step that seemed trivial to you at the time, but is in reality important to someone trying to follow what you did. Also, do not simply copy information from your lab manual. You need to write down exactly what you did in the lab, even if it was different from what the lab manual suggested you do. Just like that recipe, the goal of the Procedure section is to allow a complete stranger to sit down, perform the same experiment, and get similar results to yours.
Data – The Data section is where all your collected data should be presented. Any measurements you make should be entered under the Data section. Only “raw data” is to be presented in the Data section. Raw data is either data that you measured directly yourself, or data that was given to you from an alternate source. Measured data is best presented in the form of a neat and organized table. In the case of data taken from an exterior source, such as a textbook or your lab manual, you must reference the original source. Any data that you calculate, regardless of how “simple” the calculation seems to you, must be presented in the Analysis of Data section.

Analysis of Data – This is the most important section, and hence it is also worth the most amount of points. In the Analysis of Data section, you must present any and all calculations or analysis you do with your raw data. For calculations, be sure to show enough steps of your work so that it is easily followed by a reader. If you have any doubts as to whether you should skip a line in your calculation, include it. It is always better to show too much detail in your calculations than to confuse a reader by moving to quickly through the calculation. It is also an excellent way to check for any mistakes you might have made. You also need to include any analysis you performed on the data. This is a little tricky, because you do not want to mention any conclusions about the data yet, only analysis. Typical examples of analysis would include any fitting you did to the data (and why you chose that kind of fit), justifications of any intermediate results (i.e., “this makes sense, because we expect…”), and pointing out any trends or relationships you discover (i.e., “as can be seen from Equation 1, the force of gravity is stronger for more massive objects.”). To summarize, any calculations or reasoning you use to get from your raw data to your conclusions should be included here.

Error Analysis – This section must contain all possible sources of error, or uncertainty. Regardless of whether your data comes from a telescope, an experiment on the lab table, or the computer, there are always sources of error. Some sources of error are inherent to the data, e.g., “The sky was a little more hazy than usual, so my measurement of the brightness of that star is not as accurate as it could be”. Other sources of error are human-based, e.g., “I did my best measuring the width of that crater, but I can’t identify the exact location of where the crater ends.” While error analysis does contain a large mathematical basis (the entire field known as “statistics” deals with error analysis), it also requires a qualitative, sometimes even creative side to identify all sources of error in an experiment. Use your head to think critically about your sources of error; be reasonable, but not limited. For those sources of error that you can calculate values for, you should provide those calculations in this section. For those sources of error where you can’t mathematically compute the values, give your best estimate to how much you think it affected your results.

Conclusion – Finally, this last section is where you discuss conclusions you have made from your experiment. Your Conclusion should be sure to address every issue you discussed in your Introduction. If you get a result that is contrary to what you expected, then state your result and offer suggestions as to why it came out differently. Whatever you do, do not lie or fiddle with your data to get what you think is the right answer. In any scientific research, experimenters usually have ideas as to what they will find, but they must always keep an open mind and present the facts as they have observed them, and then understand what those values truly mean. It is not considered a failure if an experiment fails to justify or disprove a theory one way or the other. A lab experiment is considered a failure only if the author(s) fail to present their data truthfully and/or do not provide a well-thought out discussion as to why the experiment did not
go as planned. You may also briefly summarize what was done during the experiment or mention some values that were measured to remind the reader before making a concluding statement, particularly if your experiment was a particularly long or involved experiment. Suggestions as to additional future work to improve results (or obtain them in the first place) is always a nice addition as well.

Lab Report Requirements:
Here is a checklist of some formatting issues your lab must contain:

- The exact title of the lab, centered and on the top. Use the same name that is in your lab manual for the title.
- Your full name, on the top right of the lab report.
- The names of all the other students you worked with (if any) while collecting data, listed below your name.
- The date you performed the lab, listed under all names
- **Page numbers, located on the bottom right corner of each page**
- Labeled sections, in bold or underlined. Be sure to include all the sections mentioned in this guideline!

You should also number any equations you use in your lab report so you can refer back to them if necessary. Place the number on the same line, in parentheses, and on the right side of the equation. Example:

\[ E = m c^2 \quad (1) \]

If you have any questions regarding your lab report, please feel free to contact me or stop by during office hours. Once you’ve written your first report, subsequent lab reports will be much easier to write. It’s important to take the time and write a good lab report your first time, so that you have an excellent template you can use for your other lab reports.
A Very Short Example Lab Report

Introduction:
This is the introduction section. The first thing you write should be a concise statement describing what the purpose of your lab was and what questions you wanted to answer. Also, include at least 2-3 sentences on important background information related to the experiment. Don't forget page numbers!! Put them in using your word processor or simply in pen by hand.

Procedure:
Extremely important for you to be detailed in this section. Provide step-by-step instructions IN PARAGRAPH FORM of everything you did. I.e., don't number them, present it in narrative form. Pay attention to details and also anything different you did compared to what is written in the (very old) lab report manual.

Data:
All of your data..................................................................................................................................................................................goes here. You should put....................................................................................................................................................................it all in table1..................................................................................................................................................................................format.

Analysis of Data:
Be sure to include all your analysis in this section. Write out each step (for at least one example calculation)! That way someone reading the report can follow what you did. Plus, you can find any errors that way. An example equation should look like this
\[ y = mx + b \] (1)
Be sure to explain what all of your variables mean! For example, in Eq. 1, m is the slope, b is the y-intercept, x is the x-coordinate and y is the y-coordinate. This is crucial to do for each new variable (symbol) you introduce in your report.

Also, you should talk about any and all graphs you make in this section. Be sure to refer to them “See Graph 1, attached,” and then discuss the results of the graph. ALSO BE SURE TO ANSWER EACH AND EVERY QUESTION IN THE “YOUR REPORT” SECTION OF YOUR LAB MANUAL HERE. Otherwise, you haven't done the whole lab! Again, do not number your answers, put them all in a simple, paragraph form.

Error Analysis:
You should be sure to discuss in detail any and all sources of error in the experiment in this section. Again, this should be at least one full paragraph (4-5 sentences). Describe the sources you think are possible, and if they had a small or large effect on your final answers. If the lab asks you to calculate the errors (and we will go through that as a class) here is where you show your calculations. If not, try and estimate how large the errors might have been.

Conclusion:
Finally, the conclusion should contain a summary containing all your findings. Discuss whether you actually were able to find answers to your questions in the Introduction or not. Also, suggest some ways which this experiment could be made better in the future to provide better answers.

1 Source: and include any outside sources, if any, here