
Completing Your Lab Report

Learning Goals

- Understand how to organize your lab report
- Practice writing introductions and conclusions
- Learn how to synthesize ideas properly

Abstract

When writing a scientific paper, it is important to make your language amicable and inviting. Often times it is the best written papers that yield the most scientific impact, as the best ideas when poorly communicated are often ignored.

The abstract is the first invitation the reader has to your paper, and so you want to get your message out in as concise, yet clear a way as possible. You should restrict your abstract to having approximately 5 sentences that introduce the motivation for writing the paper, the essential result that you are trying to get across, and then the main takeaway the reader should have. Let's look at an abstract for a physics paper below.

Molecules and particles make up $\sim 40 - 70\%$ of carbon in the interstellar medium, yet the exact chemical structure of these constituents remains unknown. We present carbon K-shell absorption spectroscopy of the Galactic Interstellar Medium obtained with the Low Energy Transmission Grating Spectrometer on the Chandra Observatory, that directly addresses this question. We probe several lines of sight, using bright AGN as backlighters. We make our measurements differentially with respect to the bright source Mrk 421, in order to take the significant carbon K absorption in the instrument into account. In the spectrum of the blazar 1ES 1553+113 we find evidence for a novel feature: strong extinction on the low-energy side of the neutral C 1s–2p resonance, which

is indicative of scattering by graphite particles. We find evidence for characteristic particle radii of order $0.1 - 0.15 \mu\text{m}$. If this explanation for the feature is correct, limits on the mass of the available carbon along the line of sight may imply that the grains are partially aligned, and the X-rays from the source may have intrinsic polarization.

Of course, since this is a larger paper than a lab report, the abstract is allowed to be slightly larger, but the structure is essentially the same. It introduces the main subject the paper will focus on, molecules in the interstellar medium. Then, it describes how the measurements were made and the main result that was found, the types of particles and their sizes. Finally, it explains the implication and importance of the result in the context of the first sentence. For another example, please look at the example lab report.

The Introduction

The introduction is the first full section of your lab report. It should flesh out the motivations you introduced in your abstract and outline the structure of the paper you are about to write. The introduction should make sure to both include proper background and necessary physics the reader should know as well as leave out anything that is irrelevant. For example, while writing about a pendulum may necessitate including some force analysis, you do not need to give the entire background of Newton's laws.

Your introduction should begin with an overview of the important physics concepts and provide a central motivation for doing the lab report. It is understandable that this can appear somewhat superficial, especially for early lab reports. Indeed, it is for the following example.

The value of g has been well measured for centuries. There are many famous consequences to uniform gravitational acceleration near the earth, including the equivalence principle. The equivalence principle says that observers in a uniform gravitational field cannot tell that they are accelerating. It is therefore incumbent on us to make sure we have a good value of g and add onto the numerous confirmations of its value, $g = 9.8$.

Superficiality aside, the goal is to get your reader invested. Once the central motivation is stated, you should include equations and math that are central for understanding the later parts of the paper. In particular, you want to at least state any equations you will be using to examine data plots you make later. In the example lab report, we had to make sure we introduced the following equation,

$$l = \frac{g}{4\pi^2} T^2, \quad (1)$$

where l is the length of the string and T is the period of oscillation.

Then, you should outline your future sections. This provides a road map for your paper and gives the reader proper context. This can be as straight-forward and concise as saying what each section contains.

You should use simple present tense to describe any known information. You should use simple past tense to describe any information that is no longer true.

Materials and Methods

Your goal in the materials and methods section should be to write the steps out in a way that there is absolutely no confusion on how you conducted the experiment. A good check is to see whether a person who did not conduct the lab understands the steps you took to do the lab report!

You should additionally attempt to justify why you are taking the steps you are taking. This should be related to what you introduced in your introduction. An example from the example lab report is presented below.

There are two ways to use (1) to find the value g . The first method is to measure the period at various lengths for a pendulum. Then, we can square the values of the period and find a graph of data for l as a function of T^2 . This should be a linear function with a slope $g/4\pi^2$. Once we find the slope, we can find the value of g . This is the approach taken in Section III.A.

You should then go into describing the steps conducted to reach your goal. You should use simple past tense to describe the steps you took in conducting the experiment.

The Conclusion

The conclusion should provide both an accurate and concise summary of why you did the experiment, what you found, and why it was important. You should then look forward to where one could go from here. What are unanswered questions? What are the errors in the experiment and how can it be improved in the future? It is usually best to eliminate any sources of systematic errors and discuss how you did so. Then, anything that could not be removed is a good starting point for discussing where you can go in the future. An important point of emphasis is that you do not have to just discuss what the errors are but also say what potential errors there could have been and how you avoided them!

In writing the conclusion, you should use the past tense to summarize your findings and the future tense to discuss future outlook.

A Comment on Writing Style

It is both important to communicate your information in a concise and understandable manner. This is done by using correct tenses and grammar in your scientific writing. The following link is helpful in summarizing what type of tense to use and where,

- <https://www.biosciencewriters.com/Effective-Use-of-Verb-Tense-in-Scientific-Writing.aspx>

The following links are helpful in terms of writing style for your lab report.

- <https://cdn.journals.aps.org/files/rmpguapa.pdf>
- <https://writingcenter.unc.edu/tips-and-tools/sciences/>
- <https://lsa.umich.edu/content/dam/sweetland-assets/sweetland-documents/WritingGuides/HowDoIPresenttheFindingsFromMyExperimentinaReport.pdf>