

Steps to organizing your manuscript

1. Prepare all figures and tables to be used in the manuscript
2. Write the Methods section
3. Write the Results part of the Results & Discussion section
4. Write the Discussion part of the Results & Discussion section
5. Tie the Results and Discussion parts into a coherent Results & Discussion section
6. Write the Conclusions section
7. Write the Introduction section
8. Write the Abstract section
9. Write a concise and descriptive title
10. Write the References section

Format of the Lab Report

- The first page of the report should be a **cover page** that includes the following information:
 - The title of the manuscript
 - The names of the authors and their affiliation (in this case it will be your lab section)
 - An abstract that summarizes the content of the report in one paragraph
- The body of the report begins on the second page of the report and includes the following six sections:
 - Introduction & Background
 - Methods
 - Results
 - Discussion
 - Conclusion
 - References

Preparing Figures and Tables

There is an old adage that posits “a picture is worth a thousand words” and in no place is this truer than in communicating science. Illustrations including pictures and schematics of experimental setups, pictures of samples, and graphs and tables of data are an efficient manner to present scientific discovery, so it stands to reason that we take care in the preparation of these illustrations so that nothing is “lost in translation”. To ensure that your figures are as efficient as possible in communicating your results, follow these four general rules from Elsevier (one of the largest publishers of academic journals in the world):

- Avoid crowded plots, using only three or four data sets per figure; use well selected scales
- Think about appropriate axis label size
- Include clear symbols and data sets that are easy to distinguish
- Never include long boring tables. You can include them as supplementary tables

In addition to these rules, it is important that all images have a scale marker or scale bar on used color only when absolutely necessary. Lastly, when making graphs it is convention to use symbols for measured data points and lines for fits to the data.

In addition to the general rules provided above, the following tips will help you to create graphs and tables (the most common types of figures found in the communication of scientific data):

- Raw data is presented only in the rare cases in which it is absolutely necessary.
- All figures must be referred to in the body of the manuscript and should contribute to the logical case made in the report.

- Tables are numbered sequentially and separate from all other figures with the caption appearing above the table. All other figures (graphs, schematics, photographs, etc.) are numbered with the caption appearing below the table.
- Style tips for tables:
 - Column headers label the quantity (name and symbol) and provide units.
 - Headers and values in each column are centered.
 - Maximize readability by using white space for clarity while keeping font sizes easy to read.
- Style tips for graphs:
 - Avoid using too much white space to ensure that the data are emphasized.
 - Use symbols for measured data and solid lines for fits to the data based on a theoretical model.
 - In general, it is best to produce graphs that are easily read when printed in black-and-white (use color only when absolutely necessary).
 - Axes must be labeled with the quantity (name and/or symbols) and its associated units.
 - Axes must be labeled with appropriate scales to set the data range and provide context for the results.
 - Captions should give enough information to understand the figure without reference to the body of the manuscript.
 - The body of the manuscript should point out what the reader should notice in the graph, guiding them to understand its key features and content.

Writing a Methods Section

The purpose of a Methods section is to describe the experiment in enough detail so that the reader may be able to recreate the experiment. While it is important to be thorough, do not rehash the details of a proven method, instead provide a reference to the work in which the method was established. Lastly, the experimental methodology should appear in this section in the same order in which the data will appear in the Results & Discussion section.

Writing a Results Section

The purpose of a Results section is to respond to the question “What have you found?” It is in this section that *your* data is presented; therefore, you should not refer to work done by others in this section (If you are referring to others’ work in comparison to yours, then you are discussing your results and should be included in the Discussion section).

Writing a Discussion section

The purpose of a Discussion section is to present your interpretation of the data. This is generally regarded as the most important section as it is here that you “sell” your story to the reader. The Discussion section should make reference to the Results section but not reiterate the results, instead present your explanation of the results. While this section is typically the hardest to write as it requires the most “original thought,” a few general rules should be followed:

- Avoid making statements and claims that go beyond what can be supported by the data.
- Avoid non-specific words and be as quantitative as possible.
- Avoid the introduction of new terminology – this belongs in the introduction.
- While speculations on possible interpretations of the data are allowed, these must be rooted in fact and supported with evidence.
- Revisions of manuscripts may require more lab work to be performed – you may need to perform more experimentation, derivations, and/or simulations to make the paper stronger.

In addition to these rules, keeping the following questions in the back of your mind while writing this section can often provide helpful:

- How do your results relate to the original question or objectives of the work?
- Does your data support your hypothesis?
- Are your results consistent with those reported by other investigators?
- Are your results unexpected? If so, why?
- Is there another way to interpret your results?
- What further studies are necessary to answer questions that are raised by your results?

Writing a Conclusion

The purpose of the Conclusion section is to wrap up the manuscript and to show how the work contributes to the present body of knowledge. In many peer-reviewed journals, the Conclusion is a stand-alone section while in others it is left as the last paragraph of the Discussion section. A common error in the preparation of Conclusions is reiterating the experimental results without providing a clear justification for your work. To combat this, in PHYS-225 we will opt for a stand-alone section that provides a clear scientific justification for your work and indicates possible uses and extensions of the work if appropriate.

Writing an Introduction

The Introduction is your opportunity to convince the reader that your work is important and useful. Good introductions should answer the following questions:

- What is the problem to be solved?
- Are there any existing solutions to this problem?
 - If so, which is the best? Why?
 - What is the main limitation of this solution that requires the need for further work?
- What is it that you hope to achieve?

It is in the introduction that the bulk of your references to others' work are made as it is here that you set the stage and discuss the general theory behind the system that you are studying. Additional tips that may help in writing the Introduction include:

- The introduction should be as simple as possible, but no simpler.
- The introduction should be organized from the global to the particular point of view. You should start broad and pare down to your objectives for the manuscript.
- It is in the introduction that the purpose of the manuscript is presented. Inasmuch, the introduction should generally end with a thesis statement of sorts.
- Your hypotheses and objectives should be clearly stated in the Introduction.

Writing an Abstract

An abstract, along with the title, serves as an advertisement for your manuscript selling readers on what you did and the important findings of your work. The abstract should be a stand-alone section allowing the reader to gather the gist of the paper without having read the whole article. That said, abstracts should be clear, precise, and brief as possible (300 words or less is a good benchmark for an abstract). In writing an abstract, it is imperative to address the "two whats"; what has been done, and what are the main findings? In addition, the abstract often addresses the "how" as well by providing a short description of the experiment.

Writing a Concise and Descriptive Title

The purpose of a title is to paint a broad picture of the topic of the manuscript. It is the title of your manuscript that makes first contact with the audience and is key to their decision to read the abstract to see if the paper is worth reading or to continue searching. In this light, while very little time is typically spent in composing a title it is critical. This is why we tend to leave the composition of the title until the end of the process. Once you have engaged with the material and written the report, it is much easier to compose a concise and descriptive title.

Writing a References Section

In the body of the manuscript, you must cite all publications on which your work is based. Your references should be thorough but not over-inflated with unnecessary references. Often, using software such as EndNote or Mendeley can be useful in organizing your references and taking care of much of the mechanics of in-text citation. Different instructors may require different styles (MLA, APA, AIP, etc) for citation so make sure that you are using the correct style.

References

<https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously>

PHYS-115 HR Manual