End of Semester Lab Report Guidelines

You have reached the end of a semester in the lab! Congratulations. As a capstone for your work, you get to practice writing up your research as a scientific journal article. This document will be roughly 10 (± 2) pages, double space, including figures, and excluding references (you will have references, they just don't count towards length). This document (that you are looking at) is a guideline on how to write a journal paper; it includes detailed how to write each section of the paper, and what audience to write to in each section. Papers are strange in that each section potentially has a different target audience to write to. This kind of writing is a separate skill to performing experiments, and is a challenging part of research. This is a learning process. Ask questions and keep trying.

The sections of your report:

1. Abstract
2. Introduction and Motivation
3. Background Information
4. Methods
5. Results
6. Discussion
7. Conclusion
8. References

1. Abstract

This is usually short, about one paragraph. Write to an audience that happened upon your document and is wondering if they should read it or not. This section will include information from your other sections (i.e. Motivation, Methods, Results, Conclusion). This is often the last part you physically write. It will hang together better after you write the sections you summarizing. Usually it follows the following structure:

1. <This is a problem for humanity that would be good to solve>
2. <This is what folks try to solve it…>
3. <…but it is still not solved due to these issues A, B, C>
4. "**Here we**" <do things to do better at A, B, C>
5. <As a result of this work we make the following novel claims: X, Y, Z>

2. Introduction and Motivation

This is longer than the abstract, but usually less than a page. Write to an audience that is now interested in your work from reading your abstract, but is still wondering why this topic has relevance. Go into detail for the motivation of your project and the broader implications of understanding it. *Why* are you doing this project? What *purpose* does this research serve for humanity? Why should taxpayers be *glad* research on this topic is being funded?

3. Background Information

This might be one to two pages depending on the degree to which you want to get into the subject. Write to an audience that is unfamiliar with your subject, bring them up to speed on the work done so far in the

field. If the field is undecided on a fact, say so! Acknowledging what is currently unknown or debated is important and goes here well. Experts in the field will likely skip this section and jump straight to the Methods section, or even the Results, but when writing this section: assume zero knowledge of your field. The Background Information section will likely be more in depth in your report, than it would be in a journal paper, where it is assumed the reader knows slightly more about the overall field. For your paper **write to an intelligent college freshman**. They took science in high school, but have never worked in a lab before.

4. Methods

This might be two to five pages. Write to an audience that has never done your experiment before but wants to do it themselves. **Spare. No. Detail.** Include the experiment design, the protocols, the equipment model numbers, anything that someone might need to know to reproduce your work exactly. They should be able to read your methods section, go buy everything you used, follow your instructions, and get the same results. A reader might skip this section, going straight to the Results section, until they read about a protocol they do not know. They will then flip back to this section to read more about it. Make subsections for each protocol for easy searching for the relevant topic. Write to the person with a printout of your paper standing at their bench trying to duplicate your experiment.

5. Results

This might be two to five pages. Write to an audience that is an expert in the field. Assume they already know the motivation and methods for this research. Assume they are a professor working in this field for 20+ years. Assume they are skeptical of the claims you made in the title and abstract. Now it is time to **prove your point**. Show your data. You might need to mention the methods again, but do so briefly just so they can understand the data they are looking at. If they want to know more about how to *do* the experiment, they can go back and read the detailed version you have in your methods section.

Part of the art and style of paper writing is using your data to tell a story, ordering your graphs and results into some narrative. Odd thing is, this order is likely not chronologic. The order in which you did the experiments is not, necessarily, the order that caries the best narrative. Order the figures in such a way it would make sense to present them to an audience, then write the story around that progression. All of your data is “true” (± noise at least) and thus, technically, the order you present it does not change how true it is. Except we are human, so it does matter for our interpretation. This is a skill in and of itself.

All that said, stick to things that are close to your data. You might make some guesses or new hypothesis based on your data and results. Unless you have data on those directly, keep speculation out of the Results section; bring them up in the Discussion section.

6. Discussion

This might be one to two pages. Write to the same audience as in the Results section, but here you are diverging from your raw data, to explanations for what it all means. Hand waving arguments go here. Everything in the Results section should be true (± noise) until the end of time, but your interpretation of the data may be wrong (hopefully not) and this is the material that goes in the discussion. Assert things you think the data proves, suggest things that you think are suggestable, say things are uncertain if they

are uncertain. Judgment and understanding of the data goes here. You are the first person to **comment on your results**. This is your section to do so and anticipate thoughts people might have about your paper.

7. Conclusion

This might be as long as a paragraph to a page. Write to two audiences: (1) an expert that only read the discussion and is looking for a summary for what they should definitely take away from this manuscript, and (2) an expert that read the abstract and then skipped the entire paper to just read the end to see your claims in more detail. You are primarily writing to the first audience, but keep in mind many people reading this section are in the second group. This is the section to **summarize your claims**. Longer conclusions have a section on future work. For this report, include this here.

8. References

Include references throughout the manuscript. Most will likely be in sections 2, 3, and 4, with some cropping up in section 6.

You are off to a good start! If this is difficult, you are not alone. Ask your mentor questions. Everyone has their own approach on how to write a manuscript, it will take you a few papers to discover what works best for you.