How to Prepare a Write-up on Laboratory Exercises

**Purpose:** This handout is provided to the student as guide to scientific writing. This handout specifically addresses the recording of experimental results and the writing of laboratory reports. For purposes of this course, the student will treat the laboratory exercises as original research. It is not within the scope of this course to improve the student's writing ability. Neither brilliant nor clever writing is needed. However, proper clarity and grammar are required. Scientific writing is functional and, indeed, sometimes dull. Its function is to relay complete and accurate information as concisely as possible. The report should be short but complete and the attached format is recommended.

Note: Not all of your experiments will require a full report! Read the individual laboratory instructions carefully and follow the instructions of the instructor.

**Report Format:**

The report should contain the following parts:

1) the "Abstract,"
2) the beginning or "Introduction,"
3) “Experimental” methods
4) the “Results” research performed
5) the implications of this research, i.e. the “Discussion of Results”.
6) the "Conclusion."

The report should also have a title page with and only with:

1) the title,
2) the author's name,
3) the date of the report,
4) the institution where performed with course/section #.

Each of the sections must be identified with a clear heading. Each of the words below that are marked with an asterisk (*) should appear as section headings in the report

**The Abstract**

An abstract or summary is required. The primary purpose of the abstract is to allow rapid scanning by potential readers. It should be concise, inclusive, easily comprehended and include the major conclusions.

**The Introduction**

The introduction includes

1) the purpose of the report and/or the justification for the research performed. A simple statement can sometimes break the writer's block: "The reason for this report is . . . " or "The purpose of the research . . . " Neither of these statements is eloquent, but they give you a beginning. Rewrite later if you wish.
Other information in the introduction includes:

2) The scope of the report, that is, what is and what is not covered,
3) Background material including reference to prior work discussed in the text,
4) Summary of theory and basic principles known prior to the report (appropriate references are required for this),
5) An indication of the organization of the report if the standard format is not followed and
6) Definitions of terms not commonly used. Define the terms central to the particular laboratory exercise.

The Middle Section:
This section can vary considerably depending on circumstances. The information included in this section consists of:

Presentation of Experimental Methods* (or "Experimental*)")

Materials Used:
Describe all materials used. Give the purity, size, shape and any other variables which may be relevant. Retain in your original records all information, observations, data etc. you collected. When the research is completed, variables originally thought to be irrelevant may be vital. If some property is suspected to be relevant but unknown or unobtainable, indicate this in the report.

Instrumentation:
Describe all instruments used. This usually requires only the instrument name, model number and/or type. Fully describe any modifications to the conventional configuration of the instrument. This may require engineering or schematic drawings. Include such drawings in the report as figures.

Experimental Procedure:
Tell how each experiment was performed. Ideally, the researcher obtains a notebook and uses it to record each experimental step and observation. Each step and observation must be reported in sequence. Experiments are often repetitive in nature. It is not necessary to describe the details of the common experiment with every variation. Describe the experiment in detail for the first experiment. In subsequent research using the same procedure, it is not necessary for the researcher to repeat the description. The researcher indicates the common experiment as a point of reference. Next the researcher describes in detail the variations on this common experiment. Each variation should be given some name or other form of identification (Run 1, Run 2, etc.). These variations are usually listed in a table for easy reference.

Experimental Results* (or "Results")
In this section all observations, both qualitative and quantitative, are presented. In an effort to make the results more easily understood, refer to figures, tables, photographs, etc. All observations and data should be recorded in "raw" form (data which has not been massaged or transformed) in a notebook as a permanent record. If the data given in the report is transformed mathematically from the original data, the method of transformation should be clearly noted under "Experimental Methods" section. Never present data in such a manner
that information is lost. The original data should be calculable from the transformed data. For example, if you report the density of a material, you should also give the weight or the volume and preferably both.

Discussion* of Results
Often this section is included in "Experimental Results", especially if the results portion is short. This section is an explanation of the experimental results. This includes formulations of new theories, reconciliation to previous work and resolution of any internal conflicts. Give the implications of the research. A discussion of possible future research which might be needed is appropriate.

The Conclusion*
The conclusion should be brief. It should include the significance of the research vis-a-vis the justification for the research in the introduction. This tends to tie the work together. Include a very brief summary and the main inferences as reported in the discussion. It may include a statement of planned future research. Do not introduce any new information in the conclusion.

Other

Figures and Tables
Provide captions (titles) for all figures, photographs, and graphics. These should be self-explanatory if possible. Many readers skim articles by reading the abstract, the conclusion and the figure captions. Therefore, captions should be clear and concise. An expert should not be required to refer to the text in order to understand the figure. Captions can be as long as three sentences in order to fulfill this requirement. Graphs should have all axes clearly labeled with a few words and the appropriate units. Tables are labeled in the same manner as figures. The title fulfills the same requirements as the figure caption. The column headings fulfill the same requirements as the axes labels. Tables and figures are included in the text of most articles. However, in reports it is common to include them after the references. This latter approach will be followed in this course.

Appendices
Avoid appendices unless they provide easier reading in the main body of the text. The material contained in the appendices should be relevant but not necessary in order to understand the main body of the text. An appendix is always referenced in the main body of the text.

References
The conventions on the form of references vary, but should be consistent within the report. Either the style given in the American Chemical Society Handbook for Authors or the Harbrace Handbook is suggested. Each journal or publisher has a preferred style. Failure to mention a reference in the text is prima-facie evidence that the reference is unnecessary and should not be listed. Use of ideas, wording, equations, etc. from another's writing without a reference is plagiarism (whether deliberate or inadvertent).
Some Comments on Writing Style:

Positive short statements are preferred. Adhere to this even at the risk of making the text sound choppy.

Break up complex sentences.

Use simple tenses. Tenses (and voice) create many problems in scientific writing, probably due to an obsession of scientists to avoid the first person. A safe rule is to use the simple present tense. A good illustration of exclusive use of the present tense is a typical cookbook. This writing style is not eloquent, but it is safe.

Mixing tenses is common in scientific writing; however, there must be a reason for this. Again simple tenses are preferred. Care should be taken in the use of present tense and past tense. Selection should be deliberate. Example: "This theory states that . . . To confirm this theory, the gas was expanded . . . Gases bubbled from the beaker bottom."

Both the active and passive voices are permissible. However, avoid the passive if possible since it is usually overworked.

The usual rules of paragraphing should be followed. In this spirit, remember that a simple train of thought (from a reader's point of view) uses no more than a half of a double spaced page. Count the number of paragraphs on each page. If you have less than two paragraphs, you are probably not paragraphing correctly or you are not being concise within each paragraph.

Lab reports are due at the end of each lab unless otherwise noted by the instructor.

Spelling and grammar count.

Neatness counts. An illegible report will not be graded. All pages must be securely attached (a staple is fine, folded corner is not)

Late reports will have 10% deducted for each week late.

Improper use of significant figures will have 5% deducted.

I hope these comments will help you with your laboratory reports. Your questions and comments are encouraged.
Sample Laboratory Report Format:

IMPORTANT !!!: The words that are underlined should always appear in the report as headings in this course. For example, the word "ABSTRACT" should appear as the heading of the abstract. Your name should be on each page. A multiple page report must be stapled.

Title Page to include:
- Title of Report
- Name of Author
- Where and when submitted
- Sponsor (Course and section# i.e. Chem1000 L01 Friday)

(new page)

Abstract
- Title of Report
- Name of Author
- Body of the Abstract
- Title of Report
- Name of Author

Introduction

Experimental Methods

Experimental Results

Discussion

Conclusion

Acknowledgments (optional)
Appendices (optional)
References
Figures and Tables (normally included in the body of the report)

Don’t forget to include:
- Figure Captions or Table Titles
- Titles, Axes labels, legends or column and row names
- The unknown # if one was given to you.