

How to Prepare a Writeup 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.

Report Format:

The report should contain four parts:

- 1) the "Abstract,"
- 2) the beginning or "Introduction,"
- 3) the middle which should contain data and sections on:
 - a) experimental methods,
 - b) research performed and
 - c) the implications of this research.and
- 4) the ending or "Conclusion."

The report should also have a title page with:

- 1) the title,
- 2) the author's name,
- 3) the date of the report,
- 4) the institution where performed

Each of the sections must be identified with a clear heading. Each of the words below that are underlined 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-facia 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.

The Recommended 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.

Title Page

Title of Report
Name of Author
Where and when submitted
Sponsor

Abstract

Title of Report
Name of Author
Body of the Abstract

Title of Report

Name of Author

Introduction

Middle Section

Experimental Methods
Experimental Results
Discussion

Conclusion

Acknowledgements*

Appendices*

References

Figures and Tables**

Figure Captions or Table Titles
Axes labels or column and row names

* Optional

** Normally included in the body of the report

On the next page is a shortened form of the grading sheet. Items marked with an asterisk (*) must be present as section titles. If not present the section is assumed missing. NO credit for missing sections.

How to Prepare a Laboratory Write-up

Area	Points	Is this covered?	DNA	YES	NO	Points
Overall Organization	5%	General - See comments Sections labeled Title Page OK	_____	_____	_____	_____
Grammar	5%			_____	_____	_____
Abstract*	10%	Does it tell what was done? Does it summarize the results? Does it give implications? Is it useful for scanning? Is it useful for searching?	_____	_____	_____	_____
Introduction*	10%	Are new terms defined? Does it give the reason for the report? Does it give background? Is the scope given? Is other relevant literature cited? Is theory presented?	_____	_____	_____	_____
Experimental Methods*	20%	Are all tools and instruments described? All materials described with specifications? Is data acquisition method described? Are all the experimental steps described? Are all mathematical manipulations given? Are all figure and tables included? Are all deficiencies discussed?	_____	_____	_____	_____
Experimental Results*	15%	Are all the data (numbers) given? Are all figures of data included? Are all transformed data listed?	_____	_____	_____	_____
Discussion of Results*	15%	Are encountered problems reconciled? Are results reconciled to theory? Are the implications described? Is other work suggested?	_____	_____	_____	_____
Conclusion*	10%	Does it tie back to the Introduction? Does it give inferences? Does it summarize the results? Does it suggest future work?	_____	_____	_____	_____
Tables Figures Drawings Photos Drawings Appendix (if present)	5%	Are the captions or titles descriptive? Are the captions or titles appropriate? Are the axes (columns) labeled? Are the units correct? Are the figures clear? For drawings, are parts labeled? For photos, are features highlighted? For photos, is a scale included with each? For appendix, is the use proper?	_____	_____	_____	_____
References	5%	Is each relevant? Are all noted in the text? Are all relevant references included? Is the form correct?	_____	_____	_____	_____
Late? _____	How Late? _____				-10%/week	_____
COMMENTS:					TOTAL	_____