Writing Laboratory and Project Reports: A Guide to Improving Written Communication Skills

1. Why write a report?

The importance of writing good reports as a key communication skill cannot be overstated. Besides its use in scientific research, report writing is an essential skill in industry and is needed in most graduate jobs. This document focuses on a style and structure of written communication that is used by scientists to report their work in articles published in scientific journals, but many of the principles are generic. No matter how impressive your results are, they will be of no consequence unless they are effectively communicated. Indeed, editors of very high-profile journals, *e.g.* Nature journals, may even rewrite the abstracts of the papers they publish! There are two typical styles of scientific papers, articles and letters (sometimes called communications). Articles tend to be longer and are structured in a typical format, with section or even sub-section headings. Letters are shorter and appear at first sight to be unstructured. However, closer inspection will reveal that even these actually follow a similar structure – albeit without the section headings. Some journals carry just one of these formats, but those with articles often include both, for example, *Journal of Applied Physics*. You may want to glance through a few journals in the library or on-line to get an impression of the typical layout and style. Pay attention also to the way figures, equations and references are included. Your report must follow the article style, be clearly structured, with section headings.

2. Structure

The structure of your report should follow a common format, irrespective of the level and whether the investigation is theoretical or experimental. The typical format is given below. However, variations on this format may be appropriate for particular modules. Your module supervisor will give further advice.

Title page

The title page should state the title of your report (lab or project title), your name, your degree course, the module and the academic year. Abbreviations should not normally be used in titles (exceptions include elements, *e.g.* He, and SI units, *e.g.* K).

Abstract

The abstract should be a self-contained (*i.e.* without references, footnotes, undefined abbreviations or symbols *etc*.) single paragraph of text that clearly and concisely summarises the project, and announces the main result. For this reason the abstract is often the last part to be written. In science the abstract is used to 'sell' the article to the reader, and is therefore considered to be very important. Scientists may also only read the abstract and the conclusion of a paper, so these two parts must clearly convey the central message of the report, including the main result and its implications. The abstract may be included on the title page, or may follow it.

Table of contents

A table of contents is an essential element for longer reports, and must be included for 3rd and 4th year modules. It is not required for short reports of just a few pages. The table of contents should navigate the reader to certain parts of the report that they may be specifically interested in, or want to refer back to, and should therefore include meaningful section headings, not simply 'Section 1', *etc.*

Introduction

The introduction should motivate the work that is described, set it in a wider context and explain why it is important or interesting. The introduction should inspire the reader to read on. The main result may be mentioned as part of this process, but repeating the results of the investigation is not the main function of the introduction.

Background

This section should give a more detailed description of the background knowledge needed to make the report intelligible to a non-expert reader from the same discipline. Standard derivations of formulae should not normally be included; rather these should be stated with a reference to a suitable source, *e.g.* a text book. Important derivations that are peculiar to the background of your particular investigation should normally be included, but if they are long then the principal results should be stated and the full derivation included in an appendix.

Experimental method/theoretical approach

This section should explain what you did in sufficient detail for the reader to be convinced that the method was suitable. Do not swamp the reader with inconsequential details, but do not omit any crucial information that would be essential for someone knowledgeable in the field to reproduce the result. This section should not simply be a copy of what is written in the module manual/handbook. For experimental projects it should include a diagram of the apparatus used. For theoretical projects this section should contain the substantial steps of original calculations that lead on to the main results.

Results and analysis/discussion

This part of the report is where the actual results of the investigation are presented, and where they can be commented on. It is here that reports will show the largest variation between different project types. You should refer to your module manual/handbook, module leader or supervisor for any specific instructions about what is expected to be included. For example, longer projects, where more discussion is appropriate, may have a separate discussion section, or there may be several sub-sections describing different sets of results. If you have a multi-part investigation using different experimental apparatus or theoretical methods, then you may decide to describe the first part (method, results) and then the second part (method, results).

For experimental or numerical projects, the data presented will not always be the raw data, *e.g.* repeated measurements of the same quantity obtained to determine statistical variation need not be listed: stating the mean value and an uncertainty is sufficient. Similarly, large data sets will not be readily digested by the reader if they are in tabular form: graphical representation is usually more appropriate. If the results presented are post-analysis, it should be clear what this analysis involved. Uncertainties should be discussed. If there is a known/standard value or result, then you should compare your result with it, and comment on the likely source of any discrepancy. Hence, you may propose further work to advance or improve the investigation.

Conclusions

Here is where you should very succinctly sum up what you have done, and restate the main result or results. You might also discuss your findings and their implications in a wider context, and discuss any further work that could or should be done to advance the investigation. Remember that together, the abstract and conclusion should provide a brief but comprehensive description of your work.

References

All reports will contain references. They should be indicated numerically in the text in the order in which they appear, either in brackets [1], or as a superscript.[2] Styles for the actual list of references vary slightly, but references to journal papers will always include the author or authors, the name of the journal, the volume, page number and the year of publication, *e.g.*

[1]*'The quantized Hall effect'* K. von Klitzing, Reviews of Modern Physics **58**, 519 (1986).

Including the title of the paper is not typically required for scientific articles, but can be very helpful, and you are strongly encouraged to do this in your report. For books the title of the book, the author, the publisher and the year should be included, *e.g.*

2. *'The physics of low-dimensional semiconductors'*, J. H. Davies, Cambridge University Press (1998).

Make sure that all the references in the text refer to the correct reference in the list, and that no reference appears that is not referred to in the text. Referring to the same work multiple times is perfectly acceptable, but you should not duplicate references.

Appendices

These contain further information that would distract or bore the reader, but may be useful for an expert in the field. Typical examples are an extended theoretical derivation that may be necessary for an expert to be able to reproduce your result, or tables of data which are displayed graphically in the main text. Appendices should not contain material that is published elsewhere, as this may simply be referred to. Appendices are not always necessary.

3. Style

Language and layout

Your report should be written in Standard English prose and be free from typographical, spelling and grammatical errors. Use spell (or even grammar) checkers, but be aware that spell checkers won't pick up correctly spelt but misused words, and will complain about technical terms or names (*e.g.* in the references).

The report should be laid out in a clear and professional way that is attractive to the eye: break up excessively long paragraphs and justify the text. Overly long sentences or a series of short sentences will make the text difficult to read, and should be avoided. Try to use a broad vocabulary: Word©, for example, has an on-line Thesaurus facility which can be very helpful with this.

Do not use the first person singular ('*I*') in your report. When describing what was happened, *e.g.* in the methods section, use the passive past tense, such as 'the sample was mounted' or 'the data was analysed'. When interpreting results use 'This can be explained…', 'This can be understood…, 'This implies…' *etc.* When expressing an opinion, *e.g.* when the result is more open to different interpretations, it is also acceptable to use 1st person plural ('we'), *e.g.* 'We think that…'. To get an impression of the writing style appropriate for reports you can look in any scientific journal.

Figures

The use of graphs and diagrams in your report is strongly encouraged. These should be drawn using suitable software, *e.g.* QtiPlot. Diagrams or pictures that are copied from books or from the internet are perfectly acceptable, but the source should always be referenced in the caption. Graphs should have properly labelled axes, and legends, if more than one quantity is plotted. The meaning of any lines through data points should be explicitly mentioned, such as 'theory from Ref. 3', 'fit to Eqn. (5)' or 'guide to the eye'. Figure captions

need to be more than titles. The general rule of thumb is that figures should be self-contained, *i.e.* it should not be necessary for the reader to refer to the text to see what is in the figure.

Equations

Similarly, equations must also be produced with a word processor. Avoid re-derivations of standard results, unless you need to refer to them in the explanation of your original work, or if they form an indispensable part of your report. All symbols used in equations should be defined prior to or immediately after the first time they are used. Elemental short names (H, He) are not considered to be symbols. Variables are conventionally italicised. Note that units which are named after scientists should not be capitalised when written in full, *e.g.* 'K' but 'kelvin'.

References, figures and equations should be numbered in accordance with the order in which they appear. Check that all figures, equations and references are referred to correctly.

4. Plagiarism

Plagiarism is considered to be an academic offence on a par with cheating in exams. The Departmental policy on plagiarism is outlined in Appendix E of the Department's Undergraduate Courses Handbook. The term covers inappropriate (unauthorised) sharing of results between students or groups of students who are expected to work independently, the fabrication of results, and copying of sections of text without proper citation. All of these forms of plagiarism are relevant to project work and reporting. Note that for all modules with reports, students must upload an identical copy of the report **once only as a single file** in portable document format (.pdf) to Moodle for plagiarism detection and for our records. **Maximum file size is 20 MB**.

5. Length

Guidance for lengths of project and dissertation reports is given below, sorted by module. Be concise and complete, but not wasteful in your use of words. Your report will be judged on substance, not mere length, *unless* it exceeds the limits given below. If this is the case, it will be marked in the usual way as submitted, but will be subject to the equivalent of a late penalty (reduction of report mark by one letter grade).

Module(s)	**Recommended length (pages)**	**Maximum length (pages)**
281, 351, 352, 363, 375, 378	12 to 15	18
353, 354, 369, 379, 452	15 to 20	25
355	20 to 30	35
451	25 to 35	40

Reports should not be 'squashed' into the limits by using, for example, tiny figures. Margins should be ≥1 inch, and the minimum font size is 11 point. Title, abstract, table of contents, references and appendices do not count towards the page limit. It should be noted that material in appendices should not be essential to the report, and hence will not typically contribute to the mark. There is no minimum length limit.

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