

Guidelines to Scientific Writing

Thesis and scientific Paper

For Postgraduate Students in Atmospheric Science Dept.

By

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This document aims to guide you in the writing up of your graduate thesis and might serve as a basis for publishing your thesis research in a scientific journal. I hope these guidelines are helpful to write up your thesis.

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1 Basic principles in scientific writing

ALL scientific writing should follow the **7 C's-rule**, i.e. scientific writing should be:

1. **Clear**: Unmistakable, not leading to confusion
2. **Correct**: Accurate, free from error
 - a. Not prone to interpretation
 - b. Not prone to speculation
3. **Complete**: Contain all necessary parts and information to be clearly understood
4. **Concise**: to the point, devoid of redundant information and words (avoid verbosity, see Appendix 1)
5. **Conform** to the requirements set by the university (thesis)/journal (journal publication)/employer/... and to the standard conventions and basic principles in:
 - a. Style: units, rules of abbreviations, literature citations etc. and
 - b. Format: shape, size, general make-up of a publication
6. **Consistent**: uniform throughout the text in spelling, structure, style, format, layout, typography, etc.
7. **Common sense prevails!**

2 Format of scientific writing

2.1 Graduate thesis

There is no minimum or maximum number of pages for your thesis manuscript. Don't try to fill pages and pages with text and words that have little to do with your thesis research. Instead, be concise and follow the rule of the 7C's, as explained previously.

Your thesis should have the following organization:

Cover (Example for –thesis Cover given in Appendix 2)

Title page (same as cover but in black and white)

now you start numbering your pages with roman numbers: i, ii, iii, iv, v, etc.

Acknowledgements

Abstract

Table of contents

List of tables

List of figures

List of abbreviations etc.

now you start numbering your pages with Arabic numbers: 1, 2, 3 etc.

Introduction

Literature review (optional)

Materials and Methods

Results

Discussion

Conclusion

Recommendation(s)

Literature cited/References

now you stop numbering your pages

Annexes (=plural of Annex)/Appendices (=plural of Appendix)

Index (optional, don't include an index for a short report of 10-20 pages)

2.2 Scientific article

Title

Authors names and affiliations, author for correspondence

Abstract

Keywords

Introduction

Materials and Methods

Results

Discussion and Conclusion

Acknowledgements

References

Most journals handle a specific format and they all have "guidelines for authors" published on their website. See e.g. Author Guidelines on the home page of the Journal of Ecology (<http://www.blackwellpublishing.com/journal.asp?ref=0022-0477&site=1>)

3 Structure of your thesis

A research paper or thesis is a report of original findings organized into several sections according to a format that reflects the logic of a scientific argument. First the author states the purpose of the investigation, placing the work in a broader scientific context (Introduction). Then the procedure is described (Materials and Methods). Afterwards, the findings are presented (Results), interpreted (Discussion) and summarized (Conclusion).

3.1 Title and abstract

Both the title and the abstract are very important parts of your thesis, since these will be read most often by many readers. They serve two purposes for your readers:

1. to disclose the basic information of your research
2. to help readers decide whether or not to read the entire paper.

3.1.1 Title

The title should attract attention, but most important, it should be **informative and concise**. A good title indicates the **main point** of your study, so use:

- The most precise words possible (e.g. appropriate taxonomic information)
- Words that lend themselves to indexing the subject (your title is the first source for key words for indexing services)

On the other hand, be sure your title will make sense to someone not familiar with your subject. Provide adequate information, but don't make your title too long: **8-12 words** is a good range.

Table 1. Example of good versus bad titles

Bad title	Good title
Ecological Studies of Some Northern Lakes	Seasonal Algal Succession and Cultural Eutrophication in Three Northern Temperate Lakes
Effect of Hormones and Vitamin B on Gametophyte Development in a Moss	Effect of Hormones and Vitamin B on Gametophyte Development in the Moss <i>Pylaisiella selwyni</i>
Studies on the Reproductive Biology of <i>Drosophila</i> , Including Sperm Transfer, Sperm Storage, and Sperm Utilization	Sperm Transfer, Storage and Utilization in <i>Drosophila</i>

Advice on how to formulate a good title for your manuscript is given in Appendix 3.

3.1.2 Abstract

The abstract gives the reader a clear idea of the subject studied, it helps him to decide whether or not to read the full thesis/paper and it provides words for indexing.

The abstract is a **concise** (max. 1 page, condensation of the content of the full report by 95%), **complete** report of your work that can stand alone without further explanation. It should include:

- The objectives/hypothesis of the study and justification for conducting the investigation (What?, When?, Why?)
- The basic materials and methods used (How?)
- The main results obtained and significant conclusions that can be drawn

The abstract should not include:

- A discussion of your results
- References
- Tabulated data
- Any abbreviations, unless they are understood when standing alone (e.g. "DNA", "pH", "USA")

3.1.3 Keywords

Keywords are usually not required for a thesis, but most journals ask the author of a scientific article to include research keywords for indexing and possible readers can easily screen the content of the publication. If you decide to add keywords to your manuscript, put them right below the abstract (on the same page). **Three to five** keywords is enough. Keywords are the most pertinent informative words pertaining to the research done that did not occur in the abstract.

3.2 Introduction

=WHAT?

The introduction sets the stage for your scientific argument. It places the work you have done in a broad theoretical context and provides the reader with enough information to appreciate and understand the relevance your objectives. For example, if your thesis work is carried out in the framework of a larger research project, describe the project and your part in it.

The introduction should

- be informative
- explain the rationale for the study and your major objectives
- clearly identify the subject of your research
- state the hypothesis you are investigating or define the problem you are trying to solve
- bring the reader up-to-date on what has already been done
- provide background information on the research subject
- give a concise literature review (unless you have a separate "literature review" section) to orient the reader by summarizing pertinent literature in your field
- be written in the present tense

3.3 Literature review

In case of a thesis manuscript, a review of the relevant literature can be done in a separate section, but, in case of a scientific article, the literature review is generally included in the introduction. It should be written in the present tense.

The general rule on which tense to use is that you use the **past tense** when reporting your own findings (Materials and Methods, Results) and the **present tense** when discussing the published work of others (Introduction, Literature review, Discussion).

How to search for literature: see course Information retrieval, Management and Presentation.

3.4 Materials and methods

= WHERE and HOW?

Your methodology creates the context for evaluating your data. How you took your samples and did your measurements, what controls you used, what variables you did and did not consider, which assumptions you made; all these things play an important role in the interpretation of the results.

This section should

- provide information such that your study can be duplicated/repeated by others
- describe procedures and methods used, e.g. sampling strategy/frequency/location/date, experimental design, tools and sampling devices used, manipulation of the samples, statistical analysis, complete taxonomic information of the organisms used, data quality assurance etc.
- where appropriate, use flowcharts to visualize the processing methods and handling of your materials
- be organized logically and orderly
- be written in the **past tense**

If you used a well-known method, name it and refer to the paper in which it is described. If you modified the well-known method, describe how and why you modified it.

3.5 Results

=WHAT DID YOU FIND?

This is the most important part of your thesis! The Results section should summarize the data, emphasizing important patterns or trends, and illustrate and support your generalizations with explanatory details, statistics, examples of representative or atypical cases and references to tables and figures. Use the **past tense**.

Do:

- Present your results in a logical and orderly fashion and use the same sequence as in the Materials and Methods section
- Be complete, but concise
- Make maximal use of tables and figures (see section 4). **One good graph can be worth a 1000 words!**
- Give final and meaningful data only (no raw data), e.g. after statistical processing

Do NOT:

- Give the same results twice or more, e.g. in the text, a table and a graph, but chose the most appropriate way for presentation
- Omit data that you consider negative (in the sense that they don't comply to your hypothesis)
- Give primary (raw, unprocessed) data
- Interpret the data or draw major conclusions; this should be done in the Discussion and Conclusion sections, respectively

3.6 Discussion

=WHAT DO ALL THESE RESULTS MEAN?

The Discussion section should

- Relate your results to your hypothesis: do your results prove that your hypothesis is correct or not, and how/why?
- Interpret the results with emphasis on the problem, question or hypothesis you put forward in the introduction
- Relate the data to their causes: i.e. why the data are what they are
- Relate your findings to those obtained by other researchers: whether they corroborate your results or whether they don't and support this with evidence

Be careful with extrapolating your results too broadly: avoid speculation and generalization.

3.7 Conclusions

- What conclusions can you draw from your findings (these can be enumerated)?
- What is their significance with regard to the problem you tried to solve?
- State briefly any implications for practical applications or future studies if appropriate
- Eventually recommendations (if appropriate)

Many scientific journals do not publish a separate Conclusions section, instead, Discussion and Conclusions are combined, but for a thesis, keep them separated.

3.8 Acknowledgements

Briefly (max 1 -1.5 pages) thank people who helped you professionally, namely with:

- Sampling
- Reviewing your manuscript
- Statistical analysis
- Lab work (technicians)
- Providing access to specific equipment or facilities, not available in your laboratory (e.g. use of an oceanographic research vessel)
- Funding your research: mention the source of funding (e.g. This research was financed by a student grant from the National Science Foundation) or mention the project number or code when applicable
- If your work was part of a larger project, mention it as well as the financing or sponsoring authority

Only mention people who really contributed to your work.

For the thesis specifically, you should express your gratitude towards the people who guided you (promoter, copromoter) and if you want, you can express your appreciation for the support of your family and friends.

3.9 References

3.9.1 Referring in the text

In your manuscript you will refer many times to the published studies of other authors or other sources of information. You should **refer to the original source** to acknowledge the source of all material that is not your own. In the text refer to the author's name (without initials) and year of publication. When you have multiple references to literature for the same finding in your text, refer in **chronological order**, then if there are two publications from the same year, use alphabetical order. If reference is made in the text to publications written by more than two authors the name of the first author should be used, followed by "et al.".

3.9.2 List of references cited

The list of references is an **alphabetically ordered** list of sources of information you have referred to, mostly manuscripts, scientific publications, but also websites, computer software, online databases etc.