GEOPHYSICAL REPORTS

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What is a report?

A report is written for a clear purpose. Specific information and evidence are presented, analyzed and applied to a particular problem. The information is presented in a clearly structured format making use of se Writing is a very important part of science; it is used to document and communicate ideas, activities and findings to others.

Scientific writing can take many forms from a lab notebook to a project report, or from a paper in an academic journal to an article in a scientific magazine. This guide focuses on scientific writing for academic course work, much of which is devoted to describing and explaining.

This brief guide is intended to help you improve the quality of your written geological and geophysical reports **or** prepare your graduation projects (GEO 499 & GPH 499). The language should be accurate and concise. Spelling, punctuation and use of grammar must be correct. Effective organization of the presented material is a key to communicating in science. The easier your report is to read, the more effective it is!

KEY STAGES IN SCIENTIFIC WRITING

1) Define the purpose, title and readership of the report.

2) Design a suitable structure with appropriate headings and sub-headings.

3) Gather all the relevant material (e.g. books, articles, information from web-sites; your own field notes) and note down the main points under the appropriate headings and subheadings; try to avoid information overload; be ruthless – reject anything which is not necessary for the main purpose of the report.

4) Think about appropriate diagrams to illustrate the text; prepare draft versions of these before starting to write .

5) Write a rough first draft as quickly as possible; it is good idea to do this directly on PCs – writing things out long-hand is time-consuming.

6) Write the final version, carefully checking all facts, references, figures, etc; make sure that the text flows smoothly; check that you have used paragraphs appropriately; check for spelling mistakes using the spell-check function of your word processor; check that you have used correct grammar and punctuation; make sure that your sub-headings agree with the Table of Contents; read it through carefully to ensure that everything you have written is relevant.

7) Write an ABSTRACT or EXECUTIVE SUMMARY; this should be done last and should summarize the main issues and conclusions of the report.

8) Get a friend or colleague to read through the report to see how clear and comprehensible it is.

Characteristics of good scientific writing

Good scientific writing is:

- **clear** - it avoids unnecessary detail;
- **simple** - it uses direct language, avoiding vague or complicated sentences. Technical terms and jargon are used only when they are necessary for accuracy;
- **impartial** - it avoids making assumptions (Everyone knows that ...) and unproven statements (It can never be proved that ...). It presents how and where data were collected and supports its conclusions with evidence;

- **structured logically** - ideas and processes are expressed in a logical order. The text is divided into sections with clear headings;
- **accurate** - it avoids vague and ambiguous language such as about, approximately, almost;
- **objective** - statements and ideas are supported by appropriate evidence that demonstrates how conclusions have been drawn as well as acknowledging the work of others.

Before you write

Whenever you read or research material for your writing, make sure that you include in your notes, or on any photocopied material, the full publication details of each relevant text that you read. These details should include:

- surname(s) and initial(s) of the author(s);
- the date of publication;
- the title of the text;
- if it is a paper, the title of the journal and volume number;
- if it is a chapter of an edited book, the book's title and editor(s) the publisher and place of publication*;
- the first and last page numbers if it is a journal article or a chapter in an edited book.

For particularly important points, or for parts of texts that you might wish to quote word for word, also include in your notes the specific page reference.

* Please note that the publisher of a book should not be confused with the printer. The publisher's name is normally on a book's main title page, and often on the book's spine too.

HOW TO PLAN AND WRITE A GEOPHYSICAL REPORT

The purpose of a scientific report is to inform, not to impress the reader with how much you know or have read, or to gloss over what you don't know. Your priority is to communicate your information clearly.

TITLE PAGE

PAGE NUMBERING

By convention the title page is not numbered. The pages of the preliminaries are numbered with Roman numerals, with the page immediately following the title page being Roman ii). The text pages are numbered with Arabic numerals, 1,2 etc. Most word-processing software should manage this.

TITLE

Essentially the title is a statement of the aim of the report. It should state briefly and clearly what the report is about. The title page includes the name and address of the author, the date and, for a formal business report, the name of the person or group to whom the report is addressed. t.

ABSTRACT

You are expected to provide an informative (not a descriptive) abstract. This is the concise statement of the essential information contained in the work and must be able to stand on its own without reference to the main text; an abstract is often given much wider circulation than the report itself. It should not be confused with a summary, which is a restatement within a document of its salient findings and conclusions. The abstract for your report should be between 250 and 300 words, and never longer than one side of A4.

The abstract should include:

- a statement of the problem
- the methods used to deal with it
- results obtained
- conclusions reached
- recommendations made

ACKNOWLEDGEMENTS

It is courteous to acknowledge anyone who has contributed substantially by advice, discussion, reviewing your manuscript, or with technical or professional services. Acknowledgements should not be confused with dedications .

LIST OF CONTENTS

The contents list should be detailed, as there is no index, and is arranged by chapter/section numbers with the appropriate headings and sub-headings and the page number on which they start.

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

All reports should start with a statement of the aim, i.e. a clear statement of the purpose of the report. A long report will need an introduction that answers the questions:

- Who is the report written for?
- When was the work for the report carried out?
- What was the nature of the investigation?
- Why has the subject been investigated and what is the background of the problem or task that has been tackled?
- Where is the location? Refer to a map and outline the geological and geographical setting.

LITERATURE REVIEW

Mention all documentation which has any bearing on subject**.** Include not only your bibliography but also a record of everything done in the broad context of your topic

GEOLOGIC SETTING

METHODOLOGY

RESULTS

Results should be organized to support your aim. **E**xplain what happened and what you learnt**.** Include sufficient results to justify conclusions**.** When appropriate, include a discussion of computational methods (e.g. computerized analyses) or statistical methods. Use tables and graphs to display results vividly & concisely.

DISCUSSION & INTERPRETATION

In the Discussion results are interpreted and discussed in relation to previous work. The discussion contains the substance of the report and must be a strong section. If fairly extensive, it may be set out in chapters or sections, including analysis, arguments and deductions. First state the problem in sufficient detail, with figures, to set the scene. Then apply all the information and technical facts to the problem to produce readily understood deductions. Make sure you link discussion with your objectives & show what findings mean to the entire area of knowledge, if possible discussing them in terms of the literature surveyed.

CONCLUSIONS & RECOMMENDATIONS

Conclusions may be part of the Discussion. As a general rule nothing should appear as conclusions, whether or not they are allocated their own section, that has not already appeared in the body of the report.

These should be:

- concise statements of inferences made
- each complete in itself
- developing the findings in a logical order
- to the point
- numbered for emphasis

RECCOMENDATIONS where appropriate, would normally be included along with or adjacent to the CONCLUSIONS.

REFERENCES / BIBLIOGRAPHY

Scientific writing must be properly referenced because :

- the reader must be able to check the sources of ideas, methods or findings you have used.
- You need to distinguish your own work from others' to avoid charges of plagiarism

You need to reference anything that is not generally accepted or known knowledge. You should cite (refer to a piece of work in your text) every time you use a reference and add the full reference to a reference list at the end of the document (before the Appendices) .
A BIBLIOGRAPHY differs from a reference list in that you can include items that you have not referred to in your text, but which provide a survey of the literature about your chosen topic, and annotations may be attached.
References in both bibliographies and reference lists should contain enough information for people to be able to identify the items: accuracy is essential. There are no absolute rules of referencing, but several commonly accepted systems. The main thing is to stick to one system and be consistent.

APPENDICES

You should put into one or more appendices material which would interrupt the flow of the main text, and thereby the ease with which the main arguments may be understood, such as material with very fine detail including lengthy mathematical proofs or derivatives, computer programs, and any lists, glossaries, documents, tables etc., All loose material must bear your name and date, and sufficient information to identify it if it should get separated from the report.

Revision checklist

Keep the following questions in mind as you revise your report:

- Is the purpose of the report clear?
- Is the report suitable for its intended readers?
- Is the title correctly worded, apt and succinct?
- Are you satisfied with the abstract?
- Is it easy for the reader to see the structure of the report; are the sections adequately signposted?
- Have all the main factors been given the correct emphasis, and looked at objectively?
- Is the topic developed in a logical order?
- Is the discussion of your results adequate, logical and convincing?
- Is everything you have written essential?
- Does the conclusion follow from the earlier sections?
- Are the sentences short, simple, easy to read and necessary?
- Is there any unchecked and unreferenced data in the text?
- Do the diagrams convey their message clearly?
- Are they correctly captioned and numbered?
- Is the association between text and illustration as close and clear as possible?
- Do photographs have an indication of scale, and are they the right way up?
- Are references in the text in the correct form?
- Do they correspond with the reference list?
- Have you made due acknowledgements?
- Have you checked for spelling and typing errors?
- Are the pages and Appendices numbers numbered correctly and do they correspond exactly with their listing on the Contents pages or with any in-text reference etc ?

REFERENCES

When to use references

Your source should be acknowledged every time the point that you make, or the data or other information that you use, is substantially that of another writer and not your own. As a very rough guide, while the introduction and the conclusions to your writing might be largely based on your own ideas, within the main body of your report, essay or dissertation, you would expect to be drawing on, and thus referencing your debt to, the work of others in each main section or paragraph. Look at the ways in which your sources use references in their own work, and for further guidance consult the companion guide.

Referencing styles

There are many different referencing conventions in common use. Each department will have its own preferred format, and every journal or book editor has a set of 'house rules'. This guide aims to explain the general principles by giving details of the two most commonly used formats, the **'author, date'** system and **footnotes** or **endnotes**. Once you have understood the principles common to all referencing systems you should be able to apply the specific rules set by your own department.

How to reference using the 'author, date' system

In the 'author, date' system (often referred to as the 'Harvard' system) very brief details of the source from which a discussion point or piece of factual information is drawn are included in the text. Full details of the source are then given in a reference list or bibliography at the end of the text. This allows the writer to fully acknowledge her/his sources, without significantly interrupting the flow of the writing.

1. Citing your source within the text

As the name suggests, the citation in the text normally includes the name(s) (surname only) of the author(s) and the date of the publication. This information is usually included in brackets at the most appropriate point in the text.

When a publication has several authors, it is usual to give the surname of the first author followed by et al. (an abbreviation of the Latin for 'and the others') although for works with just two authors both names may be given, as in the example above.

Do not forget that you should also include reference to the source of any **tables of data, diagrams** or **maps** that you include in your work. If you have included a straight copy of a table or figure, then it is usual to add a reference to the table or figure caption thus:

Figure 1: The continuum of influences on learning (from Knapper and Cropley, 1991: p. 43).

Even if you have reorganized a table of data, or redrawn a figure, you should still acknowledge its source:

Table 1: Type of work entered by humanities graduates (data from Lyon, 1992: Table 8.5).

You may need to cite an **unpublished** idea or discussion point from an oral presentation, such as a **lecture**. The format for the text citation is normally exactly the same as for a published work and should give the speaker's name and the date of the presentation.

Recent research on the origins of early man has challenged the views expressed in many of the standard textbooks (Barker, 1996).

If the idea or information that you wish to cite has been told to you personally, perhaps in a discussion with a lecturer or a tutor, it is normal to reference the point as shown in the example below.

2. Reference lists/ bibliographies

When using the 'author, date' system, the brief references included in the text must be followed up with full publication details, usually as an **alphabetical** reference list or bibliography at the end of your piece of work. The examples given below are used to indicate the main principles.

Book references

The simplest format, for a book reference, is given first; it is the full reference for one of the works quoted in the examples above.

Knapper, C.K. and Cropley, A. 1991: Lifelong Learning and Higher Education. London: Croom Helm.

The reference above includes:

- the surnames and forenames or initials of both the authors;
- the date of publication;
- the book title;
- the place of publication;
- the name of the publisher.

The title of the book should be formatted to distinguish it from the other details; in the example above it is italicized, but it could be in bold, underlined or in inverted commas. When multi-authored works have been quoted, it is important to include the names of all the authors, even when the text reference used was *et al*.

Papers or articles within an edited book

A reference to a paper or article within an edited book should in addition include:

- the editor and the title of the book;
- the first and last page numbers of the article or paper.

Lyon, E.S. 1992: Humanities graduates in the labour market. In H. Eggins (ed.), Arts Graduates, their Skills and their Employment. London: The Falmer Press, pp. 123-143.

Journal articles

Journal articles must also include:

- the name and volume number of the journal;
- the first and last page numbers of the article.

The publisher and place of publication are not normally required for journals.

Pask, G. 1979: Styles and strategies of learning. British Journal of Educational Psychology, 46, pp. 128-148.

Note that in the last two references above, it is the book title and the journal name that are italicized, **not** the title of the paper or article. The name highlighted should always be the name under which the work will have been filed on the library shelves or referenced in any indexing system. It is often the name which is written on the spine of the volume, and if you remember this it may be easier for you to remember which is the appropriate title to highlight.

Other types of publications

The three examples above cover the most common publication types. You may also wish to refer to other types of publications, including PhD dissertations, translated works, newspaper articles, dictionary or encyclopedia entries or legal or historical texts. The same general principles apply to the referencing of all published sources, but for specific conventions consult your departmental handbook or your tutor, or look at the more detailed reference books listed in the Further reading section of this guide.

How to Write Your Graduation Project or Thesis

Title Page

Title (including subtitle), author, institution, department, date of delivery, research mentor, mentor's institution

Acknowledgments

Advisor(s) and anyone who helped you:

1. technically (including materials, supplies)
2. intellectually (assistance, advice)
3. financially (for example, departmental support, travel grants)

Abstract

- A good abstract explains in one line why the paper is important. It then goes on to give a summary of your major results, preferably couched in numbers with error limits. The final sentences explain the major implications of your work. A good abstract is concise, readable, and quantitative.
- Length should be ~ 1-2 paragraphs, approx. 300 words.
- Abstracts generally do not have citations.
- Information in title should not be repeated.
- Be explicit.
- Use numbers where appropriate.
- Answers to these questions should be found in the abstract:
    1. What did you do?
    2. Why did you do it? What question were you trying to answer?
    3. How did you do it? State methods.
    4. What did you learn? State major results.
    5. Why does it matter? Point out at least one significant implication.

Table of Contents

List all headings and subheadings with page numbers. The list should include a short title for each heading and subheading.

List of Figures

List page numbers of all figures. The list should include a short title for each figure but not the whole caption.

List of Tables

List page numbers of all tables. The list should include a short title for each table but not the whole caption.

Introduction

You can't write a good introduction until you know what the body of the report says. Consider writing the introductory section(s) after you have completed the rest of the paper, rather than before.

Be sure to include a hook at the beginning of the introduction. This is a statement of something sufficiently interesting to motivate your reader to read the rest of the paper, it is an important/interesting scientific problem that your report either solves or addresses. You should draw the reader in and make them want to read the rest of the paper.

The next paragraphs in the introduction should cite previous research in this area. It should cite those who had the idea or ideas first, and should also cite those who have done the most recent and relevant work. You should then go on to explain why more work was necessary (your work, of course.)

What else belongs in the introductory section(s) of your report?

1. A statement of the goal of the report: why the study was undertaken, or why the report was written. Do not repeat the abstract.
2. Sufficient background information to allow the reader to understand the context and significance of the question you are trying to address.
3. Proper acknowledgement of the previous work on which you are building. Sufficient references such that a reader could, by going to the library, achieve a sophisticated understanding of the context and significance of the question.
4. The introduction should be focused on the thesis question(s). All cited work should be directly relevant to the goals of the thesis. This is not a place to summarize everything you have ever read on a subject.
5. Explain the scope of your work, what will and will not be included.
6. A verbal "road map" or verbal "table of contents" guiding the reader to what lies ahead.
7. Is it obvious where introductory material ("old stuff") ends and your contribution ("new stuff") begins?

Methodology

What belongs in the "methods" section of a scientific report?

1. Information to allow the reader to assess the believability of your results.
2. Information needed by another researcher to replicate your experiment.
3. Description of your materials, procedure, theory.
4. Calculations, technique, procedure, and equipment.
5. Limitations, assumptions, and range of validity.
6. Description of your analytical methods, including reference to any specialized statistical software.

Results & Data Analysis

- The results are actual statements of observations, including statistics, tables and graphs.
- Indicate information on range of variation.
- Mention negative results as well as positive. Do not interpret results - save that for the discussion.
- Lay out the case as for a jury. Present sufficient details so that others can draw their own inferences and construct their own explanations.
- Use S.I. units (m, s, kg, W, etc.) throughout the thesis.
- Break up your results into logical segments by using subheadings

Discussion & Interpretation

Start with a few sentences that summarize the most important results. The discussion section should be a brief essay in itself, answering the following questions:

1. What are the major patterns in the observations? (Refer to spatial and temporal variations.)
2. What are the relationships, trends and generalizations among the results?
3. What are the exceptions to these patterns or generalizations?
4. What are the likely causes (mechanisms) underlying these patterns resulting predictions?
5. Is there agreement or disagreement with previous work?
6. Interpret results in terms of background laid out in the introduction - what is the relationship of the present results to the original question?
7. What is the implication of the present results for other unanswered questions in earth sciences, ecology, environmental policy, etc....?
8. What are the things we now know or understand that we didn't

know or understand before the present work?

9. Include the evidence or line of reasoning supporting each interpretation.
10. What is the significance of the present results: why should we care?

Conclusions

- What is the strongest and most important statement that you can make from your observations?
- If you met the reader at a meeting six months from now, what do you want them to remember about your paper?
- Refer back to problem posed, and describe the conclusions that you reached from carrying out this investigation, summarize new observations, new interpretations, and new insights that have resulted from the present work.
- Include the broader implications of your results.
- Do not repeat word for word the abstract, introduction or discussion.

Recommendations

- Include when appropriate (most of the time)
- Remedial action to solve the problem.
- Further research to fill in gaps in our understanding.
- Directions for future investigations on this or related topics.

References

- cite all ideas, concepts, text, data that are not your own
- if you make a statement, back it up with your own data or a reference
- all references cited in the text must be listed
- cite single-author references by the surname of the author (followed by date of the publication in parenthesis)

    - ... according to Hays (1994)
    - ... population growth is one of the greatest environmental concerns facing future generations (Hays, 1994).
- cite double-author references by the surnames of both authors (followed by date of the publication in parenthesis)
    - e.g. Simpson and Hays (1994)
- cite more than double-author references by the surname of the first author followed by et al. and then the date of the publication
    - e.g. Pfirman, Simpson and Hays would be:
    - Pfirman et al. (1994)
- do not use footnotes
- list all references cited in the text in alphabetical order using the following format for different types of material:
    - Hunt, S. (1966) Carbohydrate and amino acid composition of the egg capsules of the whelk. *Nature*, 210, 436-437.
    - National Oceanic and Atmospheric Administration (1997) commonly asked questions about ozone. http://www.noaa.gov/public-affairs/grounders/ozo1.html, 9/27/97.
    - Pfirman, S.L., M. Stute, H.J. Simpson, and J. Hays (1996) Undergraduate research at Barnard and Columbia, *Journal of Research*, 11, 213-214.
    - Pechenik, J.A. (1987) A short guide to writing about biology. Harper Collins Publishers, New York, 194pp.
    - Pitelka, D.R., and F.M. Child (1964) Review of ciliary structure and function. In: *Biochemistry and Physiology of Protozoa*, Vol. 3 (S.H. Hutner, editor), Academic Press, New York, 131-198.
    - Sambrotto, R. (1997) lecture notes, Environmental Data Analysis, Barnard College, Oct 2, 1997.

Appendices

- Include all your data in the appendix.
- Reference data/materials not easily available (theses are used as a resource by the department and other students).
- Tables (where more than 1-2 pages).

- Calculations (where more than 1-2 pages).
- You may include a key article as appendix.
- If you consulted a large number of references but did not cite all of them, you might want to include a list of additional resource material, etc.
- List of equipment used for an experiment or details of complicated procedures.
- Note: Figures and tables, including captions, should be embedded in the text and not in an appendix, unless they are more than 1-2 pages and are not critical to your argument.

OUTLINE OF A GEOSCIENCE REPORT

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