General guidelines for Writing a Scientific Report

Format

A scientific report usually consists of the following:
- Title
- Abstract
- Introduction
- Materials and methods or Description of the Model
- Results
- Discussion
- Conclusions and Summary (optional)
- Acknowledgements (optional)
- References
- Appendix (optional)

Materials and methods / Description of the Model and Results can be compiled into one single section in purely theoretical projects. If in doubt, talk to your supervisor about the details of your report format.

There is general agreement among scientists that each section of the report should contain specific types of information.

Cited from 1 and 2.

Title

The title should reflect the content and emphasis of the project described in the report. It should be as short as possible and include essential key words. The author's name (e.g., Ana F Silbering) should follow the title on a separate line, followed by the author's affiliation (e.g., Lehrstuhl für Neurobiologie, Universität Konstanz, D-78457 Konstanz, Germany).
Cited from 2.

Abstract

The purpose of an abstract is to allow the reader to judge whether it would serve his or her purposes to read the entire report. A good abstract is a concise (100 to 200 words) summary of the purpose of the report, the data presented, and the author's major conclusions.
Cited from 1.

Introduction

"A good introduction is a clear statement of the problem or project and why you are studying it." (The ACS Style Guide. American Chemical Society, Washington, DC, 1986.)

The nature of the problem and why it is of interest should be conveyed in the opening paragraphs. This section should describe clearly but briefly the background information on the problem, what has been done before (with proper literature citations), and the objectives of the current project. A clear relationship between the current project and the scope and limitations of earlier work should be made so that the reasons for the project and the approach used will be understood.
Cited from 2.

Materials and Methods / Description of the Model
In theoretical reports, this section would include sufficient theoretical or mathematical analysis to enable derivations and numerical results to be checked. Computer programs from the public domain should be cited. New computer programs should be described in outline form.
Cited from 2.

As the name implies, the materials and methods used in the experiments should be reported in this section. The difficulty in writing this section is to provide enough detail for the reader to understand the experiment without overwhelming him or her. It should be sufficiently detailed that other experienced researchers would be able to repeat the work and obtain comparable results. When procedures from a lab book or another report are followed exactly, simply cite the work, noting that details can be found in that particular source. However, it is still necessary to describe special pieces of equipment and the general theory of the assays used. This can usually be done in a short paragraph, possibly along with a drawing of the experimental apparatus. Generally, this section attempts to answer the following questions:

What materials were used?
How were they used?
Where and when was the work done? (This question is most important in field studies.)
Cited from 1.

If the experimental section is lengthy and detailed, as in synthetic work, it can be placed at the end of the report or as an appendix so that it does not interrupt the conceptual flow of the report. Its placement will depend on the nature of the project and the discretion of the writer.
Cited from 2.

Results (for lab rotation report only, if there are results)
This section of your report should concentrate on general trends and differences and not on trivial details. Many authors organize and write the results section before the rest of the report.

The results section should summarize the data from the experiments without discussing their implications. The data should be organized into tables, figures, graphs, photographs, and so on. But data included in a table should not be duplicated in a figure or graph.

All figures and tables should have descriptive titles and should include a legend explaining any symbols, abbreviations, or special methods used. Figures and tables should be numbered separately and should be referred to in the text by number, for example:

> Figure 1 shows that the activity decreased after five minutes.
> The activity decreased after five minutes (fig. 1).

Figures and tables should be self-explanatory; that is, the reader should be able to understand them without referring to the text. All columns and rows in tables and axes in figures should be labeled.
Cited from 1.

Explain your actual findings, using subheadings to divide the section into logical parts, with the text addressing the study aims. Link your writing to figures and tables as you present the results. For each, describe and interpret what you see (you do the thinking -- do not leave this to the reader). If you have many similar figures, select representative examples for brevity and put the rest in an appendix. Mention any uncertainty in measurement or calculation, and use an appropriate number of decimal places to reflect it. Make comments on the results as they are presented, but save broader generalizations and conclusions for later. Answer the question "what did I find out?"
Cited from 3.

Lab Rotation Report: if there are no results mention preliminary results and/or why there are no final results. It is okay not to have final results in the Lab Rotation Report.

Discussion
This section should not just be a restatement of the results but should emphasize interpretation of the data, relating them to existing theory and knowledge. Speculation is appropriate, if it is so identified. Suggestions for the improvement of techniques or experimental design may also be included here. In writing this section, you should explain the logic that allows you to accept or reject your original hypotheses. You should also be able to suggest future experiments that might clarify areas of doubt in your results.
Cited from 1.

Discuss the importance of what you found, in light of the overall study aims. Stand back from the details and synthesize what has (and has not) been learned about the problem, and what it all means. Say what you actually found, not what you hoped to find. Begin with specific comments and expand to more general issues. Recommend any improvements for further study. Answer the question "what is the significance of the research?"

Important Note: this section is often combined with either the Results section or the Conclusions section. Decide whether understanding and clarity are improved if you include some discussion as you cover the results, or if discussive material is better as part of the broader summing up.
Cited from 3.

Conclusions and Summary (optional)
A separate section outlining the main conclusions of the project is appropriate if conclusions have not already been stated in the "Discussion" section. Directions for future work are also suitably expressed here.

A lengthy report, or one in which the findings are complex, usually benefits from a paragraph summarizing the main features of the report - the objectives, the findings, and the conclusions.
Cited from 2.

If you choose to include ‘Conclusions and Summary’, restate the study aims or key questions and summarize your findings using clear, concise statements. Keep this section brief and to the point.
Cited from 3.

Acknowledgements
The last paragraph of text in manuscripts prepared for publication is customarily dedicated to acknowledgments. However, there is no rule about this, it is an optional section. Thank people who directly contributed to the paper, by providing data, assisting with some part of the analysis, proofreading, typing, etc. It is not a dedication, so don't thank Mom and Dad for bringing you into the world, or your roommate for making your coffee.
Cited from 2 +3.

References
This section lists all articles or books cited in your report. It is not the same as a bibliography, which simply lists references regardless of whether they were cited in the paper. Provide sufficient detail to enable somebody to actually track down the information. The listing should be alphabetized by the last names of the authors. List all authors for the "et al." publications. Different journals require different formats for citing literature. Follow a standard format such as the examples below, and note the distinctions regarding italics, capitalization, volume/page numbers, publisher address, etc. between the various kinds of references.

Personal (unpublished) communications
Cited in the text only, e.g., "... x is greater than y (Comrie 1999, pers. comm.)."

Lecture Notes
Comrie, A.C., 1999: The climate of Tucson. April 1 lecture, GEOG 230 Our Changing Climate, University of Arizona.

Web Site
Comrie, A.C., 1999: The climate of Tucson. Internet:
<http://geog.arizona.edu/~comrie/tucson.html>.
Accessed / downloaded / visited 2003-05-01

Single Author Journal Paper
Comrie, A.C., 1999: The climate of Tucson. Climate Journal 5, 123-132.

Multiple Author Journal Paper
Comrie, A.C., B.C. Smith and C.D. Jones, 1999: The climate of Tucson. Climate Journal 5, 123-132.

Book
Comrie, A.C., 1999: The Climate of Tucson. Academic Publishers, Boston.

Government/Technical Report
Comrie, A.C., 1999: The climate of Tucson. Report ABC-001, Institute for Climate Studies, University of Arizona.

For chapters in books/in an Edited Volume:
Smith, C.J. 1989. Basal cell carcinomas. In Histological aspects of cancer, ed. C.D. Wilfred, pp. 278-91. Boston: Medical Press.

When citing references in the text, do not use footnotes; instead, refer to articles by the author's name and the date the paper was published. For example:

> Fox in 1988 / Fox (1988) investigated the hormones on the nest-building behavior of catbirds.
>
> Hormones are known to influence the nest-building behavior of catbirds (Fox, 1988).

When citing papers that have two authors, both names must be listed. When three or more authors are involved, the Latin et al. (et alia, note the period) meaning "and others" may be used . A paper by Smith, Lynch, Merrill, and Beam published in 1989 would be cited in the text as:

> Smith et al. (1989) have shown that...

Attribute every idea that is not your own to avoid plagiarism.
Cited from 1 + 2 + 3.

Appendix
If necessary, one or more appendices containing raw data, figures not used in the body of the paper, sample calculations, etc. may be included. They are considered as additional material to the report, and may not be examined by the reader at all.
Cited from 3.

General Points
Aim
The main purpose of a scientific report is to communicate. A typical structure and style have evolved to convey essential information and ideas as concisely and effectively as possible. Precise formats vary by discipline and scientific journal, but always treat them as flexible guidelines that enable clear communication.
Audience
Assume that your intended reader has a background similar to yours before you started the project. That is, a general understanding of the topic but no specific knowledge of the details. The reader should be able to reproduce whatever you did by following your report.
Clarity of Writing
Good scientific reports share many of the qualities found in other kinds of writing. To write is to think, so a paper that lays out ideas in a logical order will facilitate the same kind of thinking. Make each sentence follow from the previous one, building an argument step by step. Group related sentences into paragraphs, and group paragraphs into sections. Create a flow from beginning to end.
Consistency of Format
Within the report, the exact format of particular items is less important than consistency of application. For example, if you indent paragraphs, be sure to indent them all; use a consistent style of headings throughout (e.g., major headings in bold with initial capitals, minor headings in italics, etc.); write "%" or "percent" but do not mix them, and so on. In other words, establish a template and stick to it. Consult real journal papers for examples.
Cited from 3.

General Comments on Style

- All scientific names (genus and species) must be italicized. (Underlining indicates italics in a typed paper.)
- Use the metric system of measurements. Abbreviations of units are used without a following period.
- Be aware that the word data is plural while datum is singular. This affects the choice of a correct verb. The word species is used both as a singular and as a plural.
- Numbers should be written as numerals when they are greater than ten or when they are associated with measurements; for example, 6 mm or 2 g but two explanations of six factors. When one list includes numbers over and under ten, all numbers in the list may be expressed as numerals; for example, 17 sunfish, 13 bass, and 2 trout. Never start a sentence with numerals. Spell all numbers beginning sentences.
- Be sure to divide paragraphs correctly and to use starting and ending sentences that indicate the purpose of the paragraph. A report or a section of a report should not be one long paragraph.
- The report should be grammatically sound, with correct spelling, and generally free of errors. Every sentence must have a subject and a verb.
- Avoid using the first person, I or we, in writing (disputable!). Keep your writing impersonal, in the third person. Instead of saying, "We weighed the frogs and put them in a glass jar," write, "The frogs were weighed and put in a glass jar." However, employ the active rather than passive voice to avoid boring writing and contorted phrases (e.g., "the software calculated average values" is better than "average values were calculated by the software").
- Avoid jargon, slang, or colloquial terms. Define acronyms and any abbreviations not used as standard measurement units.
- Be consistent in the use of tense throughout a paragraph--do not switch between past and present. Most of the report describes what you did, and thus it should be in the past tense (e.g., "values were averaged"), but use present or future tense as appropriate (e.g., "x is bigger than y" or "that effect will happen").
- Be sure that pronouns refer to antecedents. For example, in the statement,

    "Sometimes cecropia caterpillars are in cherry trees but they are hard to find," does "they" refer to caterpillars or trees?

- After writing a report, read it over, watching especially for lack of precision and for ambiguity. Each sentence should present a clear message. The following examples illustrate lack of precision:

    "The sample was incubated in mixture A minus B plus C." Does the mixture lack both B and C or lack B and contain C?

    The title "Protection against Carcinogenesis by Antioxidants" leaves the reader wondering whether antioxidants protect from or cause cancer.

The only way to prevent such errors is to read and think about what you write. Learn to reread and edit your work.

Cited from 1 + 3.

Large parts of this text were directly adopted from the following sources:

1 Dolphin, W.D., 1997: Writing Lab Reports and Scientific Papers. Internet: <http://www.mhhe.com/biosci/genbio/maderinquiry/writing.html>

2 Chemistry.org - The Web Sit of the American Chemical Society. Internet

3 Comrie, A.C.: Scientific Report Writing. Internet:
<http://geog.arizona.edu/~comrie/geog230/report.htm>