General Guidelines for Writing a Technical Report, Thesis, or Dissertation

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Abstract/Executive Summary

An abstract or executive summary is commonly included to briefly summarize the study. The abstract is generally written as a single paragraph and placed after that title/author block, and is customary for journal articles, theses, and dissertations. The abstract is a paragraph, within 250 words, that provides the study objective(s), a description of the methodology and samples, and a summary of the major findings and conclusions. The executive summary, within 2,000 words, is customary for longer documents, such as professional reports, and provides a broader overview of the objectives, methods, results, and conlusions.

Keywords. Writing methods; Scientific report writing (it's helpful to list a few keywords)

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1 Introduction

Clear, concise, and grammatically correct presentation of scientific data is the final step in the scientific process. Reporting your research findings is an attempt to convince the reader that your data have been collected and analyzed in a manner that meets your study objectives, are accurate, and that your conclusions based on these data are valid. Hence, the way you present and discuss your data and analyses is crucial in communicating your findings.

Reporting can be done in a variety of formats, depending on your objectives and your audience (just Google "report writing" for a variety of formats, e.g., Novikova, 2015). The objectives of this report are to describe a simple format used to present data and analyses, and then to come to some conclusion about that data, including recommendations if appropriate. This document is an example of basic report.

2 Materials and Methods

Here you should clearly state what samples were collected and how, describe your lab methods, and state what measurements were made. Include enough detail so that someone can replicate your study and (hopefully) get the same results. You can cite a reference for a method you used, or just describe how you did the experiment. All analyses (e.g., computer models, statistical tests) should be clearly and completely described.

3 Results and Discussion

Here you present and discuss the data you collected along with the results of your analysis of your data. Tables should be done neatly, with all columns clearly labeled and numbers aligned using an appropriate number of significant figures. Figures and tables should be clearly labeled and readable (see Table 1). Both should have captions describing the contents, and should be understandable without much reference to the accompanying text.

Table 1: An example table. Note that there are no vertical lines, and the only horizontal lines are at the top and bottom of the table, and below the headings. Journals commonly require that figures and tables be placed at the end of the document, with only one figure or table on a single page. If you do place them in the text, make sure that they are at the top or bottom of the page.

Header	Data Column 1	Data Column 2	Data Column 3	Data Column 4
Variable A	21.33	2.65	5.54	0.0125
Variable B	101.2	33.8	9.97	0.0785

Discuss your data in relation to the stated objectives of the study. First, try to evaluate if you think your data are reliable, or if any mistakes were made. If you are confident with your results, refer to the tables and figures directly, and aim at making a final conclusion with regards to the study objectives. Refer to any other studies or to regulatory agency information if they relate to the study objectives.

4 Conclusions and Recommendations

This section should clearly state your conclusion and any recommendations as to risk, remediation, or follow-up studies that might be done related to your site. Try to make your conclusions as specific as possible, but firmly based on the data you collected. If possible, present a range of options for your recommendations as to how to proceed, based on your findings.

5 Literature Cited

Use a consistent format taken from any scientific journal; check to make sure all text citations have a reference listed here, and vice-versa.

Novikova, Irina (2015). *How to Write a Lab Report*, accessed on January 10, 2015, at
`http://physics.wm.edu/~novikova/phys251/AddDocs/labreport.pdf`

A Appendix: Some notes on writing. . . .

Reports are the final output of scientific activity, the actual evidence of what was done and conclusions that were drawn. You will be judged professionally on your writing ability and style as well as the scientific content of what you write. In this course, part of the evaluation of your reports will be the quality of your writing.

Some of the attributes of *good writing* include:

- Mechanically correct - spelling, punctuation, grammar, syntax
- Well-organized - including sections and subsections where needed
- Clear: wording - sentence structure, pro-noun reference, etc.
- Concise - no unnecessary words or phrases, not repetitive
- Interesting - varied sentence structure and word choice
- Compelling - makes a logical argument, comes to a definite conclusion

A.1 Tips to good writing

Here are some general writing guidelines:

- All manuscripts for review should be double spaced except labelling for tables, figures, and figure captions. Tables and figures need not be double spaced.
- Contents must be organized logically. Prepare a detailed outline prior to writing your manuscript. All manuscripts should have headings and subheadings. Large manuscripts normally have at least three levels of headings.
- Content is dictated by the nature of the manuscript. In general, it is recommend that as much of the long mathematical derivations and supporting data as possible be placed in appendices. Keep the primary part of the text brief and informative.
- Be as original and imaginative as the topic allows. Use a multiple-hypothesis approach and treat the competing hypotheses without prior bias.
- Factual material based on measurements and observations must be distinguished clearly from inferences and conclusions. Also, your own work should be identified clearly as contrasted with the work of others. Do not introduce new factual material into sections intended as summaries or conclusions.
- Strike a good balance between naively accepting data and conclusions given in published reports and a hypercritical attitude towards everything.
- Be consistent throughout your report in punctuation, abbreviation, capitalization, and other matters of typographical style even though the initial choice of style may be arbitrary.
- Use a standard citation style from any major scientific publication, but make sure the following facts are included: Author's name with initials, date of publication, full title of article or book, name of journal or publisher, volume, and pages which include the material being cited. Whatever style is used, it must be consistent throughout the paper.
- Use your word processor to spell- and grammar-check as you write; dashed underlining that appears in MS Word, for example, usually indicates a misspelling or grammar error. Right-click on a word to get alternate spellings or grammar suggestions.
- Use active voice (mostly). Writers often use passive voice in scientific writing ("the experiment was performed…") in order to take the experimenter (us!) out of the picture so the study appears more *objective*. This is sort of silly, since *we* (or somebody) obviously did the experiment. Try to use active voice if possible ("we performed the experiment…").

- Proof-reading is pretty obvious; usually we don't do this out of laziness, but it is essential to catching obvious errors. Even a *draft* report should be free of spelling, punctuation, and grammar mistakes, and make a logical argument. If you've forgotten when to use a comma, check a reference such as St. Martin's Handbook.
- Get a second opinion. Find a friend or classmate to read your report and offer criticism on the overall clarity/quality of the report, and/or point out errors or ambiguous sentences. Your reports are intended for a scientific audience who knows something about the topic, but should be readable (at least) by the general public
- Revise. Nobody writes a great report at one sitting, so you need to budget time to go back and revise your wording, sentence structure, even organization if needed. If you submit a report full of errors in this course, you will be asked to re-write it before a grade is assigned. So, do it right the first time.

A.2 Figures and Tables

- Make sure that, insofar as possible, illustrations can be understood without reading the text. To do this, special care should be taken with labels and figure captions.
- All figures and tables presented should be numbered and should include titles and/or captions.
- Copies of figures from published literature can be used but they must be renumbered and the source must be given.
- All illustrations and tables should be cited in the text.
- Citations should be in numerical order; that is, Table 2 should not be discussed prior to Table 1 in the text.
- Orient figures properly - do not turn them side-ways on a page. The legend on the many graphs may end up being upside down on the page if the figures are oriented side-ways. It is better to reduce the figure so that it can be placed upright on the page.
- Exact camera location and direction in which the camera was pointed should be given in captions to all photographs.
- All maps should include a scale, geographic coordinates, and a north arrow.

A.3 Equations and Units

- Number all equations and define all symbols used in an equation. Use symbols instead of names in the equation, i.e., $y = mx + b$ instead of $Growth = a \times Water\ Content + b$. Also, do not place the multiplication sign ($\times$) in equations.

- Always use metric (S.I.) units. Report all measurements in consistent units, preferably *mks* (meters, kilograms, seconds) instead of *cgs* (centimeters, grams, seconds).
- If a unit conversion is required for some reason, place the english equivalent in parentheses following the metric value, example: "The core measured 5.1 cm (2 inches)"
- Use liters (L) for all volume measurements instead of m^3 or km^3.
- Use standard metric prefixes (μ for millionth, m for thousandth, c for hundredth, k for thousand, M for million, etc.) for small and large numbers.

A.4 Common Writing Errors

- Reversal of sentence structure. One of the most common errors is to reverse the proper order of a sentence.

  Incorrect: To understand the nature of the problem, I performed an experiment.

  Correct: I performed an experiment to understand the nature of the problem.

- Spell out numbers less than or equal to twelve. Do not used phrases such as "The 1st day was rainy, ...", or "The student measured rain for 3 days". It is allowed to use numbers if decimal points are provided, "The core measured 5.0 cm in diameter".
- Abbreviations vs. Acronyms. An acronym is a voiced abbreviation, such as "NASA". "NSF" is spelled out so it is an abbreviation. Proper use in a sentence depends upon whether the word is an acronym or an abbreviation. For example, we would say " a NASA project was funded" because NASA is voiced, while "an NSF project was funded" is correct because NSF is not voiced.
- No periods are ever used for federal abbreviations (e.g., TVA, NASA, USGS, etc.). The only allowed use of abbreviations is for abbreviating the United States (e.g., U.S. Department of Interior, but not U.S.D.I.)
- Avoid the future tense. "This paper will address the issue of..." should be written "This paper addresses the issue of...".
- Citations in the present tense. All published work is already completed and should be referred to in the past tense.

  Incorrect: "Smith (1980) reports his results..."

  Correct: "Smith (1980) reported his results..."

- Poor punctuation. Commas are used primarily to substitute for conjunctions such as "and" in a series of words. To avoid confusion, a comma can also be used before the conjunction as in the following example:

  "Supplies and equipment included chemicals, bottles and caps, and augers."

- Commas are also necessary to set off words or phrases which do not follow the normal English word order (subject-verb-object). Example:

  "If the test is negative, further data are needed."

- Poor spelling. In addition to obvious errors, preferred spelling should be used.
  - "Through" not "thru"
  - "gray" not "grey"
  - "acknowledgment" not "acknowledgement"
  - "vapor" not "vapour"

A.5 Choice of Words

- Make good use of words and phrases such as *however*, *but*, *because*, *in spite of*, *in order to*, and *in contrast with*. While their use often helps the reader follow your thought process, their overuse can be distracting.

- Avoid incorrect words. A number of incorrect and/or slang words have been adopted by Americans. Avoid these if possible.
  - "antedate" not "predate"
  - "proved" not "proven"
  - "heterogeneous" not "nonhomogeneous"
  - "correct" not "OK"
  - "affected" not "impacted"

- Confusion of singular and plural words.

Singular	Plural
datum	data
stratum	strata
analysis	analyses

  (Note: Never write or say "the data is ...", use instead "the data are ...")

- Unnecessary words. Examples follow and are underlined.
  - The color of the water was red.

  - The area is located in the Coronado National Forest.
  - Tests were difficult because of the close proximity of the motor.
  - The storm lasted three months of time.
  - The storm started at 3 a.m. in the morning.

- Confusion of time and abundance terms.

Time	Abundance
never	absent
infrequent or sometimes	rare or scarce
frequent or often	common
constant or continuous	ubiquitous or everywhere

  (Note: "continuous" can be used for linear "abundance," such as "The outcrop was continuous...")

- Poor choice of words. Note the following examples.
  - "since the pumping test..." could mean "Since" in a time sequence, such as "Since (after) the pumping test was made, we continued with the project." "Since" could also indicate a cause and effect relation ship, but the words "because" or "inasmuch as" convey this meaning better. "Inasmuch as the pumping test was a failure, further work was necessary..." leaves no doubt in the reader's mind that a cause and effect relationship is being discussed.
  - "The data were evaluated via the Theis equation." The word "via" should be replaced by "with". The word "via" should be used only in a geographic sense, as "The trip was routed via Tucson."

- The meaning of the following pairs of words should be checked before using:
  - affect vs. effect
  - apt vs. likely
  - alternate vs. alternative
  - decide vs. determine
  - fewer vs. less
  - farther vs. further

- Use "over" to indicate position in space and not to mean "more than". Words such as "very", "many", "most", "extremely", "little", "few", "occur", and "instance" convey little meaning and should be used sparingly. "For example" should be used in place of "for instance."

- Proper use of assure, ensure, insure.
  - *Insure* means to underwrite an insurance policy: "We payed Lloyd's of London to *insure* the water."
  - *Assure* means to set a mind at rest: "The test *assured* me that the water was clean."
  - *Ensure* means to make certain: "We treated the water to *ensure* that it was clean."
- Modern writers and speakers misuse the adverb "hopefully". The phrase "Hopefully, we can walk to the store," means "We can walk hopefully to the store." Which does not make sense. The author really means "I hope we can walk to the store."
- Weak opening statements. Avoid "One may say that," "it is," "there were," "it may be shown that," and similar constructions in sentences and phrases. Example:

  Incorrect: "It was generally thought that the well was dry."

  Correct: "The well was thought to be dry."
- Compounding of adjectives. Do not use a Germanic style, "...the wide turbid high gradient desert ephemeral stream."
- False elegance. Scientific writing should always use direct and simple expressions. Nothing is gained by using unusual, showy, or wordy prose. Examples follow:

Wordy or showy	Better style
A majority of	most
as far as our own observations are concerned, they show	observation shows
initiate	start
fewer in number	fewer
in the near future	soon
lenticular in character	lenticular
there can be little doubt that	undoubtedly
he is in a position to	he can
inaugurate	begin
portable, manually operated pump	hand pump
prioritize	rank

- Pathetic fallacy. Do not ascribe human traits or emotions to inanimate objects.

  "The happy gushing of the spring water."
- Avoid copying the style of Washington, D.C. bureaucrats. Examples follow.
  - Too many words: "Among the options considered, the one with the least amount of cost associated with it was eventually selected". The author could have said, "The cheapest option was chosen."

- Too many abbreviations "The APR stated that NRC contacted PI's of the NSF grant to check MPC's listed in CFR 190-40 prior to issuance of the RFP."
- Needless capitalization: "The Committee met with Federal and Western State representatives to University Contractors."
- Senseless buzz phrases: "To be cost effective in the bottom line, power requirements were adapted by prioritization to allow a retrofit of existing equipment". Say instead, "The old equipment was refurbished in order to save money."