Thesis structure

Title Page

Title (including subtitle), author, institution, department, date of delivery, research mentor(s) and advisor, their institutions and email addresses

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. 400 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?
  5. Why does it matter? Point out at least one significant implication.

Table of Contents

- list all headings and subheadings with page numbers
- indent subheadings
- it will look something like this:

```
List of Figures  xxx
List of Tables
Introduction
subheads ...?
Methods
subheads ...?
Results
subheads ...?
Discussion
subheads ...?
Conclusion
Recommendations
Acknowledgments
```

Page #
References
Appendices

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 paper 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 paper 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 paper?

1. A statement of the goal of the paper: why the study was undertaken, or why the paper 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?

Remember that this is not a review paper. We are looking for original work and interpretation/analysis by you. Break up the introduction section into logical segments by using subheads.

**Methods**

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

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, equipment, and calibration plots.
5. Limitations, assumptions, and range of validity.
6. Description of your analytical methods, including reference to any specialized statistical software.

The methods section should answering the following questions and caveats:

1. Could one accurately replicate the study (for example, all of the optional and adjustable parameters on any sensors or instruments that were used to acquire the data)?
2. Could another researcher accurately find and reoccupy the sampling stations or track lines?
3. Is there enough information provided about any instruments used so that a functionally equivalent instrument could be used to repeat the experiment?
4. If the data are in the public domain, could another researcher lay his or her hands on the identical data set?
5. Could one replicate any laboratory analyses that were used?
6. Could one replicate any statistical analyses?
7. Could another researcher approximately replicate the key algorithms of any computer software?

Citations in this section should be limited to data sources and references of where to find more complete descriptions of procedures.

Do not include descriptions of results.

**Results**

- 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
• Key results should be stated in clear sentences at the beginning of paragraphs. It is far better to say "X had significant positive relationship with Y (linear regression p<0.01, \( r^2=0.79 \))" then to start with a less informative like "There is a significant relationship between X and Y". Describe the nature of the findings; do not just tell the reader whether or not they are significant.

**Note: Results vs. Discussion Sections**

Quarantine your observations from your interpretations. The writer must make it crystal clear to the reader which statements are observation and which are interpretation. In most circumstances, this is best accomplished by physically separating statements about new observations from statements about the meaning or significance of those observations. Alternatively, this goal can be accomplished by careful use of phrases such as "I infer ..." vast bodies of geological literature became obsolete with the advent of plate tectonics; the papers that survived are those in which observations were presented in stand-alone fashion, unmuddied by whatever ideas the author might have had about the processes that caused the observed phenomena. How do you do this?

1. Physical separation into different sections or paragraphs.
2. Don't overlay interpretation on top of data in figures.
3. Careful use of phrases such as "We infer that ".
4. Don't worry if "results" seem short.

**Why?**

1. Easier for your reader to absorb, frequent shifts of mental mode not required.
2. Ensures that your work will endure in spite of shifting paradigms.

**Discussion**

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 and caveats:

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
8. Multiple hypotheses: There are usually several possible explanations for results. Be careful to consider all of these rather than simply pushing your favorite one. If you can eliminate all but one, that is great, but often that is not possible with the data in hand. In that case you should give even treatment to the remaining possibilities, and try to indicate ways in which future work may lead to their discrimination.

9. Avoid bandwagons: A special case of the above. Avoid jumping a currently fashionable point of view unless your results really do strongly support them.

10. What are the things we now know or understand that we didn't know or understand before the present work?

11. Include the evidence or line of reasoning supporting each interpretation.

12. What is the significance of the present results: why should we care?

This section should be rich in references to similar work and background needed to interpret results. However, interpretation/discussion section(s) are often too long and verbose. Is there material that does not contribute to one of the elements listed above? If so, this may be material that you will want to consider deleting or moving. Break up the section into logical segments by using subheads.

**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.

**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)

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:
  - New York Times (1/15/00) PCBs in the Hudson still an issue, A2.
- it is acceptable to put the initials of the individual authors behind their last names, e.g. Pfirman, S.L., Stute, M., Simpson, H.J., and Hays, J (1996) Undergraduate research at ......
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.