Writing an Honours Thesis in the Sciences
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Agenda
1. The purpose of the Honours Thesis
2. The Abstract
3. The Introduction and Literature Review
4. The Discussion and Conclusions
5. General Writing Tips
6. Open Forum

The sections
Title page
Abstract
Acknowledgements
Table of Contents
List of Abbreviations
List of Figures and Tables
Introduction and Literature Review
Material and Methods
Results
Discussion
Literature Cited
Summary or Conclusions

The Title
- should not be too vague – should be thorough, specific and accurate
- may relate to the main objective, species involved, location (if relevant)
- may be derived from the x/y axis of the main figure in the lab report

Examples:
An analysis of wolverine (Gulo gulo) hunting behaviour in the Claire Lake watershed, Yukon Territory
(includes main objective, species involved, and location)

Heart Mountain and South Fork fault systems: architecture and evolution of the collapse of an Eocene volcanic system, northwest Wyoming
(includes location, geological feature, and age)

The Abstract
The abstract is a single page and often a single paragraph that provides a miniature version of the whole report. It should include the purpose of the study, the method, the results (including numbers), and the significance of the results. An abstract should be written in complete sentences.
Key elements:
1. **Reason for writing** – What is the importance of the research? Why would the reader be interested in the work?
2. **Problem** – What problem does this work attempt to solve?
3. **Methodology** – describes the models or approaches used in the study
4. **Results** – gives the specific data that indicates the results of the project
5. **Implications** – How does this work add to the body of knowledge on the topic?

What an abstract should not include:

References to other works

Information not contained in the study itself

Definitions of terms

*Note: the abstract should be able to stand alone. It should be a self-contained paragraph that can be read with no reference to the rest of the thesis.

Sample Abstract

This study was undertaken to determine the wavelengths of light that are most effective in promoting photosynthesis in the aquatic plant *Elodea canadensis* since some wavelengths are generally more effective than others. Rate of photosynthesis was measured at 25°C, using wavelengths of 400, 450, 500, 550, 600, 650, and 700 nm and measuring the rate of oxygen production for 1-hr periods at each wavelength. Oxygen production was estimated from the rate of bubble production by the submerged plant. We tested 4 plants at each wavelength. The rate of oxygen production at 450 nm (approximately 2.5 ml O2/mg wet weight of plant/h) was nearly 1.5x greater than that at any other wavelength tested, suggesting that light of this wavelength (blue) is most readily absorbed by the chlorophyll pigments. In contrast, light of 550 nm (green) produced no detectable photosynthesis, suggesting that light of this wavelength is reflected rather than absorbed by the chlorophyll.


Use the introduction to:

- explain
  - clearly state the problem that your thesis addresses
  - identify special factors you considered in defining it

- contextualize
  - explain what is new, important, and relevant in your approach (within the narrow domain of your specialty)
  - clarify how your research will extend or contrast the work of others

- define
  - define terms and concepts
  - explain special uses of familiar terms

The Introduction and Literature Review

The introductory section is usually less than 10 pages and does the following:

- establishes the background of the topic
- gives a brief review of current knowledge (CAN INCLUDE LITERATURE REVIEW in some departments/courses)
- identifies the gap(s) in knowledge
- states the aim of your research and how it fits into the gap
- includes your hypotheses (possibly)
- includes an outline of the chapters/sections to follow (possibly)

Stages In A Science Thesis Introduction

1. state the general topic and give some background
2. provide a review of the literature related to the topic
3. define the terms and scope of the topic
4. outline the current situation
5. evaluate the current situation (advantages/disadvantages) and identify the gap
6. identify the importance of the proposed research
7. state the research problem/questions
8. state the research aims and/or research objectives
9. state the hypotheses
10. outline the order of information in the thesis
**The Literature Review**

The review traditionally provides a historical overview of the theory and the research literature, with a special emphasis on the literature specific to the thesis topic. It serves as well to support the argument/proposition behind your thesis, using evidence drawn from authorities or experts in your research field.

The review must be shaped by a focus on key areas of interest, including research that provides a background to the topic. It should also be selective. A common mistake in writing the review is to comment on everything you have read regardless of its relevance. It is useful to think of the review as a funnel – start wide with the overview and then quickly narrow into discussing the research that relates to your specific topic.

### The Literature Review should

- set up a theoretical framework for your research
- summarize and synthesize the arguments and ideas of others
- clarify important definitions/terminology
- be organized according to a particular theme or organizational principle

### Questions you need to ask yourself when you are planning and drafting your Literature Review:

- What has been done in your field of research? What principles of selection are you going to use?
- How are you going to order your discussion? (Chronological, thematic, conceptual, methodological, or a combination? What section headings will you use?)
- How do the various studies relate to each other? What precise contribution do they make to the field? What are their limitations?
- How does your own research fit into what has already been done?

### Tips for writing the Literature Review

- demonstrate that you
  - have a clear and comprehensive understanding of the key concepts/ideas/studies/models related to your topic
  - can trace the intellectual progression in the field and demonstrate your knowledge of any related debates/controversies
  - can provide a new interpretation of old material or combine new with old interpretations
  - can evaluate the work of others and advise the reader on the most pertinent or relevant

- set up a theoretical framework for your research
- present studies based on themes or concepts relevant to your research, not in a chronological format (unless chronology is relevant)
- determine the necessary level of currency needed in selecting your sources
- use quotations sparingly (paraphrase instead)
- summarize and synthesize your sources within each paragraph as well as throughout the review
- keep your own voice (begin and end paragraphs with your own ideas/words)
- avoid plagiarism

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**Example: Evaluation of Boron Solid Source Diffusion for High-Efficiency Silicon Solar Cells**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Sample sentence extracts (complete introduction is 4 pages)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Give background about the topic</td>
<td>Currently in the PV industry aluminium–silicon alloying using screen-printed aluminium and belt furnace firing is the prevalent method of forming p-type layers because it is relatively easy and also forms the rear electrical contact.</td>
</tr>
<tr>
<td>2. Evaluate current methods</td>
<td>The use of aluminium as p-type dopant has two major disadvantages, however...</td>
</tr>
<tr>
<td>3. Identify importance of proposed research</td>
<td>Given the limitations associated with using Al to form p-type diffusion, boron as a dopant for diffused layers is therefore more suitable for high-efficiency silicon solar cells...</td>
</tr>
<tr>
<td>4. State research aims</td>
<td>The goal of this thesis is to evaluate boron nitride (BN) as a potential replacement for liquid-source diffusion presently being used for p-type diffusions in the high-efficiency buried contact solar cells under development at UNSW...</td>
</tr>
<tr>
<td>5. Outline order of information in the thesis</td>
<td>This thesis is divided into five chapters: Chapter 2 discusses in more detail about diffusions in general and the case of boron diffusion. Chapter 3 outlines the experimental work carried out in the project...</td>
</tr>
</tbody>
</table>
Discussion

In many ways, this is the most important part of your thesis. The discussion should follow logically from the previous sections and you should be constantly aware of the previous sections when you write.

The discussion primarily describes the relation between the results and the theory.

The discussion should contain the following material:

- interpretation of the results
- findings of significant tests
- comparisons with literature values
- assessment of sources of error
- suggestions for improving the accuracy and/or the precision of the experiment
- suggestions for further research that could be performed in this area

The discussion answers these kinds of questions:

- How do the results relate to the experimental objective?
- Did the results turn out as expected qualitatively (shapes of graphs or trends)?
- How do the results compare to theoretical or accepted values?
- Was anything new or unexpected discovered?
- What are the strengths or weaknesses of the experimental design?

A typical paragraph in the discussion section would include the following:

1. Some aspect of the results
2. Some theory or discussion point about this result and any necessary scientific elaboration
3. A literature citation or citations to substantiate the theory or discussion point
4. Further elaboration if needed

Sample 1: The discrimination of worker bees against worker-laid eggs could result from three possible factors: the workers somehow “knew” the relatedness of eggs; they preferred queen-laid over worker-laid eggs; or they detected colony odors despite the double screen we used to separate them.

(from Pechenik)

Sample 2: Since none of the samples reacted to the Silver foil test, therefore sulfide, if present at all, does not exceed a concentration of approximately 0.025 g/l. It is therefore unlikely that the water main pipe was the result of sulfide-induced corrosion.

(from U of T website)

When you interpret your results, you discuss their significance, raise questions, and possibly give explanations for problems in the data.

Sample: Although the water samples were received on 14 August 2000, testing could not be started until 10 September 2000. It is normally desirable to test as quickly as possible after sampling in order to avoid potential sample contamination. The effect of the delay is unknown.
The following sample is from the Discussion section of a student report:

I find the small number of species represented in our sample surprising, since the pond is fed by several streams that might be expected to introduce a variety of different species into it, assuming that the streams are not polluted. It appears that the conditions in the pond at the time of our sampling were especially suitable for one species in particular out of all those that are most likely to have access to it. Perhaps the physical nature of the pond is such that the number of niches is small, in which case competition would become very keen; only one species can occupy a given niche at any one time (Ricklefs and Miller, 2000). The reproductive pattern of the fishes might also contribute to the observed results. Possibly Lepomis macrochirus, the dominant species, lays more eggs than the others, or perhaps the young of this species survive better, or prey on the young of other species.

(from Pechenik)

**Summary or Conclusions**

The conclusions section summarizes the results and relates them to the objectives of the study or experiment. It may also make suggestions for improvement or future work.

*A note about referencing: be sure to use the style indicated by your course instructor. If no style has been specified, follow the style used in an accepted scholarly journal in your field. Above all, be sure that your referencing is consistent.*

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**General tips**

**What to avoid in science writing:**

1. Not clearly identifying the precise focus of the research – readers need to know, in the abstract and introduction, precisely what problem will be addressed and why
2. Not conveying why the work is important
3. Not clearly identifying and defending the choice of method(s) to solve the question addressed in the research
4. Not situating the work within the context of other work in the field
5. Not clearly differentiating the work from that of others
6. Not defining and defending all assumptions
7. Not providing a suitable level of detail and explanation
8. Not clearly identifying the study’s unique contribution – must be clear in the abstract, introduction, and discussion/conclusion sections
9. Not identifying practical applications, either theoretical or practical
10. Not proofreading for consistent headings, missing citations, gaps in logic, missing words, grammatical and spelling errors

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**Effective Writing**

**Style and Tone**

In all disciplines in the sciences, clarity and simplicity in writing are key. Use ordinary, familiar words and write in short, complete sentences. Writing should be precise and accurate.

As well, unnecessary wordiness should be eliminated.
The tone should be formal and objective.

To achieve a formal tone, don’t use contractions, clichés, or colourful descriptors.

To achieve objectivity, don’t overstate your conclusions: reasons for results can be suggested, not proven.

Avoid using the second-person point-of-view (“you”). Using the first-person singular (“I”) has been generally considered too informal for science-writing. However, that view is changing in many disciplines in the sciences.

Voice

In Computing Science and Chemistry, the third-person point-of-view and the passive voice are still preferred.

Passive voice: The samples were diluted with 100ml of H2O.

Active voice: The researcher diluted the samples with 100ml of H2O.

In Physics, students are advised to avoid using “I” but can use “we” in explaining technical matters. Writing in Physics seems to be undergoing a shift from passive to active voice, from the third-person to the first-person plural “we.”

Biology, on the other hand, now prefers the use of the active voice in student writing. The first-person singular point-of-view “I” is perfectly acceptable.

Tense

Generally, the past tense should be used to describe the methods and results. The present tense is used to refer to other studies or to generally occurring phenomena. There is some flexibility, however.

Past: The sample was inserted in liquid helium.
Present: The sample is inserted in liquid helium.

The first is written like a chronology of what was done in the experiment; the second is written as if describing a phenomena or procedure. Depending on the context, either is acceptable. Just be consistent.