

Guide to Writing your Honors Thesis

Professor Kristine Madsen, MD, MPH
School of Public Health

Table of Contents

Introduction to this Guide	3
Practical Approach to Writing Your Thesis	6
Abstract	8
Introduction.....	8
Methods	10
Results	11
Discussion	11
References.....	12
Tables and Figures	12
Resources	13

Introduction to this Guide

Congratulations on embarking on an Honors Thesis project! Your thesis is a synthesis of at least two semesters of independent research and represents one of the most important documents you will write at UC Berkeley. It is critical that you turn in your very best work.

This guide is designed to help you write your Honors Thesis. You should become very familiar with this guide, and return to it throughout the writing process. I have pulled on multiple sources in creating this document,¹⁻⁴ and you can refer to these sources for greater detail. Your thesis will have the following sections:

- Abstract
- Introduction
- Methods
- Results
- Discussion
- References
- Tables/Figures

This guide will break down each section of your thesis in detail, to help you write a strong initial draft.

Basic Concepts

Traditionally, the thesis is written in the format of a research paper with Abstract, Introduction, Methods, Results (including tables and figures), Discussion, and References. Your research advisor may have additional requirements for your thesis, which you should discuss with her/him well ahead of the due date. We are often asked “How long should my thesis be?” It should be long enough to fully develop your ideas, clearly present your data, and carefully discuss the results and the implications of the work. Longer is not necessarily better. You will have read many scientific articles in preparation for your thesis; use them as a guide as you write your thesis. Most theses are between 10 and 20 double-spaced pages (not including tables, figures or references).

A thesis usually describes hypothesis-based research. A hypothesis is experimentally testable and allows one to predict outcomes of experiments or interventions. When experimental results are consistent with the hypothesis, they increase the probability that the hypothesis is valid. Hypothesis-driven research often appeals to a much broader audience than a more descriptive paper because (a) the emphasis on the question (“big picture”) addressed by the hypothesis helps readers understand the motivation for the work, (b) possible experimental outcomes are predicted and interpreted in the context of the hypothesis, and (c) the reader becomes engaged in the logic of your arguments and thus the justification for your experiments. Sometimes, a student engages in qualitative or descriptive research to develop new theories or to

understand various phenomena; although this work is not usually hypothesis-driven, the student can and should provide a clear explanation to justify why s/he undertook the project.

Your thesis should include significant background and references so that any professor, postdoctoral fellow, graduate student, or advanced undergraduate from public health, can understand the motivation for and significance of your work. References must be included when discussing the work of others. Plagiarism (copying text or figures from any source, printed or online, without attribution) is unacceptable and will result in an automatic failure.

Hallmarks of an “Excellent” Piece of Scientific writing
(adapted from UC Davis “Writing across Curriculum” Program):

- Ideas: A well-written thesis will provide a thoughtful answer to a question worth asking. The hypothesis and central ideas of the work are clearly stated. The thesis clearly addresses any nuances and complexity, but stays on track, without straying unnecessarily from the main point.
- Support: The data presented convincingly support the main conclusion(s). It should be clear that the author has critically and thoroughly analyzed the data, as well as the work of others.
- Organization and Coherence: The document is well organized and logically structured and follows a standard scientific format that is familiar to the reader. Transitions are well crafted and lead the reader easily from one idea (or experiment) to the next. Paragraphs make clear points in support of the question/hypothesis and represent logical transitions from one idea to the next.
- Style: The document demonstrates that the author has a clear command of the English language. The sentence style is appropriate for the scientific audience and varied enough to keep their interest. Words are chosen carefully and for their precise meaning.
- Mechanics: The document contains very few, if any, spelling, punctuation, or grammatical errors. Abbreviations are defined the first time they appear in the text. References follow standard, accepted format.

TIP: One of the best guides to writing your thesis is modeling it on high-quality publications in your field.


While I have listed the sections of your thesis in the order they should appear, Figure 1 shows the order in which I suggest you write your thesis. While you may deviate from this approach, it is very important that you finish all analyses and have a thorough understanding of your results before you begin writing your Results and Discussion sections. You should conduct your literature review before you do your research; however, it is often most efficient to write your Introduction section after you

understand your results and their implications. This allows you to describe what is already known and what the gaps in in the literature are in a way that helps your reader understand the importance of your findings.

Practical Approach to Writing Your Thesis

While this guide provides details on the sections of your thesis in the order they should appear, Figure 1 shows the order in which I suggest you write your thesis. While you may deviate from this approach, it is very important that you finish all analyses and have a thorough understanding of your results before you begin writing your Results and Discussion sections. You should conduct your literature review before you do your research; however, it is often most efficient to write your Introduction section after you understand your results and their implications. This allows you to describe what is already known and what the gaps in the literature are in a way that helps your reader understand the importance of your findings.

Figure 1: Order in which to write your thesis

- 
1. Methods & Materials
 2. Figures/Tables
 3. Results
 - Re-evaluate data
 - Revisit figures/tables
 4. Discussion
 - Re-evaluate data
 - Revisit figures/tables
 5. Introduction
 6. Title
 7. Conclusion paragraph
 8. Abstract

These are only suggestions – in talking with your research advisor and lab members, you may come up with a different approach! This approach assumes that your hypothesis is already well developed and has guided your experiments.

1. **Methods & Materials.** You can generally write your Methods section as soon as you have finalized your study protocol. If you write your Methods section before you have completed your study, be sure to carefully review and update your Methods once your study is complete.
2. **Figures/Tables.** Once you have analyzed your data and know what your results are, summarize the data through tables and figures. Tables and figures should be of professional quality and have descriptive legends, comparable to those published in scientific journals. For each major finding (whether positive, null, or negative). Start with your major results.
3. **Results.** Once you lay out the big picture and the data, talk through your tables and figures to envision the text transitions between them. You may see obvious gaps when more information/ data is needed for a particular transition, or you may decide that you need to present the work in a different order. Science is rarely linear. To support your conclusions, the presentation of your results should be in a LOGICAL order.

After deciding on a logical order for your results, including tables and figures, you will be able to write the Results section. Every table/figure should be referred to, in order, in the narrative, in a way that readers understand the motivation for the experiment, the proposed outcomes, and the actual observations. In the Results section, some data interpretation may be necessary;

however, remember that a full discussion of the implications of the results should be reserved for the Discussion.

4. **Discussion.** After writing the Results section, it will be much easier to see how to discuss your results. Whereas the Results describe the data, the Discussion is the place to highlight the importance of your findings and put them in the context of the field. You will draw heavily on your literature review to write your discussion, since the details of all relevant studies should be in your lit review.

Writing the Discussion after the Results are completed will also help you see what background you need to cover in the Introduction to ensure the reader has the appropriate context to understand the question addressed by your hypothesis and to follow the experimental logic.

Discussion Tip: To help organize your discussion, Craft a “summary statement” for each major finding/result.

- Clearly state the finding (noting if it was contrary to your hypothesis)
- Set the result in the context of prior studies (consider using verbs like “confirms,” “contradicts,” or “extends”)
- Provide implications for the finding (actions that the field should take, like more research or new policies)

Then organize the statements into a coherent discussion, fleshing out the summary statements.

5. **Introduction.** When you draft the Introduction, you will be working from the outline you completed for your literature review. The Introduction tells the reader why your research question is important, what is already known about the topic, and what gaps your study addresses.
6. **Title.** Your title should be brief and informative, and provide the “answer” if possible.
7. **Conclusion paragraph.** The final paragraph of your discussion should briefly summarize your main findings and their implications, ending with a call to action (what’s the next step for the field, based on your work?).
8. **Abstract.** Write the abstract LAST. An abstract is typically 200-400 words and outlines the hypothesis and the key conclusions of the work. Your main points will be obvious and much easier to state after completing the Results and Discussion.

If you are having difficulty, get help from your mentor or others in the lab early on.

Abstract

Your abstract summarizes your findings and should be understandable to a wide audience. It should be between 250 and 500 words and does NOT include references. You'll use the following headers for your Abstract (unless your research mentor asks for a different approach):

Abstract Tip: Look at the abstracts of published papers in your field to see how abstracts are generally written.

Background. The background is 2-4 sentences that explain why you conducted the study, and what your research objectives were.

Methods. Summarize your methods in 1 - 2 sentences, describing your study design, sample, and measures used. If your statistical analyses are important, you can mention the approach taken.

Results. In 1 - 2 sentences, summarize the important results - not *all* of your results. Use numbers and p values as appropriate.

Conclusion. This is usually 1-2 sentences that highlights the implications of your findings and possibly the next steps for research.

Introduction

The goal of your introduction is to **help the reader** understand why you chose to conduct your study and why it matters. When your reader gets to the final paragraph of the introduction (your research objectives), she should already anticipate what your research questions are, based on the gaps you wrote about. Your introduction guides your reader through what is known about the problem, and what we still need to understand.

Start with a bullet outline (use phrases - not full sentences). When you are dealing only with brief phrases, you can see whether or not the logic and the concepts flow.

Your introduction should cover all of the following points and include appropriate citations/references. Most Introductions will be 2 to 3 double-spaced pages

WHY SHOULD WE CARE? First paragraph: this should draw your reader in - let them know why it matters.

- What is the problem you are trying to address?

- Why is it important
- Can you quantify its impact?
- Does it lead to further problems?

WHAT DO WE ALREADY KNOW? Next set of paragraphs – this is the meat of what you discover in your lit review.

- What studies have already explored the problem and what have they found?
- What causes the problem? (if relevant)
- What solutions currently exist? (if relevant)
- Be sure that you include a reference/citation for every point you make

WHAT ARE THE GAPS IN OUR KNOWLEDGE? (Next paragraph, or set of paragraphs)

- What don't we know? Reading the limitation and discussion sections of papers you find in your lit review will be very helpful in framing the gaps. The authors will talk about what their study was not able to do (limitations) and what they see as the next steps to take (discussion).
- Be sure that you include a reference/citation for every point you make
- Be sure to focus on gaps that your study can address. If you talk about gaps that your study can't address, your reader may get confused.

WHAT ARE YOUR RESEARCH OBJECTIVES? (Final paragraph)

- State your research questions, usually beginning with a phrase like, "We sought to determine/understand/explore..."

Length of Introduction

Your introduction should be 1 to 2 pages (it can be longer if you feel the reader needs more breadth of background to best understand the problem, but details are best left for the Discussion section). It should summarize what you found in your review of the literature, but does not need to include gritty details. A very good introduction can only be written when you have a strong understanding of the existing research. If you have a strong understanding of what has already been discovered, and what the next steps in

Avoid jargon. Your reader may not be familiar with the field. Be sure another researcher not in your field of study would understand the terms you use. Always spell out your terms before using abbreviations, even if the abbreviation seems common to you.

Avoid tangents. Don't talk about gaps in our knowledge that your study won't be able to address. For example:

- If your research tool is a cross-sectional survey, don't bring up the lack of experimental studies as a gap. While this is an important gap, your cross-sectional survey isn't an experimental design, so it can't address that gap.
- Similarly, if the problem you are trying to address is social isolation, and your study looked at social isolation among college students, don't talk about how a lack of education may increase social isolation. Your study cannot address this aspect of the problem.

research should be (i.e., the gaps), you can convey the important findings to your reader in a few paragraphs. You need to know the details of the existing studies (e.g., What experiments have already been done? What associations have been found? Which demographic populations have been studied? How large have existing studies been? What study designs have been used) so you can articulate the gaps. However, you don't have to include all the study details in your introduction.

You can find a sample of an Introduction Outline on bCourses.

Methods

Your methods section should describe what you did in a way that would allow other researchers to replicate your experiment. If your methods section will be long, it is a good idea to use subheadings to organize the section. Most Methods sections will be between 1 and 3 double-spaced pages. Your methods should include the following information:

- Study design in a sentence
- Setting
 - If clinical trial, hospital, clinic, community, etc.
 - Geographic sites as applicable
- Participants/subjects
 - If human participants:
 - How recruited
 - Eligibility criteria
 - If animal subjects:
 - Pre-experiment handling and care
 - IRB approval (or exemption) if applicable
- Origins of lab samples and materials
- Timing and protocol for data collection
- Measures
 - Source and content of surveys
 - Equipment used (if applicable), name, company, location of company
 - Assays used (if applicable)
- Statistical Analyses
 - Statistical tests used
 - Software used (name and version)

Include references as needed to document instruments (including surveys), equipment, or procedures.

Results

Your results section describes what you found – it should not include interpretation or opinion. It is a very simple and straightforward description of the results of your research – you will provide the “why” and “how” in your Discussion section. Most Results sections will be only 1 or 2 double-spaced pages.

Before writing your results, you will need to have run all your analyses and constructed your tables and figures - this is the first step in preparing the outline of your thesis. I provide suggestions on what you should state in your text and what is better left to your Tables and Figures in that section below. As you work on each section of your thesis, you may re-evaluate your data and revisit your tables and figures (Figure 1) to make your findings and the implications more clear. However, you need to know what all of your experiments showed (the answers to your research question) and understand the implications of your findings before you begin to draft your thesis.

I suggest that you make a **summary of your main results**, using brief phrases, to help you organize your Results section and prepare for your Discussion. The list should be high level - it should include answers to your research questions, and any other findings that make a unique contribution to the field. Use your tables and figures to help you write the summary.

For human subjects research, the first paragraph of your results should describe your study population, typically including number of participants, mean age, education, sex, etc., providing an overview of the detailed information available in your Table 1.

The rest of your results describe the results of your experiments/research, supporting what is in your figures and tables. You should not include all results from your tables and figures in the text - that’s why we use tables and figures. Rather, you should use the text guide your reader through the results shown in tables and figures, including important results as appropriate.

Discussion

The first paragraph of your Discussion should summarize your principal findings - the results that answer your research questions. This is a restatement of your results (with fewer details), but now you comment on whether or not the findings were consistent with your expectations/hypotheses. Most Discussion sections will be between 3 and 6 double-spaced pages.

The next paragraphs of your Discussion should follow a logical order and highlight all of your important findings (see sidebox *Discussion Tip* in [Practical Approach to Writing](#)

[Your Thesis](#), above). Explain the relationship between variables in terms of cause and effect, and discuss the any potential unmeasured confounders you were not able to include. Place your findings in the context of the existing literature: Do your results confirm prior studies? If so, how do they extend what is known? Do your results differ from prior studies? If so, why might that be? Present a thorough analysis of what your study results mean and include appropriate citations throughout.

Throughout the Discussion, you should not mention results that are not included in the Results section. Do not overstate your findings and do not draw conclusions that go beyond your results.

The second to last paragraph of your Discussion should highlight the limitations of your research. All research has limitations and it's important to show that you understand what your research could not do.

The final paragraph of your Discussion should be a conclusion that summarizes the main implications of your research and points to the next steps for the field.

References

You should use a citation management software package to format your references throughout.

Tables and Figures

Tables and figures present data so that is readily understood. To this end, data should be summarized, condensed, and displayed as transparently and memorably as possible. The most common and significant problem with tables is that authors will attempt to present too much information

You've probably heard the expression, "A picture is worth a thousand words"; that's also the rule to use when thinking of including a figure. If the information in a figure can be conveyed readily in text or in a table, it's probably better not to use a figure. Figures should be used when they are the most compelling and succinct way to convey information.

Tables, similarly, should be used to convey information that takes up too much room in the text. Tables (and figures) and text should not be duplicative – they should be complementary.

Both tables and figures must stand on their own, meaning that a reader who glances at a

table or figure before reading the manuscript can interpret the information. The title of the table/figure should be informative, all abbreviations should be made clear, the numbers should all be readily interpreted, and statistical significance should be clearly conveyed. For your thesis, Tables and Figures may all be placed at the end of the thesis, after your references, or embedded in the thesis in the sections in which they are mentioned. **If you want to embed your tables and figures in the text of your thesis, do so AFTER you have finished writing your thesis** (otherwise you may have to move your tables and figures and reformat your thesis many times – very inefficient!).

Resources

The sources I used for this guide are below. All of them provide additional details that may be useful.

1. O'Connor TR, Holmquist GP. Algorithm for writing a scientific manuscript. *Biochem Mol Biol Educ*. 2009;37(6):344-348. doi:10.1002/bmb.20329.
2. Liumbruno GM, Velati C, Pasqualetti P, Franchini M. How to write a scientific manuscript for publication. *Blood Transfus*. 2013;11(2):217-226. doi:10.2450/2012.0247-12.
3. Writing Scientific Manuscripts: A Guide for Undergraduates. 2005.
Available at:
https://ugr.ue.ucsc.edu/sites/default/files/jyi_guide_to_scientific_writing.pdf.
4. Kliewer MA. Writing It Up: A Step-by-Step Guide to Publication for Beginning Investigators. *J Nucl Med Technol*. 2006;34(1):53-59.