

Honors Biology Senior Thesis Guidelines - Fall, 2012

(Adapted from St. Mary's Senior Thesis Document)

General Questions to consider from BioTAP:

Does the project represent significant research?

Is literature accurate and complete?

Are methods appropriate given research question?

Is data analysis appropriate accurate and unbiased?

Does thesis make compelling argument for student's research in the context of the literature?

Does the student interpret results in a meaningful, versus just summarizing them?

Is there a compelling discussion where the implications of the findings are presented?

Is the writing appropriate for the target audience, any faculty member in the department in the same general area as the student?

Does the thesis articulate the student's research goals?

Is the thesis clearly organized?

Are citations presented consistently and professionally throughout the text and in the works cited?

Are the tables and figures clear and informative?

These guidelines are not meant to be rules that you have to follow. Please work with your advisor and honors seminar professors if you have questions about these guidelines.

I. Plagiarism

Plagiarism is the illegal use of someone else's work without giving them credit (without citing them). It also reveals a lack of effort and understanding. It is considered a serious offense in academia and can result in suspension from the university. There are several forms of plagiarism listed below. The first is rarely seen in the biology department and is the most severely punished. The other three are seen at some regularity, often due to a misunderstanding by the student about what constitutes plagiarism. Please avoid all three forms.

1. Submitting someone else's work as your own. This includes buying essays off the web, having another student complete a project for you or turning in essays/reports from past years.
2. Copying someone else's work (published paper, grant proposal, website, textbook, lab manual, *etc.*) without giving the person any credit or referencing them.
3. Making minimal changes to another person's work with a proper citation. Plagiarism includes using another person's ideas, format and writing style. This type of plagiarism often takes the form of changing a few words or the order of a sentence or paragraph to avoid directly quoting someone, but the ideas and the way the person said the information have not really changed significantly. This is often the hardest plagiarism to avoid because as an undergraduate it is difficult to comprehend how you could possibly provide the information in a way that is better than a published authority. The easiest way to avoid this type of plagiarism is to become an authority on the subject. You do this by taking notes from several sources and closing the original sources when it comes time to write the information in your own words.

Please understand that in scientific writing the use of citations is most often to provide support for a specific scientific statement. You are giving a reader a source to go to if they question the validity of your statement and showing that the statement you have made is not just your opinion.

Further information on plagiarism can be found at: <http://www.plagiarism.org/>

II. General Information

- a. Theses should be 25-40 pages (double spaced, 12 pt., 1 inch margins) submitted as a pdf to Dr. Whaley, Honors Program faculty coordinator.
- b. Use the format of a scientific journal article or master's thesis. If using a journal article format, the introduction and discussion should be expanded more than what is found in a typical published paper. If using a master's thesis format, here are links to two examples:
[1.http://search.proquest.com.proxy.library.nd.edu/pqdtft/docview/304399760/abstract/1389AB5B12E40693C4E/2](http://search.proquest.com.proxy.library.nd.edu/pqdtft/docview/304399760/abstract/1389AB5B12E40693C4E/2)
[2.http://etd.nd.edu/ETD-db/theses/available/etd-12142007-102953/](http://etd.nd.edu/ETD-db/theses/available/etd-12142007-102953/)
- c. Use proper sentence construction, spelling and punctuation. Read your thesis and check it multiple times before submitting it. A spell checker is helpful, but it is no substitute for careful proofreading.
- d. Use proper paragraph construction. Paragraphs must include a topic sentence, supporting sentences and a concluding sentence.
- e. Consider using Refworks or another system to manage your references for your thesis.
<http://www.library.nd.edu/refworks/>
- f. Your thesis will be evaluated by a faculty member on the Undergraduate Research Committee. You will see the evaluation rubric before you submit.

III. Title Page

- a. Content:
The title should be concise and descriptive. Think about what you expect in a title when you do searches for articles. Include the organism being studied, if it is not obvious.
- b. Mechanics:
 1. Use standard sentence capitalization rules for your title
 2. Center the title in the middle of the cover page.
 3. Include the following on your title page for the senior thesis:
 - a) Title (centered vertically and horizontally)
 - b) Name (centered one space below the title)
 - c) Advisors Name
 - d) Date

IV. ABSTRACT

- a. Content
The abstract provides a person perusing the literature the information necessary to determine if the paper is relevant and worth reading. An abstract provides a summary of each part of the paper that includes 1-2 sentences of introduction, a clear research question, your methods and results, and a brief discussion of why the results are meaningful.

b. Mechanics

1. Head this section with the underlined title: **ABSTRACT**. Place the title at the left margin.
2. Be concise, but thorough. Include actual results in the abstract.
3. The abstract for the thesis is typically ~250 words.
4. Please allow time for your mentor to edit your work.

V. INTRODUCTION

a. General Content

The introduction provides the reader with the background information that is necessary to understand your work. Unlike a literature review, the introduction is focused on only those aspects of the background information that are important to understanding the experiments performed. The introduction must include the following:

1. The larger context explaining why this work/study is important.
2. The background information needed to understand the work including the knowledge gap in your area of study and why your project will make an impact. .
3. Citations (see the “Literature Cited” section for the proper format).
4. The hypothesis or overarching research question
5. The purpose of your experiment stated clearly where you justify your research contribution from this work.
6. The last paragraph of the introduction is typically a transition to your study.
7. Refrain from using figures from other sources outside your lab, given that this is someone else's intellectual property. If you feel the figure is necessary, then consider including it as an additional file rather than putting into your thesis. Another alternative, especially if it is a conceptual diagram of a process, is to recreate the figure yourself and use that in your thesis.

b. Mechanics

1. The introduction should move from the general (ex. why are enzymes important) to the specific (purpose and hypothesis). In other words, the purpose and hypothesis is typically at the end of the introduction.
2. Refrain from using footnotes or direct quotes. Instead, summarize your information giving credit through citations to the people that provided the information.
3. Use citations in one of the following ways:
 - a. Smith (1996) reported that . . .
 - b. The gene for X increased expression levels following treatment (Smith, 1996).

***Please note, we are looking for more of a master’s style introduction with a strong literature basis, not a published paper introduction that is shorter.**

VI. MATERIALS AND METHODS

a. Content

The main purpose of the materials and methods section is to provide the reader with the information they need to repeat the experiment. Just like any other section of the paper, it is written in paragraph form using concise language and consistent units. The materials are included in the paragraph with the method and not listed separately. Previously published

methods should be cited, and at least a brief outline of the method should be included in the report. Special attention should be given to those aspects of the method that were modified or are unique to the study. For example, PCR is a fairly standard procedure in molecular biology, however the times, temperatures, type of machine, type of polymerase and sequences of the primers can all affect the outcome of the experiment and should all be reported in this section. Standard procedures, such as the measuring of liquid, or the type of container used, should be omitted unless they have a direct effect on the outcome of the experiment.

b. Mechanics

1. Head this section with the underlined title: **MATERIALS AND METHODS**. Place the title at the left margin.
2. Indent and use paragraph form. Do not use lists.
3. A list may be used in the rare instance when paragraph form becomes extremely cumbersome (ex. A list of 26 PCR primer sequences).
4. Avoid descriptions of mundane tasks, unless they are unique or they affect the outcome of the experiment.
5. Generally, methods are written in chronological order. Avoid the word “then”, as it is assumed that the second sentence in a method was performed after the first sentence was completed.
6. Numerals:
 - a. Use a numeral for expressing any number that immediately precedes a standard unit of measure or its abbreviation (ex. 1 g, 18 mm, 3 hr, 5 min).
 - b. Except in the preceding case, words should be used for numerals one through nine. Use numerals for larger numbers. (one, eight, 22, 1008)
 - c. In a series containing numbers both larger and smaller than 10, use numerals (ex. The 3 cell lines and 44 plasmid constructs were . . .).
 - d. Treat ordinal numbers as cardinal numbers are treated (ex. third, 44th).
 - e. In writing a number containing multiple zeroes at the beginning or end, either substitute a word for the number or add an appropriate prefix to the unit of measure (ex. 1.32 million, not 1,320,000; 3.6 ng, not 0.0000036 mg).
 - f. Do not leave decimals naked (0.5 not .5).
 - g. Do not begin a sentence with a numeral. Either spell it out or reword the sentence.
7. Use the concentration, molarity or percent of a solution if possible (ex. 20% sucrose, not 20 g in 100 ml; or 5 g/L NaCl, not 2.5 grams of NaCl was added to 500 ml of water).
8. Chemical mixtures should be named. The name should be followed by the contents of the mixture in brackets. [ex. The blot was washed twice in 1X phosphate buffered saline (1X PBS: 137 mM NaCl; 2.7 mM KCl; 4.3 mM Na₂HPO₄; 1.47 mM KH₂PO₄; pH 7.4) for 5 min.].
9. State the controls of the experiment clearly.
10. If your experiment involves multiple methods, consider using subdivisions.
11. In general, minimize “we” and “I” in this section.

VII. RESULTS

a. Content

The results of a research report are also written in paragraph form. Results are supported by tables/figures with legends, but the paragraph portion of the results must also contain all of the important methods, results and discoveries. Tables and figures included must be referenced somewhere in the text of the paper.

b. Mechanics

1. Head this section with the underlined title: **RESULTS**. Place the title at the left margin.
2. Have subsections with appropriate headings
3. Generally, make direct conclusions from the data and point out problematic results, but do not overly analyze this as that is one of the purposes of the discussion section.
4. Experimental results should always be compared to the controls.
5. Be clear and concise.
6. The actual data should be shown in the most appropriate format: Tables or Figures (pictures, charts, graphs, diagrams).
7. Quantify your results and use statistics where appropriate
8. All figures and tables must have a number and a title before the figure legend text (Figure 1. The effect of temperature on mouse respiration rates).
9. Tables and figures are numbered separately (you can have a Figure 1 and Table 1).
10. Tables and figures are numbered in the order that they appear in the report.
11. Tables: The table number and title are placed at the left margin immediately (no space) above the table.
12. Figures and tables should be embedded in the text, not at the end of the thesis.
13. Figures
 - a. The figure number and title are placed at the left margin just below the figure.
 - b. A figure explanation must be included with all figures. The explanation is single-spaced and placed directly below the figure number/title.
 - c. The explanation (or legend) is used to describe the figure to the reader and to point out the important point(s) to notice.
 - d. Label figures appropriately (X and Y axis, Lanes, Control sizes, Units, etc): Describe the lines on a graph or the lanes on a gel in the explanation.

VIII. DISCUSSION

a. Content

The discussion is used to put your results in the context of what is already known and published. The narrative should include a very brief summary of your results, maybe one or two sentences in any given paragraph. The Discussion should include a comparison of your results to the published literature, supported with relevant citations, and establishing areas of agreement and/or disagreement, with discussion the implications of the agreement or disagreement. Furthermore, published reports that explain your results should be included. Even if the results are negative, they should be reported and explained, especially in the context of the experimental design. Future experiments should be also be proposed, with reasons why. The implications or significance of your results in the wider context should be given and explained (i.e., why anyone should care that about the outcomes of the research). Finally, your Discussion should end with a brief summary stating what was accomplished. Overall, the narrative should be used as

an opportunity to use your biology background and ingenuity to discuss, within very specific and limited bounds, the interpretation and significance of the results produced. However, in so doing one should not go beyond the limits of the results, and begin to speculate beyond those limits.

b. Mechanics

1. Head this section with the underlined title: **DISCUSSION**. Place the title on the left margin.
2. Use a logical format. This may not be the chronological order of the results as you may want to group experiments to emphasize a certain point.
3. Conclude, where appropriate, with comments on the direction of future studies
4. Explicitly credit the work of others: because undergraduate research projects often closely relate to the ongoing work of other undergraduates, graduate students, and postdoctoral fellows in the laboratory, it is particularly important to give explicit credit to other collaborators and to reference any research, data, figures or text that were obtained or produced by someone else. Most of the research, results, and conclusions presented in your thesis should be your own.

IX. LITERATURE CITED (adapted from Pechenik, 2007)

a. Content

1. The full reference (including all of the author names) is listed after the discussion under the heading: LITERATURE CITED. Use the format of any scientific journal article.
2. If there are more than 10 authors, list the first 10 authors followed by “*et al.*”. In all other cases you must list all of the authors.
3. Every reference listed in the literature cited section must show up somewhere as a citation in the body of the report.
4. Literature is listed in alphabetic order, using the first author’s surname. If more than one paper is used by the same first author, the papers are ordered in chronological order. If more than one paper by a first author is published in the same year, add letters to the citation after the year (Kosek, 2007a; Kosek, 2007b).
5. A journal article title follows normal sentence rules for capitalization, but all words in a book title are capitalized (except “or”, “the” and “and”).
6. Latin words (species names, *et al.*, *etc.*) are italicized.
7. Journal names are written out in full (no abbreviations) and are italicized. If you do not know the full name of a journal, Google the abbreviation to find it.

2) Mechanics:

1. Head this section with the underlined title: **LITERATURE CITED**. Place the title on the left margin.
2. Literature is listed in alphabetic order based on first author’s last name.
3. Do not number your references.
4. Use standard formatting.

APPENDIX

a. Content

The appendix is not usually used in the lab report, but it may be useful in a honors thesis. An appendix is used to include content that does not fit into the body of the report. You should not use an appendix without first discussing it with your advisor.

b. Mechanics

Head this section with the underlined title: **APPENDIX**. Place the title at the left margin. The appendix is placed after the Literature Cited section.