Neurobiology Senior Thesis Guide 2016-17

Your senior thesis is a formal research report that summarizes the work you have conducted in the laboratory. Important goals of your thesis are: 1) to review the relevant background in your field; 2) to describe how your work fits into the larger scientific context; 3) to clearly describe your experimental data; and 4) to fully analyze and criticize your results. It is also important to 5) discuss how future experiments should address particular issues or build upon your work. As you write your thesis, you should keep in mind that *clarity is of the utmost importance*. In order to write very clearly, it is crucial that you always keep in mind the basic scientific question(s) that your work attempts to answer. These questions should be introduced and explained well in your Introduction. You should return to these driving questions in subsequent sections throughout the thesis, regularly reminding the reader how each result fits into your overall scientific goal.

**THESIS DEADLINES**

1) **For all thesis writers**, a 6-10 page rough draft is due at 5:00 PM on Friday, December 9, 2016. (For students enrolled in Neurobiology 91 in fall, this draft serves as the required final paper for the course.) The format should be one of the following: 1) a rough draft of the thesis Introduction; or 2) a rough draft of the Results section. Regardless of the chosen format, you must also include an addendum that briefly lists all experiments/analyses and states whether or not each has been completed (we understand that some of the results may not yet be complete). This paper should be emailed to both your research director and James Poolner (jp@mcb.harvard.edu). The format is designed to provide you with early feedback on your thesis, and you should request comments from your lab director after s/he receives your draft.

2) A **one-page abstract form** (downloadable from the Neurobiology website, “Neurobio Forms” link) is due to James Poolner’s office (BioLabs 1082) by 5:00 PM on study card day: **Friday, January 27, 2017**. (If you plan to enroll in Neurobiology 99, this will also serve as your required registration form.) It is assumed that the abstract text may change somewhat before you turn in your final thesis. We will use your preliminary abstract draft to attract appropriate faculty readers. On the abstract form, students and their mentors should suggest three appropriate faculty members as potential thesis readers. You should not simply list friends/collaborators, but rather individuals who have the relevant expertise to evaluate your work. Readers should be affiliated with the Faculty of Arts and Sciences, Harvard Medical School, or one of the Harvard-affiliated hospitals or institutes (e.g., the Broad Institute, MGH, McLean, etc.). These individuals
may or may not be selected as your eventual readers, but the list provides us with helpful
guidelines for identifying appropriate evaluators.

3) A rough draft of your entire thesis is due on Friday, February 24, 2017 at 5:00 PM. This
draft should be emailed directly to your research director with James Poolner cc’ed on the email
(jp@mcb.harvard.edu). This draft is due two weeks before the final deadline.

4) One bound copy AND one complete digital copy of your thesis (in PDF format only) are
due James Poolner’s office (BioLabs 1082) by 5 PM on Friday, March 10, 2017. The digital
copy may be emailed as a single pdf document to jp@mcb.harvard.edu and must also arrive by
5 PM on March 10th. Late theses will be penalized one grade step per day, counting weekends.
These penalties will be waived only in cases of serious extenuating circumstances. Students
should contact their advisors and Head Tutor immediately in that event. (The following are
NOT considered valid excuses: crashed computers, malfunctioning printers, and scheduling
problems at the Science Center or copy center. You must plan in advance.)

**THESIS GRADES**

As an undergraduate, you may need to stop doing experiments before you have a complete
story because of looming thesis deadlines. The completeness of the experiments is a major
difference between the undergraduate thesis and a doctoral thesis, and it is understood that
undergraduates often are not able to fully complete their intended story. **How well the thesis is**
written, presented, and analyzed **is the major determinant of its grade.**

You will receive two separate grades for your thesis work:

1) The letter grade that appears on your transcript for Neurobiology 99 is assigned
independently by your research mentor. S/he will also write a short letter to the thesis evaluation
committee on your behalf.

2) Your overall Latin thesis grade is determined by a separate faculty committee. At least two
anonymous faculty members will read and evaluate your thesis individually. A neurobiology
faculty committee will then examine all evaluations to produce your overall Latin mark. Your
thesis evaluations will be available to you by the end of the final exam period, and Dr. Draft will
notify you when they are available. If you are nominated for a Hoopes Prize, please inform Dr.
Draft or Dr. Magnotti. The faculty committee will forward your thesis evaluation comments to the
Hoopes Committee.
Latin grading from neurobiology faculty committee:

There are no specific quotas for thesis grades, so the number of theses awarded within each category varies every year.

**Summa:** This grade distinguishes beautifully written theses that report scientific research of high quality. The thesis should be without flaw in both the design and the execution of the project. (Mastery of difficult techniques alone is not an adequate criterion for earning the summa distinction, nor is the judgment that a particular thesis is publishable.)

[High magna: Distinguishes theses that are deserving of a mark that falls between magna and summa.]

**Magna:** Distinguishes clear, very well-written theses that reflect an excellent effort.

[High cum: Distinguishes theses that are deserving of a mark that falls between cum and magna.]

**Cum:** This mark acknowledges that a good effort was made and that the rationale, methods, and results are well described in the thesis.

**Commendable:** This grade is reserved for theses that are adequate but not deemed worthy of receiving an honors distinction. The rationale, methods, and results are described but not in a manner sufficient for honors.

**No Credit:** This grade is reserved for theses that do not meet the standards expected of a Neurobiology undergraduate thesis.
NEUROBIOLOGY CONTENT OF THE THESIS

Note for students working in psychology, cognitive science, sleep, and immunology labs:

As a Neurobiology concentrator, your thesis must integrate your knowledge of neurobiology with your research topic. You may find, however, that your lab mentors do not have expertise in the neurobiology underlying or related to your study. Therefore, the onus is on you to find the appropriate literature/ background materials and think about how they relate to your work. If you have any difficulty identifying relevant material to include, please contact Dr. Ryan Draft (draft@fas.harvard.edu) or Dr. Laura Magnotti (magnotti@fas.harvard.edu), and he/she will help you find an auxiliary ‘Neurobiology’ mentor to guide this aspect of your writing.

Your thesis must satisfy the following requirements to receive full credit:

1) **Two-three pages of the introduction** should provide the neurobiological context and background for your study, *for example*:
   i) activity patterns of the cell populations or individual cells in the areas you study (fMRI, EEG, electrophysiology studies: how activity relates to specific behaviors or might affect information processing in the circuit, etc.)
   ii) connectivity/organization of the cell populations in the areas you study (layers, columns, maps; connections among regions/relationship to function; etc.)
   iii) cellular/molecular mechanisms involved in your study (neurobiological models of: learning/plasticity, addiction; cell/neurite growth/survival or signaling; etc.)

2) **One-two pages of the discussion** should speculate on how aspects of the neurobiology presented in the introduction might have influenced the results of your study.

**THESIS STRUCTURE**

In terms of how it is written and its structure (but not necessarily in terms of the quality of data), the thesis should read like a typical *Neuron* or *Journal of Neuroscience* article, but with more lengthy Introduction and Discussion sections.

Your thesis should have a clear point and there should be no doubt to the reader (or to you) what that point is. You should be able to complete the following sentence: “The goal of this thesis is to ______.” To develop your goal(s), you must first clearly identify the overall and
specific scientific questions that your experiments attempt to answer. Explicitly explain these to the reader (in your Introduction). You should also explain clearly things that may seem obvious to you (e.g., connexins form gap junctions). Your readers may not know as much about your specific topic as you do. Even if they do, what you don’t explain in your writing may seem like a lack of understanding on your part. Take the time to explain things in concrete sentences. In addition, try to frame your thesis like a good story, arranging the material so that the reader will follow enthusiastically from beginning to end.

Some flexibility is allowed for your thesis format so please consult with your thesis advisor before writing and formatting your thesis. Nevertheless, the following sections should be included. Suggested page lengths are very rough. (See below for details on each section.)

Honor Code page
Title page
Acknowledgements
List of Contributions
Abstract
Table of Contents
List of Figures/Tables
Abbreviations
Introduction (~ 7-12 pages)
Materials and Methods (~ 3-5 pages)
Results (~ 7-15 pages)
Figures (each placed where appropriate within Results or at end of section)
Discussion (~ 4-8 pages)
References

Honor Code Page. A .docx version of this page is available here to insert into your thesis: http://lifesciences.fas.harvard.edu/files/lifesci/files/honorcode.docx, or feel free to insert the .pdf version (page 17 of this guide). Please attach this as the first page of your thesis and sign the form on the printed/bound copy.

Title Page. A .docx version of this page is available here to insert into your thesis: http://lifesciences.fas.harvard.edu/files/lifesci/files/honorcode.docx, or feel free to insert the .pdf version (page 17 of this guide). Please follow this format in centering and spacing the
Acknowledgments. Acknowledgements should appear after the title page. This section is reserved for you to thank and acknowledge individuals who may have been helpful to you during the thesis process.

List of Contributions. In this section, you should clearly and simply state who did what portions of the project. You should explain which portions were done independently by you, which were done in collaboration with others, and what data others may have contributed. For example, if your name were “A. Student”:

“Following the initial discovery of spontaneous calcium waves by other members of the laboratory, the current research project was conceived by Dr. M. Labdirector but jointly designed by A. Student, Dr. M. Labdirector, and Dr. C. Postdoc. Behavioral assays, brain dissections, and histological analysis were done independently by A. Student. Sciatic nerve dissections were done by C. Technician. Electrophysiological recordings were done jointly by A. Student and C. Postdoc. The immunohistochemistry presented in Figure 9b was performed by P. Gradstudent. Cell counts and all statistical analyses were done independently by A. Student. Computer modeling was done jointly by A. Student with C. Postdoc. Data and results were interpreted by A. Student with assistance and guidance from both C. Postdoc and M. Labdirector.”

(Please note that although this example is written in the passive voice, the majority of the thesis should be written in the active voice – see “Style” section on page 11 below.) In addition, any figures that include someone else’s data should also be fully explained in the accompanying figure legend. See Figures for more information.

Abstract. The Abstract should be placed after the List of Contributions. The Abstract should be a single paragraph and should not exceed 250 words. It should be designed to define clearly what is dealt with in the thesis and should (1) state the principal objectives and scope of the investigation, (2) describe the methods employed, (3) summarize the results, and (4) state the principal conclusions. Most of the abstract should be written in the past tense, because it refers to completed work. The abstract should never give any information or conclusion that is not stated in the thesis. References to the literature should not be cited in the abstract.

Table of Contents. The table of contents should list every subsequent section of the thesis, as well as the abstract and other pages that precede it.
**List of Figures/Tables.** List all tables and figures (including data figures, other schematics, illustrations, etc.) present in the thesis. Also list the page number where each can be found within the document. Any page devoted to a table or figure should be counted and numbered like all other pages.

**Abbreviations.** List all relevant abbreviations used throughout the text for the reader’s easy reference. Any abbreviation listed here should also be introduced and spelled out the first time it appears in the text.

**Introduction.** The Introduction should present an overall framework for your research by reviewing the literature, discussing what is currently known about the particular subject (as well as perhaps how this knowledge may have evolved historically), identifying relevant questions or debates that exist in the field, and detailing the specific question/s that you investigate in the thesis. The Introduction often reads like a mini review article on your topic. It should be very obvious to the reader what specific scientific questions you aim to address with your work. If you introduce the background well, the reader should also understand why your specific experiments are an important and obvious next step for your particular field or laboratory.

You should end your introduction by clearly stating (or perhaps restating) your objectives and rationale for the thesis. This provides a starting point for the thesis and tells the reader what to expect in the forthcoming sections. For example, your Introduction may end with something like the following: “This thesis investigates the role of calcium waves in the development of the embryonic mammalian cortex. Specifically, we will 1) use calcium imaging techniques to characterize the morphology and frequency of calcium waves that occur spontaneously in embryonic cortical slice preparations; 2) demonstrate electrophysiologically that calcium waves can be recapitulated with extracellular stimulation; 3) demonstrate pharmacologically that calcium waves are dependent upon ATP receptors; and 4) use a cell proliferation assay in embryonic brain slices to demonstrate that calcium waves are crucial to embryonic neurogenesis.” Try your best to list these items in a logical order that walks the reader through your ‘story’. Also include here any significant components of your work that it might be important to highlight, for example if your research involves an involved statistical analysis.

Throughout the introduction you should supply sufficient information to allow the reader to understand the forthcoming results without her/him needing to read previous publications. Assume that your audience has the background of a general neuroscientist but not necessarily
one that knows your field well. (This means that you don’t have to describe what an “axon” is, but you should explain things like “presenilin”, “connexins”, “synapsin”, “iPS cells”, or “glioma”.) When in doubt, explain briefly. Include schematic figures or diagrams in your Introduction that illustrate the details you are introducing, e.g., important brain regions you are discussing or a complex biochemical pathway. If it is something crucial for the reader to understand, a figure is always a good idea. It improves your overall presentation and also helps the reader to focus on the important points they must understand for the remainder of the thesis. Many authors feel that one figure should be included for every main point in a scientific paper.

Throughout the Introduction and all subsequent sections, you should include in-text citations of all relevant published work. References serve multiple purposes. Beyond their most important role in giving credit to previous work, references also serve as resources for the reader to learn where s/he might find further reading on a particular subject. Be sure to include relevant reviews or even textbook chapters that you found helpful as you learned about your topic. (See “References” section below for citation format.)

**Materials and Methods.** This section details how you conducted the experiments. Give enough detail so that the reader has an idea of how to conduct a similar experiment, but don’t include the excruciating details of full protocols. For example, include concentrations or final dilution amounts, but do not explain step-by-step how to make your buffer. Use subheadings to help guide the reader through the Material and Methods section (e.g., “Tissue preparation”; “Imaging & Analysis”; etc.).

**Results.** This section comprises the body of the thesis. The Results section should be presented in an explicit, logical order, so that the reader will understand the purpose of each experiment. This section summarizes the data obtained from the experiments and should describe the results in a matter-of-fact manner but not overly interpret them (which would be done in the Discussion). Rather than simply listing one experiment monotonously after another, walk us through your logic using key transition sentences that remind us of your underlying scientific questions. For example, instead of saying “Next, we used antibodies against Protein X at three different time points”, you might say “Next, in order to determine whether autism-associated proteins are indeed localized in the striatum throughout development, we used antibodies against Protein X at various postnatal ages.” If you completed two unrelated projects, you may consider separate sections or chapters within the Results section. You may also include relevant experiments with negative or no results.
**Figures.** The visual elements in your thesis should be a mirror of the written elements such that either the figures or the text may stand alone to tell your story. In other words, you should ideally have a figure to visually represent each main result described in your text. Your figures, diagrams, and tables should be properly labeled, with descriptive figure legends and any sources acknowledged. (See below.) Clear, well-labeled figures help significantly to impress readers with the overall professional presentation of your thesis. Figures and tables should be numbered in the order that they are cited in the text (for example, Figures 1-2 in the Introduction, Figure 3 in the Methods, Figures 4-11 in the Results, etc). Ordinarily, figures should be presented in portrait orientation with the figure legends accompanying the appropriate figures. We encourage you to dedicate a page to each figure and insert that page into the appropriate position within the text. We suggest that you do not embed the figure in the document using MS Word. (This can lead to a formatting nightmare for you.) You may instead choose to place the relevant figures together at the end of a chapter or section, although some readers prefer that figures appear within the text where they are relevant. The pages on which figures appear should be numbered in sequence with the text and appear in the Table of Contents and/or List of Figures.

Most figures should be prepared as multi-panel plates, as they appear in a typical journal article, rather than as single images. Individual panels in a plate should be consecutively lettered, and for all images, a scale bar should be included in the figure and defined within the figure legend. Figures should be presented in a plain and unadorned style on a white background. All text within the figure should be large enough to be read easily. Panels should not be set off by boxes or other edging, and lettering and images should not have gratuitous effects such as highlighting, three-dimensional edging, shading, etc. Where possible, figures should consist of black lines and lettering against a white background. Color should be used to differentiate or emphasize specific features of a drawing, but only if scientifically necessary (i.e., needed to differentiate the different parts of the image, such as different lines in a graph or different labels mapped against a brain section).

In order to present a complete story, it is sometimes appropriate to include some minimal data conducted by another individual in the lab. Work done in collaboration with others or even by someone else may be included in your thesis, but this must be acknowledged in the figure legend even if the appropriate researcher is also given credit elsewhere. The reader assumes that all figure data presented are yours unless it is explicitly stated in the figure legend. Be sure
that you do not make this ambiguous to the reader; their frustration/confusion may be reflected in your thesis grade.

Discussion. The discussion section should first of all summarize and analyze the results that you have presented. For example: “We demonstrated in Figure 8 that cell proliferation was decreased in the presence of ATP receptor antagonists. This result could be interpreted in a number of ways…” then go on to explain that one likely interpretation would support your overall hypothesis, but a caveat might be that the pharmacological agents could have caused cell damage. (Ideally you have done a control experiment to rule that out – explain how that control supports your hypothesis here.) In addition to this type of discussion, recapitulate your overall argument(s) presented in the Introduction as well as strengths and weaknesses and address the theoretical issues that were used in approaching and analyzing the problem. You should also explain how you may have modified your view of the issues in the course of conducting the analysis. If your experiments did not produce significant or meaningful results, explain here your thoughts on why this might have occurred, and suggest how things could be done differently. Convince the reader that you have fully thought through and understand the implications of your work, no matter how individual experiments may have turned out. The discussion is an important aspect of your thesis and should place your findings into the larger perspective. It is the best section to demonstrate to the reader how carefully you have thought about your work and how sophisticated your thinking might be regarding its nuances and implications. Be sure to compare your findings to previously published results – are your data consistent with findings from other studies? Why or why not? Importantly, end with a section detailing further questions to be asked and directions for future study. Faculty readers will look specifically for a discussion of how future experiments may build upon or improve your work. If this is missing, they may feel that you have not adequately thought things through.

References. Factual statements and claims that you make throughout your Introduction, Methods, Results, and Discussion sections should be backed up by providing citations to relevant published work. For example, even a basic statement such as the following should include a citation (to a review article or textbook chapter, for example):

In the motor system, motor neurons whose cell bodies reside within the ventral horn of the spinal cord project a long axon toward the muscle and make a synaptic contact called the neuromuscular junction (Sanes & Lichtman, 1999).
For references, you should use the bibliographic notation style of the *Journal of Neuroscience* or *Journal of Comparative Neurology*. For example:


Regarding in-text citation, please use the author-year method as shown in the first sample above. Do not use footnote or numbered format. Here are two more examples:

Watson and Crick (1953) proposed that DNA formed a double-helix.
- or -

The nucleotide bases are on the inside of the double helix and the phosphates on the outside (Watson & Crick, 1953).

To simplify the citation process, we urge you to use an in-text citation program such as Endnote or Refworks, both of which can be downloaded online via Harvard. To read more about using these programs, visit [http://guides.library.harvard.edu/cite](http://guides.library.harvard.edu/cite).

All thesis writers should read this brief guide regarding citations: ‘*Guide to Using and Citing Sources When Writing in the Life Sciences*: [http://tinyurl.com/LSCitationGuide](http://tinyurl.com/LSCitationGuide)

**Note regarding Neurobiology/MBB theses:** Students who are writing a Neurobiology/MBB thesis should consider how their thesis fits within the structure of Mind, Brain, and Behavior (MBB). One of the missions of MBB is to elucidate the structure, function, evolution, development, and pathology of the nervous system in relation to human behavior. If you are primarily focusing on one of the broad areas within MBB, you should integrate at least one of the other areas into your thesis. For instance, a thesis on auditory neural pathways might begin by discussing the experience of hearing and deafness in society. Ideally this perspective is integrated into the Introduction and Discussion sections. As you write, you may draw upon the courses you have taken, including MCB 80, OEB 57, the MBB interdisciplinary junior seminar (MBB 980-series), etc. As always, discuss how you plan to incorporate MBB with your Research Director (PI of the lab) and other mentor/s (e.g., graduate student or post-doctoral fellow).

**THESIS FORMATTING AND STYLE**
Length: Senior theses usually range from 35 to 50 pages in length with figures and diagrams. Although this number is not a hard and fast rule, you should be wary of exceeding these limits in either direction. Long, verbose theses are often too wordy or poorly written, edited, and argued. On the other hand, the reader may criticize a shorter work; s/he may not be able to discern whether you understand the material and see the larger picture.

Style: Your thesis should read like a professional scientific journal article. It is not appropriate to describe your personal experience (outside of the Acknowledgements section) or to demonstrate your creative writing style. Use this opportunity to develop your own writing style – but write clearly. Committee members scrutinize the quality of the writing and editing. The thesis will be graded on the basis of content and writing effectiveness. Your grade will be undercut by inattentiveness to style, form, grammar, punctuation, spelling, and citations.

Active or passive voice? In all sections except for the Methods, the active voice is preferable to the passive voice. “I” versus “we”? Since your List of Contributions page specifies what parts of the work you did independently, many students choose to use “we” throughout the thesis. If you are comfortable using “I”, it is also appropriate in a senior thesis. Beware however that it can become confusing if you are constantly going back and forth between “I” and “we”, depending upon the particular experiment or method.

For examples of structure and format, previous theses are located on the shelves outside Dr. Draft and Dr. Magnotti’s offices (BioLabs 1082). We will also put on 2-3 different thesis-writing workshops for Neurobiology concentrators this year. You may also wish to consult with counselors at the Writing Center (http://www.fas.harvard.edu/~wricntr). The counselors go over drafts of your writing. They also have a number of hand-outs on format, style, and other aspects of writing. We will also try to post resources for thesis writers on the Neurobiology website.

You should begin writing the thesis while experiments are still in progress (i.e., now!) while everything is fresh in your mind. You may identify inconsistencies in the data or interesting avenues that may be followed up while writing up the results section. At the latest, you should write a complete draft of your thesis by the middle of January to allow at least a month for revisions, printing, proofreading, copying, etc. Give a copy to your mentor/s in lab as early as possible so that you can incorporate their feedback. Realize in advance that people will take longer to read and edit the thesis that you expect.

Copies/Binding: You must submit one printed, bound copy AND one complete digital copy
of your thesis (in PDF format only, which may be emailed as a single pdf document to
jp@mcb.harvard.edu). The printed copy is most commonly bound in spiral binding, which
Kinkos, Staples, Gnomon, or Flash Print can do for a nominal fee. (These copy centers are very
busy around the thesis deadline – plan a day or two ahead!) Staples even offers a service that
allows you to email them a pdf and they will print and bind the thesis for you within a few hours.
(If you choose to print the document yourself at the Science Center around the thesis deadline,
be prepared to wait long hours for printers.) (Also beware: Copy centers like Staples etc. may
charge you for color printing the entire document, even if it only contains a handful of color
pages. Best is to ask them to print the whole document in black and white, then specify the few
pages that need to be reprinted in color and inserted.) For binding, you may also purchase basic
manual binders from CVS. Unlike other concentrations, you are not encouraged to purchase the
expensive spring binders from Bob Slate. You may wish to print and bind an extra copy for your
own personal records or for your lab.

Page Formatting: Leave at least 1-inch margins on all sides of 8 1/2 x 11” paper. All textual
material should be double-spaced and printed on one side of the page only. Use regular white
copy paper; acid-free thesis paper is not necessary.

Font: Use a 12-point font, preferably Times or Arial.

Pagination: Page numbers (Arabic) should appear centered at the bottom of the page,
separated from the text by approximately 0.5 inch. Every sheet of paper in the document should
be counted in the numbering sequence. The title page is the only page not physically numbered,
but it is still counted as page one. (So your physical page numbering will begin with page “2” at
the bottom of the Acknowledgements page.) Do not use letter suffixes (e.g., 10a) for page
numbering. As specified earlier, pages with figures should be numbered in sequence with the
rest of the document.

THESIS TIPS FROM FORMER STUDENTS

- Read this guide carefully!
- Open some draft Word documents on your computer now to start formalizing early notes.

Title the documents as follows:

“Introduction” – Use this document to start jotting down ideas/main points that you want to
cover in your intro. In bullet format, write out the specific questions your research is
aiming to address. Fine-tune those questions over time.
“Methods” – Use this document to start jotting down notes about your experimental methods, protocols, concentrations, stimulus intensities, etc. It is much easier to write down these details now while you’re still doing the experiments.

“Results” – Use this document to list some of the experiments you’ve done in bullet format and how you interpret the data. You probably already keep this info in a lab notebook, but the earlier you transfer it to a typed up document, the better.

“References” – Keep a list of journal articles you want to include in your thesis as you remember them.

- Plan in now an extra day to print out and bind your thesis before the deadline.

**COMMON MISTAKES**

**Abbreviation soup.** Don't use too many abbreviations. It can be cumbersome for a reader who may not be familiar with your abbreviations, and it may detract from their judgment of your writing. For example, if you are discussing proteins with abbreviations, don't also abbreviate motor neuron (MN) and motor nucleus (MNU). Just spell out motor neuron and motor nucleus. Try to avoid using an abbreviation at all unless 1) it is usually abbreviated by most others in the field; 2) the abbreviation significantly shortens the phrase (e.g. a 4-word phrase shortened to 4 letters); AND 3) the abbreviation will significantly streamline your text (i.e., you use the abbreviation many times). If you use the word/phrase fewer than five times in your thesis, do not abbreviate no matter how long the phrase.

**Scientific jargon.** Just because a phrase is used commonly in your lab/field does not mean that someone outside of your field is familiar with it. The thesis is written for a much more general audience, and readers can feel insulted if you are not explaining your terms. Be sure to adequately introduce and explain any scientific jargon that is not common knowledge (for example, “sequence task”; “calcium dye”). Once you describe it the first time, it is appropriate to then use your shortened terminology throughout the rest of the thesis.

**Too many headings.** Headings can be useful landmarks in a long document, particularly the thesis Introduction, which may cover a lot of material. Be careful, however, that you do not use too many headings. They break up the flow of your writing. Don't use a new heading as a crutch or substitute for a key segue sentence that transitions smoothly to the next paragraph.

**Trying too hard to impress the reader.** While it is important to be proud of your achievements and sound strong and ambitious in your writing, it is also easy to sound overly naïve or arrogant
about what you have done. If your data is novel or important, you should say so, but don’t mention it more than once or twice. Avoid referring to your work in a grandiose way or saying that it has “proven” a theory or led to saving future lives, etc. Instead of saying that your results “elucidate the mechanism”, say that they “help to elucidate the mechanism”. Readers are most impressed by a confident student who not only presents the strengths of his/her work but also points out its weaknesses, addressing them before the reader can criticize. This is best done in the Discussion. Identify what are the strengths of the experiments (e.g., good behavioral paradigm, excellent expression of proteins) and what are the weaknesses (e.g., too much variability in the data, not a large enough sample size, animals were not healthy after expression, etc.) Then talk about how each of those weaknesses could be improved, for example by running a larger number of experiments to increase statistical power.

Figures are too small. Don't waste all of your efforts on your figures by printing them too small. Use the whole page if necessary. It will be easier for the reader.

If you need further guidance on any aspect of the thesis, from page numbering to data woes, please come and talk to Dr. Draft or Dr. Magnotti.

Good luck !!!
I affirm my awareness of the standards of the Harvard College Honor Code.

Name:______________________________________________________________

Signature:__________________________________________________________

The Harvard College Honor Code

Members of the Harvard College community commit themselves to producing academic work of integrity – that is, work that adheres to the scholarly and intellectual standards of accurate attribution of sources, appropriate collection and use of data, and transparent acknowledgement of the contribution of others to their ideas, discoveries, interpretations, and conclusions. Cheating on exams or problem sets, plagiarizing or misrepresenting the ideas or language of someone else as one’s own, falsifying data, or any other instance of academic dishonesty violates the standards of our community, as well as the standards of the wider world of learning and affairs.
Title Page Format:

[Title] (centered approximately 1/4 down the page)

A thesis presented by

[Name]

to
the Faculty of the Committee on Degrees in Neurobiology
in partial fulfillment of the requirements
for the degree with honors
of Bachelor of Arts

[optional: and Certificate in Mind, Brain, & Behavior]

Harvard University
Cambridge, Massachusetts
[Month and Year of Submission]