Student Guide to Writing and Defending an Honors Thesis in EBIO

Table 1. Deadlines for the College of Arts & Sciences and for the EBIO department for Honors theses.

I. EBIO Honors Classes EBIO 3980 and 4980

1. Purpose of 4980

The class is held only in the spring semester but is required for all Honors candidates wishing to defend in that year. In this class:

• (spring) candidates receive guidance, encouragement, and support during the process of thesis writing and defense preparation from their peers and the course instructor (with fall candidates getting a preview of the process).
• candidates practice communicating both strengths and limitations of their own project and those of others.
• spring candidates give a practice defense talk and fall candidates give an informal update on their research plan.
• all participants provide encouragement and support to their peers.

2. Purpose of 3980

3980 is held together with 4980 and provides a sneak preview of the departmental Honors program for those interested in the program and/or doing exploratory research. There is no obligation for those taking 3980 to go through with defending an Honors thesis before they graduate but those who defend must still take 4980.

3. Class structure and further details

Candidates for spring graduation give practice defense presentations before Spring Break and fall candidates give informal presentations on their plans and/or research progress in April. Everyone is expected to provide feedback on these presentations in the chat, which I will save and distribute to the presenters. Comments should aim to help presenters build confidence in highlighting their own contributions as well as develop a clear, unapologetic view of limitations (and how these could be addressed in future research). All participants are asked to provide (1) comments on something your peer has done well and (2) friendly suggestions for further attention (which can simply be a question about a term or concept that was unclear, such "what is this and why should we care?").

I. Getting Started with Honors Research

1. Find a thesis advisor

The EBIO Honors flyer contains a list of EBIO faculty who advise Honors students (with a one-line description of their research interests). Contact a few faculty with interests compatible with your own in a brief email message describing your interest in their research and writing an Honors thesis and ask if they are taking students. Mention your tentative graduation semester (and expect to be asked about your cumulative GPA). Faculty are most interested in candidates who show enthusiasm/passion, willingness to learn new things, good communication skills, and reliable work ethics. Conversely, you should expect to have a support system (your advisor and/or graduate students or postdocs as appropriate). You may also chose a thesis advisor from a different department or unit on campus.

2. Find a gap in the literature

Great research questions build on previous research and address gaps in the current literature. It is perfectly okay to follow the suggestion for a suitable research question/project from the thesis advisor you choose, and gradually take increasing ownership of the project as you conduct your research and write your thesis. If you already have an idea for a research question, seek feedback

on the feasibility of successfully pursuing your idea as an Honors project with its limited time frame. In either scenario, conduct a series of thorough literature searches (see section below for details) and identify aspects of a study system or phenomena you notice as needing further investigation. This helps to identify gaps in the current literature, which makes for interesting thesis topics! It usually takes quite a bit of reading to get in on the ongoing conversation in any sub-discipline of science.

Get started by looking into topics that interest you and pertain to your thesis advisor's work. Reading recently published papers show what phenomena are currently investigated, but also expand your reading frame to include some classic, older papers in your field to understand how the scientific investigation has developed through the years. It is also helpful to do a search with the keywords relevant to what you are looking for and then add "and review" to the string to hopefully find some transparently written reviews with comprehensive summaries of the field and outlooks on what needs to come next. Locate one or more reviews by doing a search with "[Keyword 1] and [Keyword 2] and review" before delving into original research papers written in language suitable only for experts. Reviews often provide a better sense of what is going on, are written for a broader audience, and contain extensive reference lists with more specialized sources.

In reading about a study system, you will often find that there are a number of questions remaining to be addressed, which creates many good opportunities for a thesis topic. Alternatively, you could consider a phenomenon or questions that were raised in one system but haven't yet been explored in many systems. The key to a good research question is that it attempts to describe and address a gap in the literature and builds on previous research in a logical and creative way.

3. Choose your committee members

Choose your committee and have their acceptances in time to be able to list them on your registration in the semester prior to your graduation semester. You need no less than three defense committee members: One Honors council member (Barbara Demmig-Adams or Pieter Johnson), your faculty advisor, and one outside (non-EBIO) member. The outside member cannot be cross-listed as EBIO faculty. You may find someone with whom you've taken a class you enjoyed, a faculty member with related research interests, or someone who would find your research interesting. Your advisor may have some good suggestions for committee members, too! Keep in mind that your outside committee member will most likely not be familiar with your research area, and that you'll need to accommodate them in your oral defense and thesis writing by being especially transparent and strictly defining all technical terms you use. You may choose to invite more than three committee members, but the more people you have on your committee the more difficult scheduling is, and the more random questions you may get!

4. More on literature searches

After discussing possible projects with your advisor, do multiple online journal searches. Keep combing the literature at regular intervals throughout the work on your research/thesis for related papers to add to your understanding of the topic. In your written thesis, you should expect to cite a substantial number of references (~30 and up!). Use both classic and newer studies to illustrate and authenticate your own research. All this will allow you to better understand your research area, grasp the meaning and importance of your own results, and compare your results with those of other authors.

Google Scholar provides a wider range of materials written by experts and can be a good starting point. Web of Science (WoS) provides a more exclusive range of articles in peer-reviewed journals. Once students start using WoS, they typically report being quite enchanted by the options available in WoS. WoS allows customizable and nested searches with separate entries into search boxes for title, topic, author, etc., which often provides for a more comprehensive search of the literature. If you are on campus or are connected to UCB VPN (for off-campus access, sign up with VPN for free through CU; https://oit.colorado.edu/services/network-internet-services/vpn), you have access to the full text of all articles in journals to which CU has a subscription. In WoS, look for *Free Full Text from Publisher* or *CU Full Text*. If the article is not available to download, request a copy via *Interlibrary Loan*. To use WoS, go to CU's *University Libraries* or *Chinook* and click on *Find* Articles, then *A-Z Databases,* and then (all the way down under W) *Web of Science*. Log in with your *IdentiKey* and password (log into VPN through Cisco after not using it for several days). Once in WoS, you can do broad searches by choosing *All Databases* and *All Years*. To start, enter one or more keywords in the *Topic* category (using word strings with *and* or *or*), followed by a click on the Search button. Use the "sort by" button in the upper right for "newest first" (from most to least recently published) or "Citations: highest first" (from most to least highly cited, which can tell you about a paper's influence on the field and/or appreciation by a broader audience). Click on *Citations* on the right to pull up additional, newer articles on the same topic that cite the article you were looking at – an incredibly useful feature.

II. Starting to Write an Honors Thesis

1. Making writing easier

Starting early with a very rough outline will lower anxiety by lowering the bar for the first draft! The writing center at CU recommends starting by quickly jotting down a list of very tentative notes that focused only on the key points you need to make and then doing multiple rounds of careful editing (reportedly, the direct quote was "write a shitty draft and then edit the heck out of it."). No thesis has ever been written in one sitting but instead gets worked on step-by-step over a longer period of time. Begin with notes and outlines of each section and then fill in these outlines with detail as you gain more information. It can be helpful to start the first full thesis draft with those sections that allow the least degrees of freedom and thus the least agony over how to narrate. These sections can be the Methods section and the Results section where you simply state what your figures and tables show. After you have a clearer picture of your findings and how they may offer some new insight, it will be easier you flesh out your full narrative for Introduction and Discussion sections that match each other by first introducing what you set out to find and then discussing what you found.

Many theses wind up not being about what the student/researcher originally set out to find, but instead describe the findings actually made (rather than what was originally planned/expected!). In your introduction, formulate the question you actually answered. Every section should prepare the reader to understand and appreciate the results and conclusions you discovered. If you find a non-significant result where you had expected something significant, prepare your readers in the introduction (and throughout the thesis) for the possibility that there is another phenomenon acting on the system.

You may find that making an outline, or a series of outlines, helps you develop your ideas and decide on a logical flow of those ideas as a convincing argument. The thesis should tell a coherent story, and everything in your thesis should support that story – develop an outline of

ideas that allows you to show this. It may be helpful to write your Methods section as you carry out the research, such that no important details are left out! You may be surprised about how much time is devoted to describing how you conducted your experiments. Additionally, before writing Results section, take some time to order all your graphs and tables into a logical sequence before you start writing, which will help you develop a logical flow of information and argument.

2. Meeting deadlines

Invest time early making a detailed schedule when you begin the thesis writing process, including the official deadlines from the Honors Program. Making your personal schedule early in the semester will give you a time buffer when unanticipated problems or delays are encountered, which occurs almost invariably. Writing all your deadlines in a day planner at the beginning of the semester will make sure that know what's due and when, and you can revise these as needed as you go along. Try to meet with your thesis advisor once a week and check in with your EBIO Honors Representative, and, potentially, the other defense committee members or the Writing Center in Norlin Library to seek further feedback. The more feedback you get, the better your product will be.

III. Thesis Sections & Formatting

1. *General guidelines*

An EBIO Honors thesis should follow the general format of a peer-reviewed publication in your research area but contain more extensive background and discussion sections as well as include justification for your hypotheses and predictions. Use headers 1-8 below for sections and sub-headers for subsections (e.g., field site, study organism, measurements, statistical analyses under Materials and Methods) and include the following sections: (1) Title page, (2) Abstract (summary), (3) Introduction ending with a hypothesis or question, (4) Materials and Methods, (5) Results with figures, tables, and/or schemes, (6) Discussion (possibly including a section on Limitations), (7) Conclusions (optional) or a separate section on Limitations, (8) References.

Throughout your thesis use a succinct professional writing style (like what you see in a peer-reviewed publication) and avoid colloquial language or lab jargon. To let your arguments flow from one section to another, set up the need for your project in your Introduction, describe the tools you used to fill that gap in your Methods, show what you found towards addressing/filling that gap in your Results, and discuss your findings in your Discussion (by comparing your results to the findings of others and stating additional questions that arose from your work and could be pursued in future research). Write topic sentences for each paragraph that provide transitions between sections that foreshadow what is coming and why. Rather than describing what you did in chronological order like in a lab book or diary, focus on your take-home messages in a logical order. Keep the audience on the same page by introducing what is coming to allow the reader to fully evaluate for themselves if and how each result supports your statements and conclusions. The thesis should not read like a suspenseful detective novel, where the answer is revealed only at the very end. If necessary, reverse-engineer your initial hypotheses to match your actual findings by framing a question that is answered by your actual findings. Once your thesis argument flows well, do several additional rounds of editing just for grammar, punctuation, and consistent format throughout. Rather than using direct quotes from your sources, paraphrase key statements and give citations for all thoughts, ideas or results taken from

your sources. Whenever you make a statement of fact, support this claim using previous research.

(1) *Title Page*: The following information is strictly required by the A&S Honors program (spread out this information along the title page)

Title of Thesis (Capitalized)

By
(Student name)
(Department), University of Colorado at Boulder

Defense Date (Month Day, Year)

Thesis Advisor:
(Advisor Name), Department or Program

Defense Committee:
(Advisor Name or 1st Committee member), Department or Program
(2nd Committee Member), Department or Program
(3rd Committee member), Department or Program

(2) *Abstract:* Brief summary of your research including 1-2 sentences of introduction, 1-3 sentences on methodological approaches, 1-3 sentences on findings/conclusions, and 1-2 sentences for how the research impacts the field at large. This should not exceed one page (~200-300 words); do not cite any literature within this section.

(3) *Introduction:* Introduce your general research area (e.g. disease ecology, pollinator biology, etc.), identify a need for your research (i.e., an open gap or question), and tie this to the rationale for choosing your topic. The Introduction should be broader than in peer-reviewed empirical publications in specialized journals and must be understandable for non-experts, like your non-EBIO defense committee member and the members of the CU Honors Council. Introduce key concepts and define all technical terms and abbreviations in a few words of plain English for non-expert readers. Begin each paragraph with a topic statement that overviews the content of that paragraph. The purpose of this section is to lead into your hypotheses and predictions, such that readers understand why you are asking certain questions and why you are predicting certain results. Clearly state your hypotheses and predictions, giving justification for each. If you have more than 2-3 pages of background, provide a short general introduction ending with your hypotheses, and add a separate Background section after this brief introduction.

(4) *Materials and Methods:* This section is a detailed description of how you performed your study and analyzed your results. Using past tense, include everything necessary to completely replicate your experiment, from the statistical program you used to specific details like the brand of auditory speaker used or GPS coordinates of your study plot. For equipment used, provide the name of the company from which it was purchased and the location of the company's headquarters.

(5) *Results:* Using past tense, succinctly report your results using text, figures, tables and schemes. Leave the discussion of results to the Discussion section! If you include figures, provide figure headers (legend/caption) that only state the topic of the figure (e.g., Relationship between Y and X) and define all symbols and abbreviations used in the figure. Do not report the results seen in these visuals in the figure legend but only in the text. Do refer to all tables and figures in the text (e.g., see Table X) and describe the main take-home point for each figure/table (e.g., "Males had longer tail streamers than females.").

(6) *Discussion:* In this section, place your results into the context of what is already known. Do not repeat your results again in any detail! When referring to specific results, say something like "The finding that males had longer tail streamers than females is consistent with (or in conflict with) other studies on …". Also summarize and interpret your findings by discussing potential strengths and weakness of these results in a constructive manner and suggest possible future research that addresses new or remining questions. Do emphasize how your data provide some novel insight, even if it's just a small extension. Limitations of your study may also be appropriate to include in this section. If there is a lot to say about limitations, break out a separate section with its own header on Limitations.

(7) *Conclusions*: This is a brief, concise statement of the most important findings (take-home messages) of your research and how they are immediately interesting to the audience. This section is optional because you may be able to cover this in your discussion.

(8) *Reference List*: List all sources you cited in your thesis (don't list sources you also read by don't cite in the thesis) and cite a source for each and every statement of fact you make in the Introduction and Discussion. Include references in earlier drafts, such that your advisors can see the sources you are relying on. Choose a format of citations your like from a sample peer-reviewed publication in your research area and follow this format consistently. Spell out the full journal names. See an example below for a full citation for the reference list (in the text of your thesis, refer to this same source as Dalton et al. 1999 (where et al. is Latin for et alteri, which means "and others").

Dalton, T. D., Shertzer, H. G. and A. Puga. (1999) Regulation of gene expression by reactive oxygen. *Annual Review of Pharmacology and Toxicology* 39, 67-101.

2. Defense copy of thesis

Submit a polished copy of your thesis (the defense copy that has undergone several rounds of revisions based on feedback from your mentors) no later than one week before your defense to all defense committee members. Whereas your thesis advisor is expected to provide feedback on earlier drafts of your thesis, your other defense committee members typically only read your thesis just prior to the defense. In addition, email a PDF version ("Lastname Firstname Defense Copy.pdf") of this copy to the A&S Honors program at honors@colorado.edu no later than on the last day allowed for defenses but preferably as soon as you defend. This defense copy will be the one used to determine your level of Honors! The title page of your thesis must adhere to the requirements of the A&S Honors program (see above).

3. Final archival copy of thesis

During your defense, your committee might suggest changes to your thesis. You have until the Final Copy due date to make any changes you wish but do not make changes to the defense copy you email to the Honors Program. Any changes you make to your final copy will ***not*** be considered when determining your Latin honors designation. The only piece that you ***cannot*** change on your final copy is your title page (unless the Honors Program specifically asked you to make changes to the title page of your final copy). Once you've completed any changes, upload the final (archival) copy of your thesis to the repository on CU Scholar by the final copy deadline. If you are trying to publish your work and don't want your paper to be available until it's published elsewhere, you can set an embargo which prevents it from showing up publicly until the date you set. (see https://www.colorado.edu/honors/graduation for links and further directions).

IV. Honors Thesis Defense Committee

1. Working with your advisor

Your advisor is expected to be available for regular meetings with you, to answer questions and give you guidance on the scientific content of your thesis. Your advisor should play a key role in the revisions of your thesis and give suggestions of studies you should read to expand and broaden your understanding of the research topic. One of the biggest obstacles is insufficient time allocated for the back-and-forth of several thesis drafts between Honors candidate and thesis advisor. This can be remedied by developing an early, rough draft for feedback from the advisor. Schedule a series of meetings with your advisor at the beginning of the semester.

V. Defense

1. *Purpose*

The oral defense of your written thesis allows you to demonstrate familiarity with specific and broader aspects of your research area, and your ability to think critically and communicate effectively. In addition to giving and overview of your work, highlight the bigger picture into which your work fits, what is important about this research area and your particular question, and describe limitations of your research and where future research could go. You do not need to have an answer to every question the committee members will ask. They often ask something out of curiosity that nobody know the answer to yet.

2. Guidelines and format

The defense starts with a brief organizational conversation among the committee members without the candidate, followed by a summary of the gist of your work as well as Q&A, followed by another conversation (of varying length) among the committee members without the candidate about the committee's recommendation to the Honors Council, and concluding remarks with everyone present again.

You begin with a 15- to 20-minute synopsis of your thesis (typically using PPT) and its take-home messages. Introduce your study by giving a rationale of your work, i.e., why it matters, why you spent time researching this, and what the bigger picture is. Then give a very brief summary of methods, results and conclusions of the study. Describe your methods such that the audience can easily understand how you are answering your research question. Discuss any pitfalls and limitations of your study, constructively – don't sell your research short, but be both realistic about limitations of your work and confident about what you have achieved. Consider presenting things in a different order than in the written thesis by, e.g., bundling each question/hypothesis with its corresponding results and conclusions. It is an excellent idea to practice your defense as much as possible. When giving your talk to yourself the first time, pay attention to bumpy sections where you stumble. Use this to identify holes in the logic or weak arguments, and the make changes to make the presentation run more smoothly. Doing this will help you feel confident when presenting to others. You might even consider recording yourself to check that you come through as confident and composed while presenting.

4. Possible questions from committee

Prepare for questions on

• any aspect of your research in the written thesis, and especially what you mention in the slide presentation.
• background knowledge of the main issues (be sure to define key concepts and terms in your thesis and be able to reiterate these definitions during the defense)
• the most relevant literature (e.g., what was known by the research community when you started, how do your results fit into the big picture),
• what you would do differently if you could perform your experiment/project over again and what you have learned through the process of doing Honors research
• future career plans

5. Scheduling the defense

You are responsible for scheduling the defense with your committee members any time before the A&S Honors program deadlines (https://www.colorado.edu/honors/graduation). Define a target time for your defense early in the semester and then plan you defense early to avoid running into scheduling problems and having to defense sooner than you like. Previous Honors students found to attractive to defend before Spring Break (for spring graduation). Send out a poll (like when2meet) to find a time that works for all your committee members. Give a range of dates over a week or two and hourly time slots throughout the day. Identify a two-hour block to reserve for the defense.

The typical defense may only take a little over an hour. However, sometimes more extensive discussion is needed if there should be any difference in opinion among the committee members or if the designation suggested by the cumulative GPA does not match what is suggested by the committee. As the thesis defense gets closer, remind your committee of date, time, and location of your defense. For an in-person defense, reserve a projector, and book a room early in the semester. Contact Jennifer.Kinion@colorado.edu in the EBIO main office to schedule a room and/or projector; book it for two hours to give yourself and the committee ample time.

VI. Honors Designations

1. How the decision is made

Your cumulative GPA suggests a specific Honors designation (see table below), but the thesis must earn this designation independently; written thesis, defense performance and GPA are all taken into consideration for the final designation. For *Magna* and *Summa,* both the defense and written thesis must demonstrate a clear command of the big picture, and the research should be conducted with a greater degree of independence (especially for a *Summa*). For a *Summa,* the written thesis and the oral defense must be impeccable. To be considered for one of the rare exception of higher Honors than your cumulative GPA suggests, thesis and defense must be **two designation levels higher** than the GPA (e.g., *Magna* level thesis is required for Honors with a GPA below 3.300, graduate-level work is required for *Summa* with a GPA of 3.500 – 3.799).

Table 2. Honors designations and eligibility by cumulative GPA.

Honors Level	**Latin Honors**	**GPA**
Honors	*Cum laude*	3.300 – 3.499
High Honors	*Magna cum laude*	3.500 – 3.799
Highest Honors	*Summa cum laude*	3.800 – 4.000

2. Honors Council

The Honors council is a group of faculty members representing all Arts & Sciences departments (50+, with many non-science disciplines). They make the final decision on your Honors designation. Their role is especially crucial when the defense committee's recommendation is not unanimous, or when the recommended designation is higher or lower than what the GPA suggests. In the latter cases, the physical defense copy of your thesis is circulated by the Honors Council members.

Table 2. Deadlines for the College of Arts & Sciences and for the EBIO department for Honors theses.
For specifics, see A&S Honors page with links and guidelines (https://www.colorado.edu/h1).

End of the semester preceding the semester of the defense	Complete online registration including a prospectus (summary of planned work & research already completed), planned timeline of work, and preliminary bibliography with initial sources. This is not an application – your Honors Council representative's agreement to serve on your committee is the approval for your project.
~6 weeks before your defense*	Submit a substantial outline of your thesis to your thesis advisor
~4 weeks before your defense*	Submit a first full draft of your thesis to your advisor, and expect 2-4 rounds of revisions before your final defense copy can be submitted to the committee
1 week before your defense (not including Spring Break for spring defenses)	Submit the polished final defense copy of your thesis to your whole committee
Deadline for submission of defense copy	Submit the defense copy of your thesis to the A&S Honors program (preferably) on the day of your defense or no later than the last day to defend.
Deadline for uploading of archival thesis copy	Upload archival thesis to CU Scholar
*somewhat negotiable, but strongly suggested; students who did not meet these deadlines frequently wound up postponing graduation for a semester (or failing to earn Honors).	