

Faculty Handbook for Mentoring University Honors Students in CBS

University of
Minnesota Biol 4960H
Honors Thesis
Seminar 2011-2012

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[FACULTY HANDBOOK]

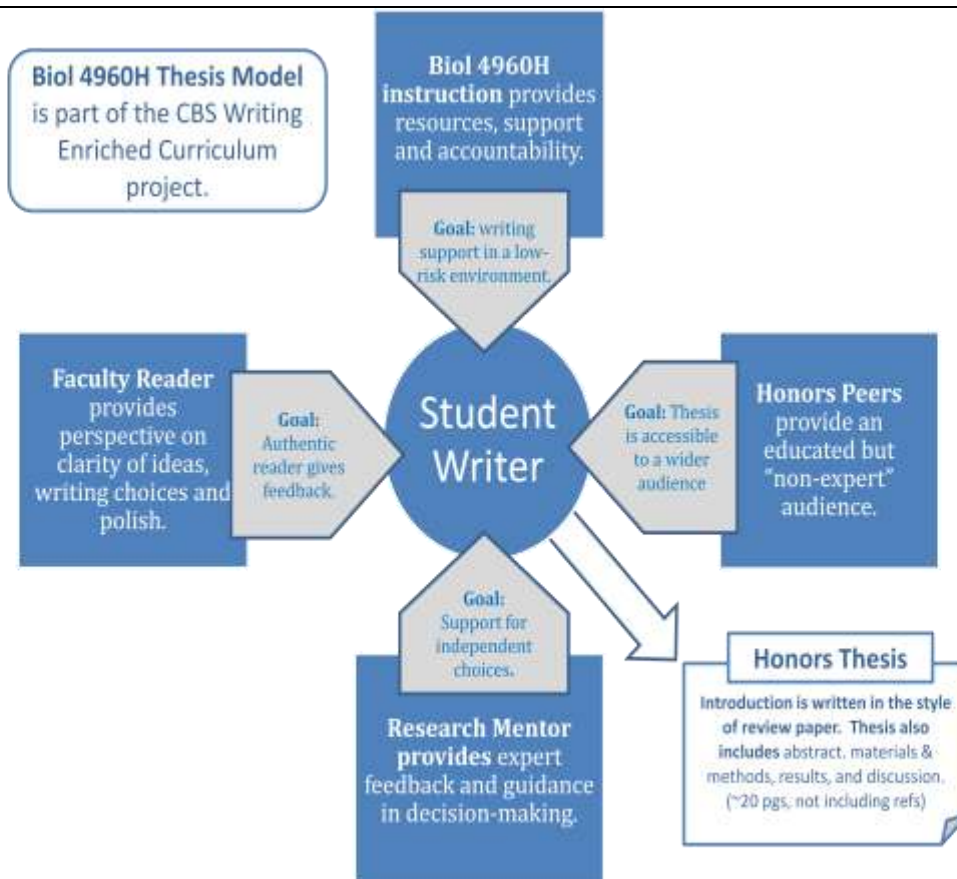
The purpose of this handbook is to provide information and guidance to faculty research mentors who are overseeing the thesis writing of a University Honors Student in the College of Biological Sciences.

The Thesis-Writing Model in CBS

The thesis is to be written in the format of a scientific journal article, but with an expanded literature review and Introduction. Students are asked to include more detail in each section of the thesis and tune their writing to a more general audience than would be appropriate in a typical journal article. This format aims:

- To ensure that students fully understand the context and implications of the lab's research and their honors project.
- To allow students to focus more on literature review and writing if their research projects were limited in scope or did not yield expected results. Success in Honors is therefore linked more closely with students' efforts in lab and with scholarly writing than the research outcomes.
- To provide a resource to their laboratory that will help new undergraduates working on continuing projects (e.g. more detailed Materials & Methods) and to give students the opportunity to describe strategies that didn't work, as well as those that yielded positive results, especially in cases where students designed or tested new protocols for lab.

This strategy is intended to help students produce "honors-worthy" thesis papers, regardless of factors potentially outside of their control, such as the level of responsibility, scope of experimentation, or opportunities for collaboration afforded them in labs across the University of Minnesota. It has been designed with the CBS-Defined Discipline-Specific Writing Characteristics and Abilities of the Writing Enriched Curriculum in mind (p4).



Thesis Development Guidelines, Assessment and Approval

Students must follow the “Instructions to Authors” for the journal *Cell* with regard to note organization, style, use of abbreviations, and manner of referencing (supported by Zotero). Design of figures and tables should be in graduate thesis format – **each on its own page following the text that references it**. The thesis includes:

1. Title Page
2. Acknowledgements
3. Abstract
4. Introduction *
5. Materials and Methods
6. Results
7. Discussion *
8. Literature Cited (goal 30 sources min.)

* Both the Introduction and Discussion are expected to be a minimum length of 5 pages, double-spaced.

Authorship

Writing a thesis is a collaborative effort, and students are directed to consult their research mentor for feedback on rough drafts. They may also solicit feedback from other colleagues in lab (graduate student or post-doc who oversees their work). However, the student must be the sole author. Students may include data and experimental results generated by other lab members or collaborators, as long as they indicate clearly which work was their own and credit is duly given to others.

Formative Feedback and Revision:

Biol 4960H Honors Thesis Seminar in CBS has been expanded to a fall-spring (2-semester) required sequence for seniors (or juniors) who are writing a thesis. The classes facilitate an iterative feedback process between peers, a faculty reader, and research mentors to model authentic scientific peer review. Please see the Mentor Strategies (pgs. 7-8) for detailed prompts and guidelines on helping students develop critical reading, writing, and editing skills. Throughout this process the thesis assessment rubric will be used (pgs. 11-19).

Engaging in **peer feedback** helps students practice formative feedback and grapple with making authorial decisions. **Faculty readers** provide a genuine audience member, similar to a grant reviewer, who is immersed in the general literature and conventions of scientific writing and review. The **research mentor** is the subject matter expert who can help the student identify, interpret, and relate the specific context and significance of their project and its outcomes. Students will complete **revision memos** to indicate how they utilized feedback from faculty readers and research mentors in subsequent drafts. **This iterative feedback process is designed to help students understand a general audience, and develop a thesis that is not targeted solely to experts in their particular field.**

Final Thesis Submission and Deadline:

Honors theses in CBS must be approved by the primary research mentor and 1-2 faculty readers, depending on the level of Latin Honors sought (pg 5). Only the PI/research mentor can be from the student’s research lab. Readers may be any person (non-relative) at the U of M or elsewhere who holds a PhD or terminal degree (e.g. MD). As a graduation requirement, the approved thesis must be submitted to the University Honors Program through the program website by **Friday, May 4th 2012** along with the signatures of the readers.

CBS Writing Enriched Curriculum (WEC) Writing Plan

CBS-DEFINED DISCIPLINE-SPECIFIC WRITING CHARACTERISTICS:

- **Concise:** Arguments or descriptions are direct and to the point, generally employing no unnecessary words.
- **Precise:** Wording is unambiguous; scientific terminology is used appropriately; objects, findings and processes are described accurately.
- **Overt:** Ideas are presented in a direct and comprehensible (“reader-friendly”) manner.
- **Presence of a logical and cohesive narrative:** Much scientific writing tells a story that emerges from logic, but remains separate from its author.
- **Evidence-based:** Ideas and conclusions are based on data; narrative moves from data to conclusions
- **Structured to reflect scientific reasoning:** Much scientific writing includes a description of a hypothesis based on current knowledge and the methodology used to test the hypothesis, the resulting data, and an interpretation of the data in light of other published work.
- **Cumulative and contributive:** Strong scientific arguments should reflect the cumulative and contributive nature of science (synthesizing and building upon foundational concepts and findings of others).
- **Organized using specific scientific formats:** For example, research reports generally contain an Introduction, Methods, Results and Discussion; text is typically accompanied by supporting data in the form of tables, figures, and/or graphs which each contain appropriate and informative legends (captions).

CBS DESIRED WRITING ABILITIES FOR GRADUATES:

- **Communicate information in a manner that is overt and logical:** Graduates should be capable of writing a scientific narrative that is direct, with an overt and transparent logic.
- **Communicate information in a manner that is precise and concise:** Graduates should be capable of communicating scientific ideas and principles in a manner that is concise, unambiguous, and inclusive of correct terminology.
- **Present and interpret data in context:** Graduates should be able to contextualize scientific problems or issues in terms of what is known and what is unknown. They should be able to generate narrative that moves from data to conclusions, reflecting the cumulative and contributive nature of science.
- **Synthesize ideas in new ways:** Graduates should be able to present ideas relevant to content at hand, building on what is known. They should be able to organize information and take a position—synthesizing information from a variety of sources rather than presenting a laundry list of ideas.
- **Analyze and interpret published work, gauging the efficacy of evidence:** Graduates should recognize and use scholarly sources without accepting everything that they read. In other words, they should be able to critique reasoning, data and/or methodology.

- **Identify significant gaps in scientific knowledge and develop research questions to address those gaps:** Graduates should be able to identify critical gaps in scientific knowledge and propose research questions that could yield findings to address those gaps.
- **Read analytically, recognizing choices made by authors:** Graduates should be able to recognize characteristics of scientific discourse in scientific articles.
- **Become comfortable with ambiguity:** Our graduates should communicate in a manner that recognizes that there are usually several ways to interpret data.
- **Demonstrate data appropriately:** Graduates should be able to properly construct, caption and format figures and tables. They should make intentional choices about how data is presented to audiences (when to use a figure, what kind of figure to use, what is the most logical sequence of evidence). They should be able to use technical programs (like Excel) to create effective figures, but should understand the underlying mathematical and/or statistical principles.
- **Understand and use recognized formats for scientific research papers:** Our graduates should understand the components of a typical scientific research paper and know how scientific information is conveyed in each component.
- **Alternate appropriately between multiple modes of communication:** Graduates should effectively communicate scientific thoughts and principles in the following ways (oral, written, graphic, numeric) and use these modalities in complementary ways.
- **Write compellingly to audiences within and outside of the discipline:** Graduates should be able to communicate both the science and the significance of the science to multiple audiences, using terminology that is appropriate for the intended audience.
- **Work and write collaboratively**
- **Develop strategies to effectively revise and/or self-edit written work**

Requirements for Graduation with Latin Honors in the University Honors Program

In order to be eligible for graduation with Latin honors students must have:

- Completed at least 60 credits at the University of Minnesota – Twin Cities campus,
- Maintained successful, continuous participation in UHP,
- Fulfilled a minimum of the junior & senior-year Honors requirements, and
- Obtained a grade point average of at least 3.5 in their last 60 graded credits (not including transfer credit).
- Submitted an honors thesis accompanied by faculty approval signatures.

The level of Latin honors students receive is contingent upon the level of honors thesis they complete and the grade point average of their last 60 graded U of M-Twin Cities credits. Summa candidates in CBS must have three faculty readers approve their thesis. All other candidates must have two.

- *Cum laude* - 3.5 or higher (CBS requires 2 readers)*
- *Magna cum laude* - 3.666 or higher (CBS requires 2 readers)*
- *Summa cum laude* - 3.750 or higher (CBS requires 3 readers)*

* One of the required readers must be the PI of the student's lab/research mentor.

Frequently Asked Questions

How independent does an honors project need to be? An honors project should give students a sense of ownership and responsibility. Students should have enough input to the project (involving critical and creative thought) to qualify them for a level of authorship of the work completed. Research is always a collaborative effort, and a student's work may be closely related to the work of others in the lab, or even depend in part on some data generated by others in the lab. It's OK to bring data and results from other projects into the thesis, as long as the majority of the work is the student's and appropriate credit is given for others' contributions.

Who provides feedback on drafts? Students should have a discussion with their Research Mentor during the first two weeks of the term about the thesis writing process and schedule for Biol 4960H. Student are asked to elicit feedback from mentors and faculty readers on drafts of thesis sections throughout fall and spring terms. **Note:** *These readers should NOT be copy-editing student writing drafts (e.g. grammar, typos, sentence structure).* Feedback on content, context, literature sources and interpreting and discussing data is most helpful. Please refer to the thesis assessment rubric and suggested strategies for guidance on the following pages.

What is the expected length and format of the thesis? The honors thesis required for CBS students in honors is a hybrid between a review article (in-depth introduction that gives the "big picture") and a primary article (the student's own Methods, Results, Discussion), and is usually 15-20 pages in length, not including references. The thesis may also give more detailed Methods to serve as a resource for future students in lab and also detail experiments that didn't work in Results/Discussion.

How extensive should the Literature Review be? Students should be familiar with research in their field of study, especially as it relates to: a) the background/context for their research project, b) the significance of work accomplished by other researchers in the past, c) how their work adds to the overall body of work in the field, and d) the significance of any findings. Students should have the goal of citing around 30-50 other articles, which may give context, reference protocols used in experimentation, and/or be used in discussing results of their project.

Can a manuscript for publication or primary paper replace the honors thesis? No. If students have already written a paper for directed research credit, it may be a useful starting point for their thesis, but a manuscript or paper is not appropriate for use as an honors thesis. Students should use Biol 4960H to add to what they've written, incorporating new references, new data, and to polish their initial writing. **Note:** Students must be the sole author of their honors thesis. A manuscript for publication is much more concise than a CBS thesis should be.

Which project(s) should be includes in the honors thesis? Students and research mentors can decide which projects are important to discuss. Students don't have to include an avenue of research completed in the past if it turned out to be a dead end or was handed off to another person. Two or more separate projects may be tied together if they were completed in the same lab and are related enough to discuss as a series of experiments.

Mentor Strategies for Offering Feedback

(adapted from Reynolds and Russell 2008)

- **Use your time effectively:**
 - **Consider holding off making any comments until you've read through the whole draft.** This allows you to get a sense of the overall writing, to ensure your comments focus on the real issues, and may save you having to amend earlier comments. Taking notes as you read, of course, is often a good idea.
 - **Consider letting students' stated concerns/goals guide how you organize your commentary.** This gives you a focus while reading, as well as a set of topics on which to center your comments. Of course, if you identify issues that you perceive to be of more concern than those the student raises, you should comment on them.
- **Be mindful of your tone:** There's no need to go overboard with niceties, but **consider integrating a couple of positive, supportive comments** for what seems to be working well, especially at the beginning of your written comments. You might use language such as: "I like how you ..." or "I'm impressed by..." Essentially, think about ways to achieve the balance between being honest and congenial that you'd aim for if you were talking face-to-face.
- **Emphasize the fact that you are one of several readers in students' target audience:** Several faculty members read each thesis, and issues that bother you may not bother other readers, and vice versa. In fact, students often receive diverse, or even contradictory comments from their readers and peers in class. Keep in mind for yourself, and emphasize to the student, that you are just one reader, and consider prefacing your comments with phrases such as, "As one reader ..." or "From my perspective" Students cannot feel free to make their own writing choices if faculty comments are framed as the definitive summary of what does and does not work in their writing.
- **Ask questions: Your job is not to "fix" the thesis, but rather to help students develop as writers by teaching them how readers interpret their writing.** It can be very helpful to ask questions about the writing instead of making suggestions for improvement. Students must reflect on these questions and make writing choices to develop as writers. For example, you might ask, "*Your research statement says what you did but does not explicitly state why you did it. What was your hypothesis?*" Or, if you think a certain paragraph doesn't belong in a certain location, you can describe your response as a reader as, "*When I got to this paragraph, I wondered what it was doing here – it seemed like you had been talking about A, but all of a sudden, here's this paragraph about B! Can you help your readers understand how this paragraph should fit in?*" The student may need better transitions, or may have left out something important that will clarify matters, or he or she may see that the paragraph doesn't really belong. But let the writer make those decisions – if you say, "Take that one out!" you are making the writing decision for her/him.

- **Look for patterns: Instead of going through a draft and pointing out every error, look for patterns of error.** If, for example, you notice wordiness, see how often it occurs; if you see one transition that troubles you, check out the others. Pointing out patterns and letting students search for specific examples will ultimately be more efficient for faculty and more useful for the students' development as a writer.
- **Beware of taking over: Avoid the following**, as easy and tempting as they may be:
 - Revising students' hypothesis or research goals
 - Rewriting individual sentences
 - Telling students to use a different word (and suggesting what the word should be)
 - Telling students to remove a paragraph or to move it to a specific place
- **Know the limitations of this type of work:** In the time you spend with a draft, you may find many writing problems. Keep in mind, however, that students may be overwhelmed (and dismayed) if presented with a list of fifteen things to work on. Therefore, it is essential that you **prioritize your comments**. Use signals such as, "If you only had time to work on one thing, I think you could increase clarity the most by considering ..." or "The three areas that gave me the most trouble as a reader were"
- **Make your organization explicit:** Consider simple visual strategies (bullet points, numbering, boldface, etc.) to keep your content clear and to emphasize your main points.
- **Refer the student to other resources:** As a scientist, no one expects you to be the expert on all issues related to writing. If you sense that there is a problem with the writing but are unsure, feel free to refer students to a textbook on scientific writing (such as Cook 1985, Day and Gastel 2006, Pechenik 2006, Williams 2003, Zinnser 2006) or to your institution's Writing Center (below). It is particularly helpful to point out several places in the thesis where problems occurs, and then let students try to resolve the issues using the resources you suggest.

Note: The strategies, class assignment schedule, and timeline for meetings with faculty readers and research mentors are designed to help students be accountable for their progress and become more independent and empowered authors. Students otherwise tend to underestimate the amount of time required for writing & revision, delay sharing early drafts with mentors, and/or expect feedback to come in the form of directives or copy-edits from the "experts".

References

- Cook, C. K. 1985. *Line by Line: How to Edit Your Own Writing*. Houghton Mifflin, Boston.
- Day, R. A., and B. Gastel. 2006. *How to write and publish a scientific paper*. Greenwood Press, Westport, Connecticut.
- Pechenik, J. A. 2006. *A Short Guide to Writing about Biology*. Longman, New York.
- Reynolds, J. A., and V. Russell. 2008. Can You Hear Us Now? A comparison of peer review quality when students give audio versus written feedback. *Writing Across the Curriculum* 19: 29-44.
- Williams, J. M. 2003. *Style: Ten lessons in clarity and grace*. Longman, New York.
- Zinnser, W. 2006. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Collins, New York.

U of M Center for Writing: Consulting is available by appointment online and in Nicholson Hall. For more information, go to writing.umn.edu/sws or call 612.625.1893.

Fall Timeline of Requested Feedback from Faculty Reader & Research Mentor

Readers: Thank you for agreeing to give formative feedback to a CBS/UHP student on a developing honors thesis. These timelines are coordinated with assignments in Biol 4960H to help facilitate timely input and revision and ensure that the drafts students share with their readers have been developed with the help of peer and/or faculty review. Our goal is that the feedback you provide early will improve the final draft, make your input more meaningful to the student, and be a more satisfying process for you! Unless otherwise specified, you should receive drafts at least one week prior to the date that feedback is requested. Students should also include revision memos from prior meetings with subsequent drafts, including a description of how feedback was/was not incorporated (and why).

	Week 1 (5-9th)	Week 2 (12-16th)	Week 3 (19-23rd)	Week 4 (26-30th)
Sept	<p>Research Mentor: Read mentor guidelines.</p> <p>Provide 3 key papers to student & discuss student's ideas for main topics of Lit. Review.</p>	<p>Research Mentor: Discuss first 5-10 papers student plans to use in the Intro. Provide/approve papers that model how the student should be writing Methods.</p>		<p>Research Mentor: Discuss Concept Map with student, answer Q's (s)he has prepared regarding thesis topics.</p>
Oct	Week 5 (3-7th)	Week 6 (10-14th)	Week 7 (17-21st)	Week 8 (24-28th)
		<p>Faculty Reader: Receive draft of 3-pg Intro from student. Use Rubric to note feedback on 3-page Intro. draft.</p>	<p>Faculty Reader: Meet with student to discuss your feedback.</p>	<p>Research Mentor: Use Rubric to provide feedback on Materials & Methods draft.</p>
Nov	Week 9 (31-3rd)	Week 10 (7-11th)	Week 11 (14-18th)	Week 12 & 13 (21-29th)
	<p>Research Mentor: Meet with student to provide feedback on Materials and Methods Draft.</p>		<p>Faculty Reader: Receive full Intro. draft. Use Rubric to provide feedback. Set up mtg with student for 1-2 weeks after Thanksgiving.</p>	<p>Research Mentor: Receive Results draft from student. Use Rubric to provide feedback on Results draft.</p>
Dec	Week 14 (5-9th)	Week 15 (12-16th)	Week 16 (19-23rd)	WINTER BREAK
	<p>Faculty Reader: Meet with student to discuss your feedback on full Intro draft.</p>		<p>Research Mentor: Receive draft of Intro, M&M and Results, set up meeting with student for Finals or Break to discuss writing Portfolio.</p>	<p>Research Mentor: Meet to discuss student's writing and progress on their research project. Student needs results by mid-March.</p>

Spring Timeline of Requested Feedback from Faculty Reader & Research Mentor (subject to change)

Jan.		Week 1	Week 2	Week 3
			Research Mentor: Meet with student to schedule meeting dates and times for the semester.	
February	Week 4	Week 5	Week 6	Week 7
	Research Mentor: Provide Feedback on Working Abstract			Research Mentor: Provide Feedback on Poster Draft 1 Meet with student to determine Results to date – thesis must be written based on what can be completed by mid-March.
March	Week 8	Week 9	Week 10	Week 11
	Faculty Reader: Provide Feedback on polished third draft of Introduction.	Spring Break	Research Mentor: Receive full thesis draft with Results to date and Discussion. Provide Feedback on Poster Draft 2.	Research Mentor: Meet with student to provide feedback on the full thesis draft. (Note: Poster due to Printing Services.)
April	Week 12	Week 13	Week 14	Week 15
		Research Mentor & Faculty Reader(s): Receive full thesis draft and revision memo. Symposium this week (TBD)?		Research Mentor & Faculty Reader(s): Provide feedback and approval on penultimate thesis draft. Sign signature sheet.
May	Week 16: Final Thesis Due on Friday, May 4th. Upload to UHP website: www.honors.umn.edu Hand in signature sheet to 20 Nicholson. Students graduating in a later term should upload their thesis draft to date to the course website and receive a “K” grade until handing in the final thesis during their term of graduation (e.g. summer, fall or spring the following year). Extensions past 5/4/12 must be approved by UHP-CBS advisor for spring degree candidates due to the need to process degrees by the Onestop deadline.			

Rubric for Faculty Feedback and Final Thesis Approval (pgs 11-19)

Please use each section as needed for review of drafts. The entire rubric will be used for final thesis approval. This rubric is based on the Duke University BioTap Biology Thesis Assessment Protocol developed in 2007 by Dr. Julie Reynolds (<http://www.biology.duke.edu/undergrad/documents/thesisrubric.pdf>), and was modified to emphasize scientific writing characteristics and abilities emphasized in the CBS Writing-Enriched Curriculum writing plan.

Introduction (1): Does the introduction make a comprehensive argument for the significance of the student’s research within the context of the current literature?

Characteristics of the Introduction:

- Includes a substantive literature review that places the student’s research within its appropriate scientific context, *and*
- Describes what is known about the topic, *and*
- Identifies the specific gaps in knowledge that the student’s project intends to address, *and*
- Makes an argument for the broader significance of his/her research when addressing these gaps.

Excellent	Acceptable	Requires major revision
The thesis reviews and accurately summarizes the relevant literature, demonstrates how the student’s research fills a gap, and presents a compelling argument for the broader significance or scientific value of the student’s research.	The thesis presents a literature review, but does not sufficiently or effectively place the student’s research within the context of current/past scientific research. The thesis may fail to explicitly present an argument for the broader significance and/or scientific value of the student’s research.	Either the thesis does not present an adequate review of the literature, OR the thesis does not make sufficient connections between the published literature and the student’s own research project to explain its significance.

Comments:

Introduction (2): Does the introduction clearly articulate the student's hypothesis and research goals?		
Characteristics of the Introduction:		
<ul style="list-style-type: none"> • Includes a research question or the goals of the project, <i>and</i> • May also include a hypothesis (if applicable) <i>and</i> • An overview of the methodological approach 		
Excellent	Acceptable	Requires major revision
The student clearly and explicitly articulates a research question or the goals of the project.	The student articulates a research question or the goals of the project, but at times in an unclear, inconsistent, or disorganized manner.	The student does not explicitly articulate a research question or the goals of the project.
Comments:		

Materials and Methods: Are the experimental methods adequately described and referenced?		
Characteristics of the Materials & Methods:		
<ul style="list-style-type: none"> • Provides sufficient details so that readers can judge the appropriateness of the experimental methods, <i>and</i> • Would allow someone to repeat the student's experiment. 		
Excellent	Acceptable	Requires major revision
The student clearly describes and references experimental methods used in the thesis work.	The student describes the experimental methods, but some may not be at an appropriate level of detail (too much or too little).	The student does not clearly describe his/her experimental methods or does so incompletely or superficially.
Comments:		

<p>Results (1): Does the thesis provide a comprehensive, understandable description of the results (or lack of results)? Results should be described in text and figures.</p>		
<p>Characteristics of Results:</p> <ul style="list-style-type: none"> • Describes the experimental rationale, approach and findings. • Interprets the results within the specific scientific context constructed in the Introduction (in relation to a hypothesis, if applicable). 		
Excellent	Acceptable	Requires major revision
Results are clearly and completely described in the text and figures. Data analysis is accurate and unbiased. The interpretation of results is insightful and the thesis explains the implications of inconsistencies, ambiguities, alternatives and/or limitations.	The thesis presents a reasonable description and interpretation of results, and mentions inconsistencies, ambiguities, limitations, but may not explain the implications of these potential problems.	There is no interpretation of the results (e.g. a simple restatement of the results) or the interpretation is superficial. Results may be minimally (incompletely) described, or described inappropriately.
<u>For theses with inconclusive results:</u> The thesis provides an insightful explanation of the reasons underlying the lack of clear results.	<u>For theses with inconclusive results:</u> The thesis provides some explanation of the reasons underlying clear results and makes an attempt to interpret the results that were obtained.	<u>For theses with inconclusive results:</u> There is little or no attempt to explain the reasons underlying the lack of clear results.
Comments:		

Results (2): Are the tables, graphs, and figures clear, effective, and informative?

Characteristics of Results:

- Written results should refer explicitly to each table or figure, *and*
- The visual elements of all tables and figures should be clear and easy to read or interpret, *and*
- The legends should provide a clear description of each table or figure and not duplicate information that is in the materials and methods.
- Appropriate choices should be made regarding how to display data (when to use a figure, what kind of figure to use, and how to organize evidence within the figure or table), *and*
- Figures, and tables should include appropriately descriptive titles.

Excellent	Acceptable	Requires major revision
The student makes appropriate choices about how to present his/her data and presents a logical sequence of evidence to support the claims. The tables and figures are exceptionally well-constructed, and the legends and titles clearly describe the visual elements.	In general, the tables figures and legends are clear and appropriate, but one or more could benefit from revision.	Many of the tables or figures are misleading, incorrect, unclear or inappropriate, and/or the legends are incomplete or unclear

Comments:

Discussion: Does the discussion provide a logical argument about the implications of findings and possible future directions?

Characteristics of Discussion:

- Briefly highlights major findings, acknowledging complexities of the data, as well as inconsistencies, limitations and alternative explanations.
- Explicitly relates the implications of their research findings (results) within the scientific context constructed in the Introduction. The narrative should draw connections between the student’s research findings and other published work.
- The implications of negative results should be discussed.
- Highlights how the project could lead to future research within the field, *and/or*
- Suggest additional experiments/alternative approaches*.
- If a student has inconclusive or incomplete results, the discussion should focus on the limitation of the results and possible explanations.

** Theses with largely inconclusive or incomplete results should focus on the latter.*

Excellent	Acceptable	Requires major revision
The thesis provides a compelling discussion of the implications of the findings (positive and negative), placing their importance within the context of current knowledge. When appropriate, the discussion recognizes that there may be multiple interpretations of the data. The thesis includes a thorough consideration of possible future studies.	The thesis makes some attempt to discuss the implications of the findings, but may not explain their significance. The thesis may mention possible future studies without explaining how they would contribute significant new knowledge to the field.	The thesis reiterates the findings from the results, but makes little or no attempt to discuss the implications of the findings or does not describe future directions for the project.

Comments:

References: Are the citations sufficient and presented consistently throughout the text and in the list of works cited?

Characteristics of the References:

- Scholarly sources are used to support thesis claims.
- The citation format should be consistent throughout the thesis, *and*
- References should be professionally presented.

Excellent	Acceptable	Requires major revision
The student makes excellent use of scholarly sources to back up his/her claims and contextualize the research project. The thesis uses a consistent and appropriate citation format and presents the list of works cited in a professional manner.	The thesis uses a citation format and presents the list of works cited in a professional manner, but there may be minor inconsistencies or errors. A few claims which should be referenced are not.	The thesis uses inconsistent citation format, is missing a number of citations, and/or presents the list of works cited in an unprofessional manner.

Comments:

<p>Overall Writing Quality: Is the writing at an appropriate level for the target audience of upper division undergraduates and faculty in the general field of biological sciences? Does it demonstrate the characteristics of strong scientific writing outlined in the CBS Writing Enriched Curriculum Writing Plan?</p>		
<p> </p>		
<p>Excellent</p>	<p>Acceptable</p>	<p>Requires major revision</p>
<p>Arguments or descriptions are direct and to the point, employing no unnecessary words. Wording is unambiguous; scientific terminology is used appropriately, with specific terms defined as needed. The author does not assume an expert level of knowledge of the reader.</p>	<p>Arguments or descriptions are usually direct, precise and concise, but some areas may need improvement. Occasionally, terminology is used inappropriately, or in a manner that assumes too much knowledge on the part of the audience.</p>	<p>A significant amount of the terminology in the thesis is either used inappropriately or is not appropriate given the audience. A significant proportion of the prose is wordy and/or ambiguous.</p>
<p>Comments:</p>		
<p>Is the thesis free of writing errors (grammar, spelling, scientific conventions such as italicizing species names, etc.)?</p>		
<p>The thesis is virtually free of obvious errors.</p>	<p>The thesis contains some errors.</p>	<p>The thesis contains many errors or is presented in a manner that does not adhere to professional standards.</p>
<p>Comments:</p>		

<p>Organization: Does the thesis organization demonstrate communication abilities for CBS graduates that were outlined in the CBS Writing Enriched Curriculum Writing Plan? Is the thesis clearly and appropriately organized? Does each section contain appropriate information (e.g. possible implications of the results are in the discussion section, not the results section)? Is the information in each section cohesive and logically organized?</p>		
<p>The thesis adheres to the IMRD organization, and the writing within paragraphs is logical and easy to follow in most cases. The background, results and discussion build a logical and scientifically contextualized narrative.</p>	<p>The thesis adheres to the IMRD organization, and the writing within paragraphs is usually logical and easy to follow in most cases. The thread of the scientific narrative is generally easy to follow but at points could be improved.</p>	<p>The thesis does not adhere to the IMRD organization, or the writing within paragraphs is frequently difficult to follow. The background and data are presented but without a clear, logical or scientifically contextualized narrative.</p>
<p>Comments:</p>		