

BioTAP

Duke University

Biology Thesis Assessment Protocol



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Preface

BioTAP is a Thesis Assessment Protocol created in response to a campus-wide initiative to promote undergraduate research at Duke University. The goals of this initiative are to increase the number of students who participate in a faculty-mentored research experience and to increase the number of students who complete an honors thesis. These goals raise interesting questions, such as:

- Assuming more students participate in research, how will faculty manage the increased workload?
- If research faculty take on the additional responsibility of mentoring students, who will provide guidance and feedback on student writing?
- How can the biology department ensure that increased participation rates do not diminish the quality of the experience, the ability of faculty to provide sufficient guidance, or the quality of student writing?
- How will the biology department know if what it is doing is successful?

BioTAP addresses these concerns in four ways.

First, **BioTAP's Protocol** simplifies the reviewing and evaluating process for faculty. The goals of this protocol are to:

1. Facilitate meaningful communication between faculty and students on early drafts of theses,
2. Help faculty focus their comments on the most substantial writing and research issues,
3. Reduce the time faculty spend line-editing student writing,
4. Encourage students to take ownership of their writing by requiring them to provide a point-by-point response to all substantial comments from each reviewer of each draft,

Second, **BioTAP's Rubrics** provide a mechanism by which students can get feedback on both their writing and their research. Rubric I assesses students' writing, and can be used not only by Research Supervisors, but also by Faculty Readers, Writing Advisors, or anyone else in the thesis' target audience. Rubric II, on the other hand, assesses students' research and is designed primarily for Research Supervisors and others with a deep understanding of the student's specific research topic. Rubric III outlines the biology department's standards of excellence that must be met for a thesis to receive the awards of Honors and High Honors.

Third, BioTAP ensures quality control by making both the assessment criteria explicit and the protocol transparent. BioTAP's rubrics promote consistency in thesis evaluations among faculty, and facilitate the decision-making process regarding the awards of Honors and High Honors.

And, finally, by making the protocol transparent, it will be easier for the department to assess where it needs to provide additional support for faculty and/or students. BioTAP is currently being used, for example, to assess whether differences exist in the overall quality of honors

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theses written by students who participated in a senior thesis writing seminar compared with those who wrote their thesis outside the context of such a course.

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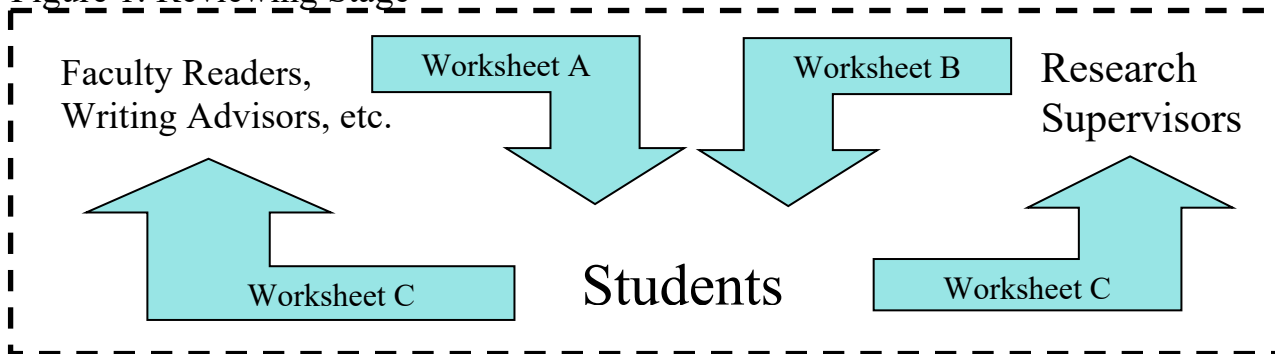
Acknowledgements

First of all, I wish to thank all the members of the biology faculty who discussed their criteria for assessing honors theses with me, either in response to an email request I sent out, as part of a focus group, or informally. Based on these conversations, I was able to distill the essential criteria by which we could collectively assess honors theses in biology. In particular, I'd like to thank Susan Alberts, Daniele Armaleo, Ron Grunwald, Dan McShea, Alec Motten, Louis Roth, Kathleen Smith, and Rytas Vilgalys. Additional thanks go to Ron Grunwald and Daniele Armaleo who wrote earlier drafts of the thesis guidelines, providing me with a great starting place for my work. I owe a debt of gratitude to Joseph Harris, Matt Serra, and Benjamin Albers, all of whom were invaluable sounding boards in the early stages of developing BioTAP. A big thanks goes out to Cary Moskovitz, Amy Sayle, and Robin Smith for their invaluable help in testing, editing, and validating this assessment tool – the final product is not only more robust due to their efforts, but the process was also more enjoyable due to their good humor. I wish to thank Robert Thompson, Dean of Trinity College at Duke University, for his financial support of this project.

BioTAP Protocol

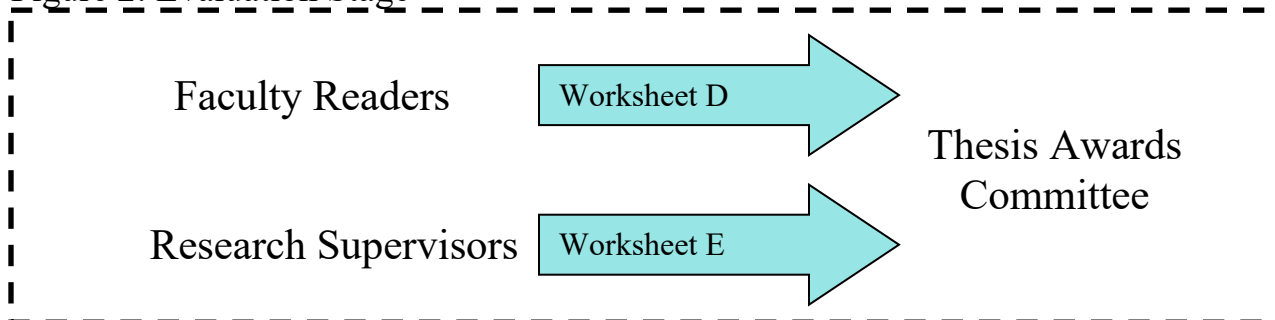
BioTAP's protocol is designed to facilitate meaningful communication between faculty and students throughout the research and writing stages, and to simplify the final evaluation of the thesis. This protocol includes two stages: the Reviewing Stage (for formative assessment) and the Evaluation Stage (for summative assessment). In the Reviewing Stage, students are expected to solicit feedback from their Research Supervisors, Faculty Readers, Writing Advisors and/or Writing Instructors using one of several worksheets (Figure 1). For each subsequent draft (including the final thesis), students are required to provide their readers with a point-by-point response to all substantial comments from each reviewer. This approach puts the responsibility for the writing process on students rather than the faculty, since the students must solicit feedback, reflect upon the value of that feedback, and make writing choices. This protocol is modeled after protocols for many peer-reviewed science journals. By engaging in this approach, students not only clarify their thinking, but also develop their writing skills.

Figure 1: Reviewing Stage



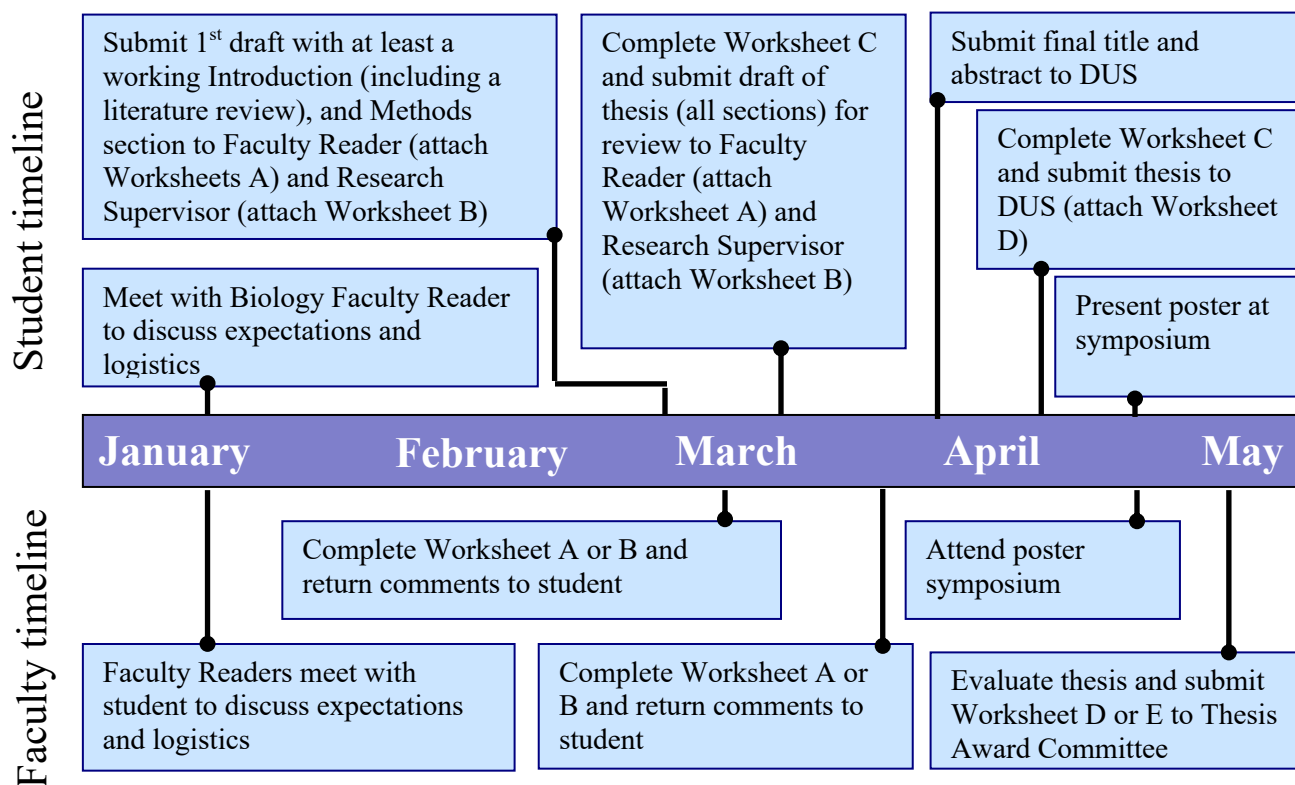
During the Evaluation Stage, on the other hand, faculty make their final assessment of the quality of the thesis, decide whether the thesis will be nominated for Honors or High Honors. Two worksheets, one for Faculty Readers and another for Research Supervisors, facilitate and standardize this process (Figure 2). All copies of these evaluation worksheets are submitted to the Thesis Awards Committee, which, based on the assessments provided by Research Supervisors and Faculty Readers, makes a recommendation to the Director of Undergraduate Studies about whether a thesis is of sufficiently high quality to be awarded either Honors or High Honors.

Figure 2: Evaluation Stage



The entire BioTAP protocol and timeline is presented in Figure 3.

Figure 3: Timeline of events for students graduating in May (see biology [webpage](#) for exact due dates)



BioTAP Rubrics

Although assessing writing is inherently subjective, BioTAP makes explicit both the biology department's expectations and the standards of evaluation. The criteria set forth in the rubrics are divided into two categories: those that relate to the student's research and those that relate to the quality of the written thesis, with the understanding that these categories are intricately linked. These criteria were selected based on input from Biology faculty through focus groups, informal conversations, and responses to an email solicitation. Additionally, this rubric is designed to make connections between the goals of Duke University's first-year writing courses (Writing 20: Academic Writing) and the capstone writing event, an honors thesis.

Dividing the rubric's criteria into two categories allows the thesis to be assessed by two groups of readers: those who can most effectively assess the quality of the research (including Research Supervisors), and those who can serve as generally knowledgeable but objective readers (including Faculty Readers). These criteria promote consistency in thesis assessment and encourage faculty to evaluate honors theses in accordance with departmental standards.

Rubric I: Assessing the writing

BioTAP Rubric I (items 1-9) assesses the student's ability to communicate clearly about their research to any member of the faculty in the biology department, including their Faculty Reader, Writing Advisor, Writing Instructor, and anyone else in the thesis' target audience. It is worth noting that items 1-5 focus on major writing issues (coherence, organization, etc.), whereas items 6-9 focus on more minor writing issues (mostly associated with correctness). For this reason, items 1-5 will be weighted more heavily than items 6-9 in the final evaluation. To provide feedback to students during the drafting process, Faculty Readers will use **BioTAP Worksheets A**, whereas Research Supervisors will use **BioTAP**

Worksheet B. Although these worksheets provide a basic structure for faculty feedback, additional feedback –whether written, digitally recorded audio, and/or in person – will also help students through the drafting and revision process.

PLEASE NOTE: Best practices in the teaching of writing discourage faculty from extensive line-by-line editing of student writing. Although this practice is commendable in terms of its intent and may improve the current piece of writing, it is extraordinarily time consuming and is less effective than other kinds of feedback in helping students improve their future writing.

-
1. ***Is the writing appropriate for the target audience?*** Honors theses should address non-specialist readers with an understanding of basic biology—specifically, any faculty member in the biology department regardless of sub-discipline. Students often struggle to realize that while faculty may be experts within their field of research (e.g., genetics, ecology, development), they are rarely familiar with the language and conceptual nuances of other highly-specialized fields of study. Students should assume their readers understand basic biological processes (such as photosynthesis), but they cannot assume that readers readily remember all the details (such as mechanisms of alternative pathways). Therefore, students should limit their use of jargon, and should explain or define all key terms and concepts that are specific to their sub-field. This item will be assessed using the following standards:
- **Inadequate:** The thesis is written with excessive jargon or is greatly lacking in definitions and explanations, making the research inaccessible to non-specialist readers.
 - **Adequate:** The thesis includes some useful definitions or explanations, but some key terms or concepts are still challenging for the non-specialist reader. Non-specialist readers are able to follow the main themes of the thesis, but the writer has not made this task easy.
 - **Excellent:** The thesis has sufficient definitions and explanations to make the research accessible and engaging to non-specialist readers.

2. Does the thesis make a compelling argument for the significance of the student's research within the context of the current literature? The thesis should contain a substantive literature review that places the student's research within its appropriate scientific context. This literature review should not only describe what is known about the student's topic, but should also identify the specific gaps in knowledge that the student's project intends to address. The student should make an argument for the broader significance of his/her research when addressing these gaps. This item will be assessed using the following standards:

- **Inadequate:** 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.
- **Adequate:** The thesis presents a literature review, but either does not place the student's research within the context of current or past scientific research, or does not explicitly present an argument for the broader significance and/or scientific value of the student's research.
- **Excellent:** The thesis reviews the 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.

3. Does the thesis clearly articulate the student's research goals? The student's research statement should include a research question or the goals of the project, and may also include a hypothesis (if applicable) and an overview of the methodological approach. This item will be assessed using the following standards:

- **Inadequate:** The student does not explicitly articulate a research question or the goals of the project.
- **Adequate:** The student articulates a research question or the goals of the project, but at times in an unclear, inconsistent, or disorganized manner.
- **Excellent:** The students clearly and explicitly articulates a research question or the goals of the project.

4. Does the thesis skillfully interpret the results? Student should interpret their results within the scientific context constructed in the Introduction (this should be done in relation to a hypothesis, if applicable). Student writers often overlook the fact that scientific data has complexities that often defy a single interpretation. Therefore, we are also assessing the student's ability to acknowledge this complexity, as well as discuss plausible inconsistencies, uncertainties, alternative explanations, counterintuitive evidence, and/or limitations of his/her results.

NOTE: It is not uncommon for students to have inconclusive or incomplete results – this is perfectly acceptable, and students should not try to obfuscate this fact. We do not expect a

student to interpret inconclusive or incomplete results *per se*. Instead, in these cases, we expect students to focus their discussion on the limitations of their results. Hence, if the thesis had inconclusive or incomplete results, please apply the standards outlined in the alternative rubric (4b). Otherwise, this item will be assessed using the standards outlined in 4a:

Rubric 4a (for theses with conclusive and complete results)

- **Inadequate:** There is no interpretation of the results (e.g., a simple restatement of the results) or the interpretation is superficial.
- **Adequate:** The thesis presents a reasonable interpretation of the results, and **mentions** inconsistencies, uncertainties, alternative explanations, counterintuitive evidence, and/or limitations of the results, but does not explain the implications of these potential problems.
- **Excellent:** The interpretation of results is insightful, and the thesis **explains** the implications of plausible inconsistencies, uncertainties, alternative explanations, counterintuitive evidence, and/or limitations of the results.

Rubric 4b (for theses with inconclusive or incomplete results)

- **Inadequate:** There is little or no attempt to explain the reasons underlying the lack of clear results.
- **Adequate:** The thesis provides a reasonably thorough explanation of the reasons underlying the lack of clear results, and includes a reasonable attempt at interpreting whatever results were obtained.
- **Excellent:** The thesis provides an insightful explanation of the reasons underlying the lack of clear results.

5. Is there a compelling discussion of the implications of findings? We expect students to explicitly explain the implications of their research findings within the scientific context constructed in the Introduction. One way students accomplish this is by making the connections between their results and other published results. Another way is by indicating how their projects could lead to future research within their field of inquiry, which could include suggestions for additional experiments and/or alternative approaches. It is appropriate for students to speculate – this is their opportunity to demonstrate understanding of the big picture.

NOTE: Although we *do* expect a discussion of the implications of negative results, this is not appropriate for inconclusive or incomplete results. In these latter two cases, we expect students to focus their discussion on future directions. For theses with inconclusive or incomplete results, please use alternative rubric 5b. Otherwise, this item will be assessed using the standards described in 5a:

Rubric 5a (for theses with conclusive and complete results)

- **Inadequate:** The thesis makes little or no attempt to discuss the implications of the findings or does not describe future directions for the project
- **Adequate:** The thesis makes some attempt to discuss the implications of the findings, but does not explain their significance OR the thesis mentions possible future studies without explaining how they would contribute significant new knowledge to the field.
- **Excellent:** The thesis provides a compelling discussion of the implications of the findings, including a thorough consideration of possible future studies.

Rubric 5b (for theses with inconclusive or incomplete results)

- **Inadequate:** The thesis makes little or no mention of future directions or alternative approaches for the project.
- **Adequate:** The thesis provides some discussion of possible future studies or alternative approaches without explaining how they would contribute significant new knowledge to the field.
- **Excellent:** The thesis provides a thoughtful and thorough discussion of possible future studies or alternative approaches.

6. *Is the thesis clearly organized?* The thesis should be organized in the standard IMRaD fashion (Introduction, Methods, Results, and Discussion). Within paragraphs, sentences should be cohesive and logically organized. This item will be assessed using the following standards:

- **Inadequate:** The thesis does not adhere to the IMRaD organization, or the writing within paragraphs is frequently difficult to follow.
- **Adequate:** The thesis adheres to the IMRaD organization, and the writing within paragraphs is usually easy to follow.
- **Excellent:** The thesis adheres to the IMRaD organization, and writing within paragraphs is easy to follow in almost all cases.

7. *Is the thesis free of writing errors?* The mechanics (spelling, grammar, punctuation) and presentation of the thesis should be correct and professional. This item will be assessed using the following standards:

- **Inadequate:** The thesis contains excessive errors or is presented in an unprofessional manner.

- **Adequate:** The thesis contains some errors.
- **Excellent:** The thesis is virtually free of obvious errors.

8. Are the citations presented consistently and professionally throughout the text and in the list of works cited? The citation format should be consistent throughout the thesis, and references should be professionally presented. This item will be assessed using the following standards:

- **Inadequate:** The thesis uses inconsistent citation format, is missing citations, or presents the list of works cited in an unprofessional manner.
- **Adequate:** The thesis uses consistent and appropriate citation format and presents the list of works cited in a professional manner, although there may be some minor inconsistencies or errors.
- **Excellent:** The thesis uses consistent and appropriate citation format and presents the list of works cited in a professional manner.

9. Are the tables and figures clear, effective, and informative? Tables and figures should be consecutively numbered, cited in consecutive order, and the captions should be in the appropriate location (above tables, below figures). The thesis should refer explicitly to each table or figure (e.g., "...reveals an upward trend (Figure 1).") and the visual elements of all tables and figures (including photographs) should be clear and easy to read or interpret. The captions should provide a clear description of the table or figure. This item will be assessed using the following standards:

- **Inadequate:** Many of the tables or figures are misleading, incorrect, unclear, or inappropriate, or the captions are incomplete or unclear.
- **Adequate:** In general, the tables, figures and captions are clear and appropriate.
- **Excellent:** The tables and figures are exceptionally well constructed, and the captions clearly describe the visual elements.

Rubric II: Assessing the research

Seldom in our professional lives do we have the luxury of having a mentor who knows enough about our research projects to ensure the accuracy of our analyses, and writing a thesis is one of those times. Therefore, BioTAP Rubric II (items 10-13) assesses the accuracy and completeness of the student's research. This part of the rubric is appropriate only for experts in the student's field of research, such as the student's Research Supervisor. Research Supervisors should use **BioTAP Worksheet B** to provide feedback to students during the drafting process. Although this worksheet provides a basic structure for faculty

feedback, additional feedback –whether written, digitally recorded audio, and/or in person – will also help students through the drafting and revision process.

PLEASE NOTE: Best practices in the teaching of writing discourage faculty from extensive line-by-line editing of student writing. Although this practice is commendable in terms of its intent and may improve the current piece of writing, it is extraordinarily time consuming and is less effective than other kinds of feedback in helping students improve their future writing.

10. Does the thesis represent the student's original scientific research? To graduate with honors, students should demonstrate the ability to conduct original research. For the award of High Honors, we are especially interested in identifying those students whose work represents significant scientific innovation or insight. This item will be assessed using the following standards:

- **Inadequate:** The thesis represents little more than the student's ability to follow the instructions of a research supervisor (including graduate student/post-doc supervisors). The student made little (if any) significant contribution to the development of the project or the research agenda.
- **Adequate:** The thesis demonstrates the student's ability to contribute his/her own thoughts and ideas into an original research project.
- **Excellent:** The thesis not only represents the student's original thoughts and ideas, but also demonstrates exceptional innovations, insights, or creativity.

11. Is the literature review accurate and complete? This item will be assessed using the following standards:

- **Inadequate:** The literature review is incomplete, missing many salient articles.
- **Adequate:** Although the literature review may have missed a few relevant articles, the literature review nevertheless makes a strong argument for the relevance of the student's research in the context of the current literature.
- **Excellent:** The literature review fully and accurately summarizes the salient literature.

12. Are the methods appropriate, given the student's research question? Often, students will use the methods they are most familiar with rather than the methods that are most appropriate for addressing their research question. *Note: If the student's research focused on testing new methods, then students should not be evaluated on whether or not the methods were effective, but rather on the appropriateness of their approach to testing new methods.* This item will be assessed using the following standards:

- **Inadequate:** The methods chosen are ineffective and/or inefficient, given the student's research question.
- **Adequate:** The methods selected were appropriate, given the student's research question.
- **Excellent:** The student demonstrated creativity or innovation in selecting a methodology that would not only address his/her research question, but would also answer that question efficiently or highly effectively.

13. Is the data analysis appropriate, accurate and unbiased? Did the student accurately and appropriately analyze the data? Were the interpretations of the results accurate and unbiased? This item will be assessed using the following standards:

- **Inadequate:** The data analysis was inappropriate, inaccurate, or biased.
- **Adequate:** The data analysis was appropriate, accurate and unbiased.
- **Excellent:** The data analysis was not only appropriate, accurate and unbiased, but the approach was also particularly insightful or proposed creative new approaches for future research in this field.

Rubric III: Standards for awarding Honors

BioTAP Rubric III is a holistic assessment of the overall quality of a student's thesis. Both Faculty Readers and Research Supervisors will use this rubric in their final evaluation of the thesis.

PLEASE NOTE: BioTAP Worksheets D (to be completed by Faculty Readers) and E (to be completed by Research Supervisors) will not be returned to students, and no additional comments are required on the worksheet or on the thesis.

For a thesis to be considered for the award of **Honors**, the student must have demonstrated ***proficiency in scientific research***, as demonstrated by:

- An original, independent, and substantive research question,
- Care in data collection and analysis,

and have produced a written thesis that achieves the following:

- Is written to a broad audience of biologists (rather than only specialists in the field of research),
- Situates the research in the appropriate scientific context,
- Explicitly interprets results in relation to the hypothesis,
- Discusses inconsistencies, uncertainties, or limitations of the results, and
- Is coherent, free of errors, and otherwise professionally presented.

Exceptional theses meet all the criteria above, plus demonstrate:

- Scientific innovation, insight, or creativity,
- Exceptional care in data collection or analysis.

BioTAP Worksheets

BioTAP Worksheet A: Feedback from Faculty Readers

To be completed by student

Student's name _____

Date _____ Draft Number _____

Thesis title _____

Faculty Reader _____

To be completed by Faculty Reader

	The writing is too incoherent to assess	No	Somewhat	Yes
1. Is the writing appropriate for the target audience?				
Comments:				
2. Does the thesis make a compelling argument for the significance of the student's research within the context of the current literature?				
Comments:				
3. Does the thesis clearly articulate the student's research goals?				
Comments:				

4. Does the thesis skillfully interpret the results?				
Comments:				
5. Is there a compelling discussion of the implications of findings?				
Comments:				
6. Is the thesis clearly organized?				
Comments:				
7. Is the thesis free of writing errors?				
Comments:				
8. Are the citations presented consistently and professionally throughout the text and in the list of works cited?				
Comments:				

9. Are the tables and figures clear, effective, and informative?				
Comments:				

Additional comments from Faculty Reader:

BioTAP Worksheet B: Feedback from Research Supervisor

To be completed by student

Student's name _____

Date _____ Draft Number _____

Thesis title _____

Research Supervisor _____

To be completed by Research Supervisor

	The writing is too incoherent to assess	No	Somewhat	Yes
Feedback on writing				
1. Is the writing appropriate for the target audience?				
Comments:				
2. Does the thesis make a compelling argument for the significance of the student's research within the context of the current literature?				
Comments:				
3. Does the thesis clearly articulate the student's research goals?				
Comments:				

4. Does the thesis skillfully interpret the results?				
Comments:				
5. Is there a compelling discussion of the implications of findings?				
Comments:				
6. Is the thesis clearly organized?				
Comments:				
7. Is the thesis free of writing errors?				
Comments:				
8. Are the citations presented consistently and professionally throughout the text and in the list of works cited?				
Comments:				

9. Are the tables and figures clear, effective, and informative?				
Comments:				
Feedback on research				
10. Does the thesis represent the student's original scientific research?				
Comments:				
11. Is the literature review accurate and complete?				
Comments:				
12. Are the methods appropriate, given the student's research agenda?				
Comments:				
13. Is the data analysis appropriate, accurate and unbiased?				
Comments:				

Additional comments from Research Supervisor:

BioTAP Worksheet C: Student response to feedback

To be completed by student

Student's name _____

Date _____ Draft Number _____

Thesis title _____

To facilitate the evaluation of revised manuscripts, we ask that students provide a concise, point-by-point listing of the significant changes that they made in response to each reviewer's comments. List each major comment you received in this table and identify the reviewer (please number each comment). Then, advise your readers about what changes you made in response to the reviewers' comments (and where these changes were made in the revised manuscript). Alternatively, you may rebut any challenges you consider inappropriate provided that you explain why. Minor comments should not be listed below, but you should attend to them in your revision, as they will undoubtedly improve the quality of your writing.

Summary of readers comment/Reader	Student response	Location in revised thesis
<i>Examples:</i> 1. My Faculty Reader said she didn't see the relevance of the article by Smith and Jones (2002) to my research.	<i>I rewrote the introduction to the paragraph in which I reviewed Smith and Jones' research, making it more explicit that this research influenced the choice of methods that are commonly used in this field.</i>	<i>Literature review (in Introduction)</i>
2. My Research Supervisor said he didn't think I needed to provide so many background details in the Introduction.	<i>I discussed this with my Faculty Reader who said that as an outside reader, she appreciated the extended background section. So, I decided to keep all the details I presented in the background section, but to revise it for conciseness.</i>	<i>Introduction</i>

Attach additional sheets as is necessary.