

# THESIS MANUAL

Molecular and Cell Biology (MCB)

Department of Biological Sciences

Quinnipiac University

Hamden, CT

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## SECTION 1

### AN INTRODUCTION TO THE MASTERS THESIS

Graduate education allows students to continue their professional development in specific topic areas. The reasons for obtaining a master's degree are varied; students may wish to increase their understanding of a specific area, change career paths or strengthen their resume for acceptance to doctoral program such as medical school, dental school or veterinary school. Graduate school demands that students think critically about the material they are learning, to be more responsible for obtaining knowledge independent of their professors and to participate in all aspects of their educational journey. Students who earn a MCB Masters degree will finish the program with an awareness of the current body of knowledge in the field of molecular and cell biology and the scientific techniques associated with molecular biology research.

The path to a master's degree can follow one of two pathways: a thesis track or a non-thesis track. This manual will focus on the requirements for the thesis track of a Master's Degree in Molecular and Cell Biology in the Department of Biological Sciences. The choice to follow the thesis track and undertake a research project should stem from the desire to make an original contribution to knowledge through research. Students must meet a minimum Graduate GPA requirement (3.5) to undertake a thesis project. They must also have successfully completed a required Lab Assessment Practical Exam (taken during the 2<sup>nd</sup> semester in Bio 605) before they may start Independent Research.

The path to a master's thesis involves significant laboratory research under the guidance of a mentor or Thesis Advisor. The process involves enrollment in 3 courses with different objectives. The typical timeline is to take BIO 649 in the spring of the first year or summer between first and second year, BIO 650 in the penultimate semester (usually fall), and BIO 651 in the final semester of the program (usually spring). In the first course, BIO 649, students spend most of their time reading scientific literature to form their thesis question(s) and conducting preliminary experiments. In the second course, BIO 650, students will conduct research towards their master's degree. In the final course, BIO 651, students will complete their research, finish the written thesis, prepare an oral presentation of their thesis and present a thesis defense. Before any of this can happen, a student must find a research mentor/Thesis Advisor who is willing to sponsor the thesis research in their lab. This will ideally be done with guidance from academic counselor and MCB program director (who will need to approve the proposal). The thesis advisor can be a faculty member at Quinnipiac University, a supervisor at a biotechnology company or a mentor at a research institute but will need to be approved by MCB program director. Once a suitable thesis advisor has been identified, the student will obtain and complete a "Proposal for Independent Study" from the MCB program director, in order to seek registration in Bio649 (Independent Study for Thesis). See guidelines for BIO 649 Independent Study for Thesis for more information. The MCB program director will approve and register student in BIO 649 (2 credits). If the proposal is declared incomplete or otherwise a poor fit for the scope of the department, the program director will meet with student and/or advisor and suggest alterations or alternatives. Note that the ability to choose the thesis track is dependent on available program resources.

[BIO 649: Independent Study for Thesis](#)

When taking BIO 649 (2 credits), students spend at least 6 hours a week reading original research papers and conducting preliminary experiments in order to devise a novel research project that is supported by the research of the Thesis Advisor. Towards the end of BIO 649, students will form a Thesis Advisory Committee whose role is to support and offer guidance to the student. The composition of the Thesis Advisory Committee must be approved by the MCB Director. The student will write up a proposal that defines the research topic, places the research in the context of the field, explains the techniques and tools that will be used to gather and analyze the data, clearly states the experimental question(s) and hypotheses, gives a time table for completion and postulates on the possible outcomes of the research. The written thesis proposal is presented to the Thesis Advisory Committee and it is orally defended the end of BIO 649. If the project is approved, the student will move on to the second step of a master's thesis, Thesis I (BIO 650).

#### BIO 650: Thesis I

During BIO 650 (4 credits), students will perform the majority of their scientific research. It is expected that students will work in the lab approximately 10-12 hours per week. Towards the end of BIO 650, students will submit an updated research proposal to their Thesis Advisory Committee and meet with their Thesis Advisory Committee to present their research to date. At the Thesis Advisory Committee meeting, students will also outline what experiments will be performed in order to complete the research portion of their thesis work. If the student has shown progress in their research and they are able to defend their work, students will be allowed to move on to the last phase of their thesis work, Thesis II (BIO 651).

#### BIO 651: Thesis II

In BIO 651 (4 credits), students will conclude the experimental phase of their research and will rigorously analyze the collected data to see if a clear answer to the original question is apparent. Conclusions will be drawn and the implications for the work will be deduced. Next, the student will document their thesis research in a written thesis. At the end of BIO 651, students will defend their written thesis in a public oral presentation. If a student successfully defends their thesis, they are awarded a master's degree in Molecular and Cell Biology.

The written thesis will be comprised of an introduction, materials and methods, results, discussion and reference sections. The specifics for each section can be found in Section 3 of this manual.

## SECTION 2

### THE ADMINISTRATIVE STEPS FOR THE THESIS PROCESS

#### Topic Selection and Thesis Advisory Committee

The first step in undertaking thesis research is to find a principal investigator who is willing to allow you to perform thesis research in their lab. The thesis advisor can be a tenure-track professor at Quinnipiac University, a researcher in an industrial setting or hospital or an individual at another academic setting. The thesis advisor must be approved by the MCB program director. The next step is to formulate the thesis question, including the key hypothesis(es) being tested. The process of defining a thesis question and writing a thesis proposal begins with an extensive review of literature in the area of the thesis advisor's research. The thesis question should be based upon the thesis student's interests as well as those of the thesis advisor. The thesis topic typically reveals itself after exhaustive reading of primary literature in the thesis advisor's area of interest. Many times, the thesis advisor may have ideas they would like to explore and therefore can suggest possible thesis projects as well. In signing up for BIO 649 mentee and mentor agree on a thesis topic to explore. Writing up a detailed Thesis Proposal and selection of Thesis Advisory Committee selection happens during BIO 649.

#### Thesis Advisory Committee

The Thesis Advisory Committee has two responsibilities: a) to advise and guide the graduate student through the thesis process and b) to maintain the standards of the graduate program.

The thesis advisory committee will also assist the student, assess the student's progress and decide on student progression. The typical thesis advisory committee is composed of three voting members, two of whom must be from the Biological Sciences department: the thesis advisor, a Quinnipiac University tenured faculty member from the Biology Department and one other Quinnipiac faculty member. The committee may contain additional non-voting faculty members who will serve in an advisory capacity. The MCB Program Director will also attend all committee meetings in a supervisory capacity. Students will consult with their thesis advisor and with the MCB Director to decide on the composition of their Thesis Advisory Committee. The composition of the Thesis Advisory Committee, including any exceptions, must be approved by the MCB Director.

#### Thesis Advisor Responsibilities

The Thesis Advisor is the direct project mentor for all thesis coursework (BIO 649, BIO 650 and BIO 651). The thesis advisor will provide the student with close support for their scientific research and in the generation of a formal thesis proposal. The Thesis Advisor's duties include the following:

- Confirm that the student is familiar with and has received training concerning the handling of dangerous materials, laboratory or fieldwork safety, as well as the ethics and standards involved with scientific research.
- Determine whether the student's research project requires IRB/IACUC/IBC/RCR training or approval and ensure the student receives the proper training or approval before beginning research.

- Work closely with the student to develop a feasible thesis project and provide assistance in research methods and data analysis.
- Work with the student to develop a reasonable timeline for the completion of the thesis project.
- Meet regularly with the student to evaluate the progress of his/her research, to assist with troubleshooting and provide support.
- Inform the Thesis Advisory Committee of any substantial divergence from the approved timeline.
- Approve the student's thesis work or presentations prior to review by the Thesis Advisory Committee.

#### MCB Student Responsibilities

As the author of the project, the student is ultimately responsible for the design and execution of the thesis project through all phases. The duties and responsibilities of the student include, but are not limited to, the following:

- Work with the thesis advisor to develop the thesis idea, proposal, experimental methods and a reasonable timeline for completion of experiments
- Work with the thesis advisor to identify and secure appropriate Thesis Advisory Committee members
- Schedule regular meetings with the thesis advisor to discuss the project and its progress
- Be familiar with the university policies on academic honesty and integrity



(<https://www.qu.edu/content/dam/qu/documents/policies/academic-integrity-policy.pdf>).

Misconduct in these areas will be treated seriously, and can result in academic dismissal.

- Make certain you understand the proper precautions to be taken when working with chemicals, reagents and lab equipment. Remember to ask if you are ever uncertain how to proceed in a situation.
- Be aware of Thesis Advisory Committee meeting deadlines and your defense date and submit written materials to committee members at least one to two week(s) before any meeting.
- Be proactive in your education. Take the initiative to work hard, be precise, learn from your mistakes and grow as a scientist. Think critically about your research and take the time to write an outstanding thesis manuscript.

## Course Progression

### Step 1: BIO 649: Independent Study for Thesis

**Registration:** In order to register for BIO 649 (2 credits), students must identify a thesis advisor with whom they will work with on their thesis project and seek approval for registration from MCB Program Director. Registration for BIO649 requires that students complete a BIO649 registration (The “BIO 649 Independent Study” form can be obtained from the MCB website or from the Program Director) which will include a description (1-3 paragraphs) of thesis topic (by agreement with mentor) and evaluation criteria (completed by mentor). The thesis description must include a statement of thesis goal as well as specific aims. At least 1 aim must consist of analysis and/or manipulation of data at the biomolecular, cellular or sub-cellular level. This form will be evaluated by Program Director and by Dean. If approved, student will be pre-registered

for class. During BIO 649 students are expected to spend at least 6 hours a week reviewing literature, conducting preliminary research, developing a research question and writing a thesis proposal. During BIO 649, students will also assemble their Thesis Advisory Committee, have the Thesis Advisory Committee approved by the MCB Director and schedule a meeting of the Thesis Advisory Committee towards the end of the semester. The written thesis proposal will be submitted to Thesis Advisory Committee at least 1 week before the Thesis Committee meeting.

### Written Proposal

Once a student has been approved for BIO 649 and has secured a thesis advisor, the student is able to register for BIO 649. Throughout BIO 649, the student will work with the thesis advisor to research and write a thesis proposal. The proposal should have the following sections: Introduction & Background, Aims, (Expected Outcomes), Materials and Methods/Experimental Approach, Predicted Timeline, any Preliminary Results and References. The Introduction should contain a statement of the problem and goals of the thesis, followed by a literature review. In the literature review, students will explain the historical development of the thesis topic, the current state of knowledge in the topic subject, including alternative and opposing theories, as well as areas of uncertainty. The Introduction should end with the background for your thesis research; it should include the rationale for the thesis project, your general hypotheses and it should convince the reader that the thesis project is worth doing. The Aims should be broken down by the area of research you are conducting. At least 1 aim must consist of analysis and/or manipulation of data at the biomolecular, cellular or sub-cellular level. The Expected Outcomes includes the general way you will test each aim and the expected outcomes. The Experimental Approach/Materials and Methods is a description of the methods and assays you will use to study each aim. This section can include techniques for data

collection and data analysis. The Predicted Timeline should include what you are going to accomplish and how long you anticipate it will take to complete each aim. In the Preliminary Results section, you will include any experiments results you have obtained that establish techniques that will support the aims of the project as well as your laboratory technical skills. This will help committee evaluate if the project aims are feasible and if student has developed or is developing technical skills necessary for a successful thesis. Finally, the proposal will end with a References Cited section where each paper cited in the proposal will be properly referenced. CSE (Citation-Sequence or Name-Year) is the preferred format. The proposal should be at least 10 pages in length.

### Oral Presentation

The student will give an oral Powerpoint presentation to your Thesis Advisory Committee explaining: the literature-based background on your research topic; the main thesis goal/question; the main hypothesis(es) being tested; the experimental design proposed to answer these questions; a reasonable timeline to complete the thesis; and preliminary data. The presentation should not simply be a reading of the written proposal, but instead a true “lecture” where you introduce and emphasize the important points of the proposal. The oral proposal should be 30-50 minutes in length including questions from the committee. Upon completion of the presentation, the Thesis Advisory Committee will discuss the student’s understanding of their proposal and determine if the proposal is a feasible research project at the masters level and assign a grade. With the completion of the first committee meeting, the Thesis Advisory Committee will counsel the student on how to proceed. Suggestions on additional literature to cover or alternative techniques to employ may be made. The Thesis Advisory Committee, in consultation with the thesis advisor, will assign a grade for BIO 649, which the program director will communicate to the registrar. If a passing grade is earned (B or higher), the student may

progress on to BIO 650 Thesis I. If a grade of a B- or lower is earned or the committee determines that the project is unlikely to yield a successful Masters thesis, the student will not be permitted to continue on with a thesis masters, and the student will be switched to the non-thesis masters track.

### Step 2: BIO 650: Thesis I

The purpose of BIO 650 (Thesis I) is to allow MCB students to conduct Master's thesis research. After successfully completing the Thesis Independent Study (BIO 649), students may register for BIO 650 Thesis I ("Thesis Form" can be obtained from the Director's or Program Coordinator's office). BIO 650 is considered the main data collection phase of the thesis project. It is expected that you will complete a considerable amount of your research during Thesis I. For a 4 credit experience, students are expected to be in the lab working about 10-12 hours per week. At the end of BIO 650, you will present a progress report (oral and written) to your committee (typically during the last 2 weeks of classes). The format will be similar to that used in BIO 649 for your proposal (see below for details). The committee will decide if you may progress to Thesis II, assign a grade, and determine whether or not an additional mid-semester follow-up meeting should be scheduled for the following semester.

Written Progress Report

The BIO 650 written document is an extension of the BIO 649 proposal. Typically, this means incorporating any changes or edits recommended by the Thesis Advisory Committee during your first meeting. If any aims have changed, these would be noted in the document. Any new methods used should be included. The timeline presented at the end of BIO 649 should be updated to indicate which tasks have been completed, which are in progress and which still need to occur. Finally, a Progress section should be added where new data is presented and future experiments are discussed. The Progress section will have data tables or figures and include a detailed description of what you have accomplished so far. This document should be approximately 10-20 pages long, double spaced. The committee will use the Bio 650 report to assess whether or not the student is on track, in terms of writing skills, to successfully write a thesis during Bio 651.

### Oral Presentation

The student should schedule the second Thesis Advisory Committee Meeting towards the end of the semester (BIO 650). A written progress report should be distributed to the Thesis Advisory Committee at least 1 week prior to the Thesis Advisory Committee Meeting. This thesis meeting will begin with a formal “stand up” presentation. The oral presentation for Thesis I will include the background information from BIO 649 and the specific aims. The focus should be on presenting the data you have collected so far. You want to highlight the experiments and results you, specifically, have done and provide an update on where the research progression is in terms of the timeline approved at the first committee meeting. You should also include a discussion of the experiments you will perform to finish up your research during Thesis II. This presentation should last approximately 30-50 minutes.

Upon completion of the proposed presentation, the committee will discuss the student's data and progress to date. With the completion of the second thesis meeting, the Thesis Advisory Committee will counsel the student on how to proceed. The Thesis Advisory Committee, in consultation with the thesis advisor, will assign a grade for BIO 650, which the program director will communicate to the registrar. If a grade of a B or higher is earned, then the student will be permitted to continue on with a thesis masters and register for Thesis II (BIO 651). If a grade of a B- or lower is earned or the committee determines that the project is unlikely to yield a successful Masters thesis, the student will not be permitted to continue on with a thesis masters, and will be switched to the non-thesis masters track.

### Step 3: BIO 651: Thesis II

The purpose of BIO 651 is to allow MCB students to finish their research, to produce a written master's thesis and to defend their Thesis with an oral presentation. After successfully completing Thesis I (BIO 650), students may register for Thesis II (BIO 651) ("Thesis Form" must be obtained from Director or Program Coordinator's office or the MCB program website). Students will continue with the data collection phase of the thesis project during the first half of the semester (approximately 6-10 weeks). Students should also be working on the initial draft of their written thesis during the first part of Thesis II. Students should keep their Thesis Advisory Committee members continually updated on the progress of their research. Students should consult with their Thesis Advisor to determine when data collection is complete. Once the data collection phase is complete, the student will spend the remainder of the semester finishing the written thesis and preparing their oral presentation. Copies of the initial draft of the thesis should be emailed to the Thesis Advisory Committee at least two weeks before the thesis defense.

## Written Thesis

Your final written master's thesis should contain the following sections: Introduction (which includes Background, Aims and Rationale), Materials and Methods, Results, Discussion (which includes Future Directions) and References. The Introduction contains the background information related to your literature review. The Background discusses the rationale for the thesis project in relation to what is known so far and introduces the main hypothesis (es) under investigation in the thesis. The Aims is a list of the specific aims of the project. The Rationale includes the methods used to investigate each specific aim and relates to the main hypothesis (es) being tested in the thesis. The Materials and Methods describes the sequence, techniques, conditions and tools actually used in the thesis research for data collection and analysis. The Results section is a presentation of the data collected during your research, without interpretation. Data should be presented in an organized fashion using figures, tables and charts. The Discussion section is where the data is rigorously analyzed and conclusions are drawn. A discussion on whether the original goals of the project have been met can be included along with speculation on the implications for the research. Future Directions includes suggestions for future experiments that will complement the results presented; any future lines of research that stem from the project can also be presented. The References section includes all citations used in the thesis, preferably in CSE format (Citation-Sequence) or (Name-Year). A final draft of the written thesis should be distributed to the Thesis Advisory Committee at least two weeks prior to the scheduled thesis defense date. The Thesis Advisory Committee will provide feedback on the thesis which is incorporated into the final thesis.

## Final Thesis Advisory Committee Meeting & Thesis Defense

The final thesis defense needs to be held before the end of the semester in which you will graduate. The final thesis defense will begin with a formal presentation of the thesis by the student (minimum 40 minute duration). In all cases, the thesis defense will be publicized and be open to any interested party. Therefore, the student's presentation should include a basic introduction to the topic area. All parts of the thesis should be covered including the literature review, rationale, materials and methods, results, data analysis and conclusion. As before, the presentation should not be a simple reading of the written document but a true lecture emphasizing the strong and exciting points of the project. The student will field questions from the committee and the general audience immediately after the presentation.

After an appropriate interval, the Thesis Advisor or MCB representative will dismiss the audience and call the meeting into executive session. At this time, the committee will pose their final questions to the student and suggest their last corrections, if needed. The student will then be dismissed and the thesis advisory committee will vote on the final acceptance of the thesis and on a course grade, which the program director will communicate to the registrar. Immediately thereafter, the student will be informed of their decision and in all likelihood be given congratulations for a job well done. If there are no corrections, the signature page of the thesis will be signed by all committee members. The signature of the MCB Director is also required to indicate acceptance of the thesis.



## Typical Timeline

BIO 649	Tasks: Preliminary Experiments, write thesis proposal		Notes
Late May - Mid June	Literature Review and Experimental Planning		
June - July	Preliminary Experiments and write draft of thesis proposal		
June - July	Choose Committee Members		Choose and invite thesis committee members in consultation with thesis advisor and MCB Program Director
Early-Mid August	Submit written thesis proposal to committee		
End of August	Oral Thesis Presentation		
BIO 650	Tasks: Bulk of Experimental work and data analysis		
All semester	Experiments and Data Analysis		
December Mid December	Submit written thesis project update to committee		
	Oral Thesis update to committee		
BIO 651	Tasks: Finish data collection and analysis, write thesis	# of Weeks	Notes
January 1 - February 28	Experiments and Data Analysis	8-10	(some experiments can be finished later during thesis editing phase)
March 1 - 31	Thesis 1st Draft Writing	4	Concentrate 100% on writing. Avoid experiments. Identify proofreaders (i.e. learning commons, labmates, professors)
April 1 - 15	Thesis 1st Draft Revisions (to advisor)	2	Main focus: thesis edits (as advisor provides them). If time allows: finish up experiments, data analysis.
April 15 - 30	Prepare Oral Thesis Presentation	2	Main focus: Oral Presentation. If time allows: finish up any remaining experiments i.e. (for potential inclusion in oral defense and/or final thesis)
May 1 - 13	Thesis Final Revisions (to committee)	<2	Main focus: final edits to Thesis. If time allows: finish up any remaining experiments (i.e. for paper)

## SECTION 3

### MANUSCRIPT PREPARATION

## Thesis Guidelines

### Organization of the thesis

The final thesis manuscript is organized into three sections consisting of the main text preceded by the preliminary pages, followed by the supportive pages (optional). The individual components of each of these parts are outlined below and described in the following section.

#### Preliminary Pages:

- Title Page
- Abstract
- Approval Page
- Acknowledgements
- Table of Contents
- List of Tables
- List of Figures

#### Main Text:

- Introduction
  - Background
  - Aims
  - Rationale
- Materials and Methods
- Results
- Discussion
  - Future Directions
- References

#### Supportive Pages:

- Appendixes (if needed)

## General Guidelines for Written Thesis

The following are general guidelines for the written thesis. Modifications can be made based on recommendations from your Thesis Advisor and/or Thesis Advisory Committee.

The thesis should be printed on 8 1/2" x 11" paper. It is suggested that the paper should be acid-neutral/acid-free, watermarked, at least 20 lb weight and contain at least 25% cotton. The margins should be 1 1/2" on the left side and 1" on all other sides (with the exception of the first page of each section where the top margin is 1 1/2"). Suggested fonts for the printed version of the thesis are 12 point Arial, Helvetica or Century Gothic, double spaced. Appendixes, reference entries, figure and table captions are single spaced. Paragraphs are indented 5 spaces. Pages should be printed single sided only.

The electronic version of the thesis should be the same as your printed version, with slight formatting changes. The margins on the electronic thesis should be 1" on all sides. Suggested fonts (which must be embedded) for the electronic version are Arial (10 point), Courier New (10 point), Georgia (11 point), Times New Roman (12 point), Trebuchet MS (10 point) or Verdana (10 point). Otherwise, all guidelines below should be followed for the electronic and printed version, except as noted.

### Pagination

Each page of the thesis is to be numbered with the exception of the title page and abstract. The Preliminary pages (excluding title page and abstract) are numbered in order with lower case Roman numerals. The numerals are placed at the bottom center of the page, once space above the bottom margin with at least a double space separation from any written line.

Beginning with the first page of the main text, all pages, including figures and tables and supportive pages are to be numbered consecutively using Arabic numerals. The page numbers should be placed in the top right corner of the page, 3/4" from the top and one inch from the right side of the page. The exceptions are the first pages of the major sections of the text and supportive pages (References and Appendixes); these pages should be numbered at the bottom center of the page, 3/4" from the bottom of the page.

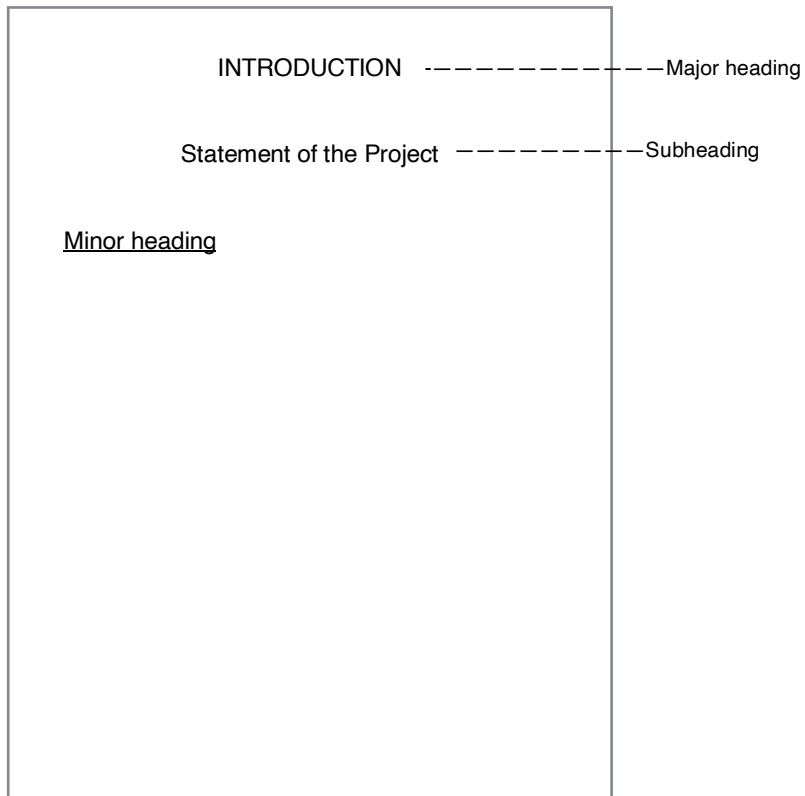
### Headings

Heading labels separate the major sections of the thesis (Introduction, Materials and Methods, Results, Discussion, References, Appendixes). These headings are centered at the top of the page and typed entirely in capital letters. The headings are spaced 1 1/2" from the top of the page and followed by three spaces before text or a subheading is typed. Each major section always starts with a new page.

Subsection headings are centered on the page and designate different subsections within each major section (Background, aims, rationale, future directions). The first letter of all important words is capitalized. The subheadings are spaced 1" below the top of a page or triple spaced below a major section heading.

If you wish to create different sections within a major section or a subsection, a minor heading is typed with the first letter of all important words capitalized starting at the left margin.

The entire minor heading is underlined. Text begins two spaces below the minor heading. See



example on the next page.

### Tables

All tables will be numbered consecutively as they appear in the text and are referred to by number: "As Table 3 shows" or "(Table 3)". All tables are typed on a separate page and must be titled. The table number is typed, centered, one inch below the top of the page and is followed by a double space. The title follows two spaces below, centered, typed entirely in capital letters.

All tables should fit within the margins of the standard thesis. Tables should present data or data summaries that are referred to in the text of the thesis. The simple listing of unanalyzed data number or conditions not specifically referred to in the text should be presented in the appendix. Tables allow the comparison of different sets of data to emphasize similarities, differences or correlations. The construction of several tables is preferable to the presentation of one crowded, unclear table. Table legends are typed below the table and are single spaced.

### Figures

Figures include graphs, diagrams and illustrative drawings. Figures are separately numbered consecutively as they appear in the text and are referred to by number: "As Figure 3 shows" or "(Figure 3)". Figures must be titled and accompanied by an explanatory legend and they should fit within the standard margins. Legends should identify symbols or lines used in the figure. The legend is placed below the figure and is single spaced.

## SPECIFIC SECTION INSTRUCTIONS

Below you will find specific instructions for each section of the thesis.

### Title page

[Title of thesis/professional project] should be spaced, 14 point font, bold, all text centered on this page

"by [your name], previous degree abbreviated, school of degree, year of degree", 12 point font, bold

"A Thesis" 12 point font, bold

"Presented to the College of Arts and Sciences and Quinnipiac University" 12 point font

"In Partial Fulfillment of the Requirements for the Degree of " 12 point font

"Master of Molecular and Cell Biology" 12 point font

"Quinnipiac University" 12 point font

"Month Year" 12 point font

Do not place a page number on this page

**Example Title Page for Thesis**

**by**

**John Student**

**B.S. Tufts University, 2006**

**A Thesis**

**Presented to the College of Arts and Sciences and Quinnipiac University**

**In Partial Fulfillment of the Requirements for the Degree of**

**Master of Molecular and Cell Biology**

**Quinnipiac University**

**May 2017**



### Copyright page

The copyright page is optional. If you choose to copyright your thesis, the copyright page should be the second page. Center the text and do not number the page.

Copyright  
by  
John Student  
2006

## Abstract

Your abstract should be a concise statement of the nature and content of your thesis. Your abstract does not have a word limit, however, only the first 150 words will be included in the ProQuest/UMI print index of theses (the online version will contain the full length abstract). Your abstract should be double spaced, 12 point font (print version), and justified to the left. Normally, it should state the problem, the method and procedures used and the main results or conclusions derived from the thesis.

The abstract should be the third page (or second if no copyright is included). The page should be numbered with Roman Numerals (iii) centered at the bottom of the page.

Top of the page should be "Abstract" in bold 14 point font, centered.

Your thesis title should be next, bold, 14 point font, double spaced and centered.

Student's full name and degree sought abbreviated, 12 point font, centered.

Quinnipiac University

Month and Year

**Abstract**

**Example of Title for Thesis**

John Student, Master of Health Sciences

Quinnipiac University

May 2013

Start writing abstract here.

### Page Approval

The title of your thesis should be at the top, 14 point, double spaced, bold and centered.

"This thesis is approved as creditable and independent investigation by a candidate for the degree of Master of Cell and Molecular Biology, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department"

You should have signatures from your thesis advisor(s), thesis advisory committee member(s), and the Director of the MCB Program. You will need multiple copies of this page if

you are getting multiple copies of the thesis bound; each printed copy should contain a signed page approval form. For electronic submission, this page will be left blank.

Use pretext numbering (Roman Numerals) placed at the bottom of the page (iv).

### **Example of Signature Pager for Thesis**

This thesis is approved as creditable and independent investigation by a candidate for the degree of Master of Cell and Molecular Biology, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department

Principal Thesis Advisor \_\_\_\_\_

Jane Smith, Ph. D.  
Professor, Biomedical Sciences  
Quinnipiac University

Quinnipiac University Thesis Advisor \_\_\_\_\_

Robert Jones, Ph. D.  
Assistant Professor, Biomedical Sciences  
Quinnipiac University

Director, School of Health Sciences \_\_\_\_\_

Sarah Stamp, Ph. D.  
Director, Master of Health Sciences Program  
Quinnipiac University

Principal Thesis Advisor \_\_\_\_\_

Jane Smith, Ph.D.  
Professor of Biological Sciences  
Quinnipiac University

Quinnipiac University Thesis Committee member \_\_\_\_\_

Robert Jones, Ph.D.  
Assistant Professor, Biological Sciences  
Quinnipiac University

Director, Molecular and Cell Biology Program \_\_\_\_\_

Alexandre de Lencastre, Ph.D.  
Director, Master of Molecular and Cell Biology Program  
Quinnipiac University

## Dedication

The Dedication page is optional.

The word "Dedication" should be 14 point, bold and centered.

Text should be 12 point and justified to the left.



Use Roman Numerals placed at the bottom center of the page (v) at least 3/4" from the edge of the page.

**Dedication**

I lovingly dedicate this thesis to my wife, who supported me each step of the way. ...

Basically, you can dedicate your thesis to anyone. A dedication is simply a statement of who the paper is dedicated to and you can or cannot give a reason.

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### Acknowledgements

The Acknowledgements page is optional. This section contains only expressions of appreciation. It recognizes the persons to whom the writer is indebted for guidance and assistance and those who he/she is grateful for any special aid. Good taste calls for acknowledgements to be expressed simply and tactfully.

“Acknowledgements” should be 14 point, bold, centered.

Text should be 12 point and justified to the left. Double spaced.

Use

Roman

### **Acknowledgements**

**\*\*Use your own words here – this is just an example\*\***

This thesis would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

First and foremost, my utmost gratitude to Dr. Jane Smith, Professor of Biomedical Sciences, whose sincerity and encouragement I will never forget. Dr. Smith has been my inspiration as I hurdle all the obstacles in the completion this research work.

Thank you to Dr. Robert Jones, Assistant Professor of Biomedical Sciences, who until her day of retirement had kind concern and consideration regarding my academic requirements.

Etc.

Numerals at the bottom center of page (vi)

## Table of Contents

The table of contents consists of a listing of section headings and all subheadings as described previously. The heading “Table of Content” should be 14 point, bold and centered.

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The list should start with the Introduction, which will be page 1. See format below for how the Table of Contents should be set up.

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TABLE OF CONTENTS	
Chapter 1: Introduction.....	1
Statement of the Problem <i>[listing of subheads is optional]</i> .....	1
Definitions.....	2
Chapter 2: Literature Review.....	3
History of xxx.....	8
Blah Blah Blah.....	13
If desired, a 2 <sup>nd</sup> Level Subhead Would Be Typed Here.....	14
Another Level 2 Subhead Would Be Typed Here.....	18
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More Blah.....	28
Procedures.....	31
Chapter 4: Research Findings/Results.....	35
Chapter 5: Conclusion.....	45
References <i>[or Works Cited or Bibliography]</i> .....	49
Appendix A: <i>[if applicable]</i> Type the Title Here Using Capitals and Lowercase.....	53
Appendix B: <i>[if applicable]</i> Type the Next Appendix Title Here, Etc.....	54

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You can include a list of tables or figures, but this is an optional page.

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LIST OF TABLES	
Table 1. Description of table one.....	4
Table 2. Description of table two.....	10
Table 3. Description of table three.....	17
ETC...	

vii

LIST OF FIGURES	
Figure 1. Description of figure one.....	4
Figure 2. Description of figure two.....	10
Figure 3. Description of figure three.....	17
ETC...	

ix

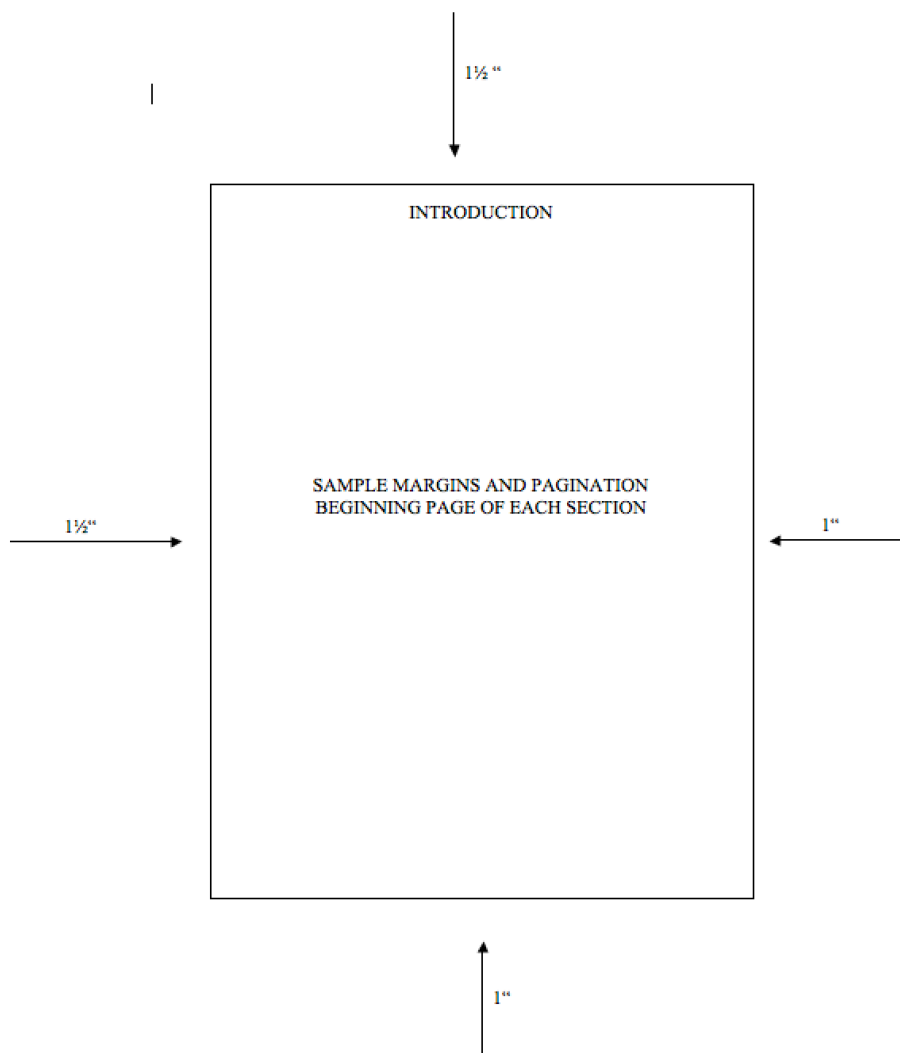
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Community college education	0275
Continuing education	0651
Curriculum development	0727
Early childhood education	0518
Education	0515
Education finance	0277
Education history	0520
Education policy	0458
Educational administration	0514
Educational evaluation	0443
Educational leadership	0449
Educational philosophy	0998
Educational psychology	0525
Educational sociology	0340
Educational technology	0710
Educational tests & measurements	0288
Elementary education	0524
English as a second language	0441
Foreign language education	0444
Gifted education	0445
Health education	0680
Higher education	0745
Higher education administration	0446
Home economics education	0278
Industrial arts education	0521
Instructional design	0447
Language arts	0279
Mathematics education	0280
Middle school education	0450
Multicultural education	0455
Music education	0522
Pedagogy	0456
Performing arts education	0457
Physical education	0523
Reading instruction	0535
Religious education	0527
School counseling	0519
Science education	0714
Secondary education	0533
Social sciences education	0534
Special education	0529
Teacher education	0530
Vocational education	0747

**HISTORY**

African history	0331
American history	0337
Ancient history	0579
Asian history	0332
Black history	0328
Canadian history	0334
European history	0335
History	0578
History of Oceania	0504
Latin American history	0336
Medieval history	0581
Middle Eastern history	0333
Military history	0722
Modern history	0582
Russian history	0724
Science history	0585
World history	0506

**LANGUAGE AND LITERATURE**

African literature	0316
American literature	0591
Ancient languages	0289
Asian literature	0305
Australian literature	0356
Canadian literature	0352
Caribbean literature	0360
Classical literature	0294
Comparative literature	0295
Creative writing	0203
English literature	0593
French Canadian literature	0355
German literature	0311
Icelandic & Scandinavian literature	0362
Language	0679
Latin American literature	0312
Linguistics	0290
Literature	0401
Medieval literature	0297
Middle Eastern literature	0315
Modern language	0291
Modern literature	0298
Rhetoric	0681
Romance literature	0313
Slavic literature	0314

**PHILOSOPHY AND RELIGION**

Aesthetics	0650
Biblical studies	0321
Canon law	0375
Clergy	0319
Comparative religion	0618
Divinity	0376
Epistemology	0393
Ethics	0394
Logic	0395
Metaphysics	0396
Pastoral counseling	0397
Philosophy	0422
Philosophy of religion	0322
Philosophy of science	0402
Religion	0318
Religious history	0320
Spirituality	0647
Theology	0469

**LAW AND LEGAL STUDIES**

Alternative dispute resolution	0649
Intellectual property	0513
International law	0616
Law	0398
Patent law	0562

**SOCIAL SCIENCES**

Archaeology	0324
Area planning and development	0341
Commerce-Business	0505
Criminology	0627
Cultural anthropology	0326
Demography	0938
Economic history	0509
Economic theory	0511
Economics	0501
Folklore	0358
Forensic anthropology	0339
Geography	0366
Individual & family studies	0628
International relations	0601
Labor economics	0510
Labor relations	0629
Military studies	0750
Organization theory	0635
Organizational behavior	0703
Peace studies	0563
Physical anthropology	0327
Political Science	0615
Public administration	0617
Public policy	0630
Recreation	0814
Social research	0344
Social structure	0700
Social work	0452
Sociolinguistics	0636
Sociology	0626
Transportation	0709
Urban planning	0999

**INTERDISCIPLINARY**

Alternative energy	0363
Biographies	0304
Climate change	0404
Cultural resources management	0436
Energy	0791
Food science	0359
Home economics	0386
Information technology	0489
Multimedia communications	0558
Museum studies	0730
Sustainability	0640
Textile research	0994
Wood sciences	0746

## Behavioral, Natural, and Physical Sciences

### AGRICULTURE

Agriculture	0473
Agriculture economics	0503
Agriculture education	0517
Agriculture engineering	0539
Agronomy	0285
Animal diseases	0476
Animal sciences	0475
Aquatic sciences	0792
Forestry	0478
Horticulture	0471
Plant pathology	0480
Plant sciences	0479
Range management	0777
Soil sciences	0481
Urban forestry	0281
Wildlife management	0286

### BEHAVIORAL SCIENCES

Behavioral psychology	0384
Behavioral sciences	0602
Clinical psychology	0622
Cognitive psychology	0633
Counseling psychology	0603
Developmental psychology	0620
Experimental psychology	0623
Occupational psychology	0624
Personality psychology	0625
Physiological psychology	0989
Psychobiology	0349
Psychology	0621
Quantitative psychology	0632
Social psychology	0451

### BIOLOGICAL SCIENCES

Biochemistry	0487
Bioinformatics	0715
Biology	0306
Biomechanics	0648
Biophysics	0786
Biostatistics	0308
Botany	0309
Cellular biology	0379
Developmental biology	0758
Endocrinology	0409
Entomology	0353
Evolution & development	0412
Genetics	0369
Histology	0414
Limnology	0793
Microbiology	0410
Molecular biology	0307
Morphology	0287
Neurosciences	0317
Parasitology	0718
Physiology	0719
Systematic biology	0423
Virology	0720
Zoology	0472

### ECOSYSTEM SCIENCES

Ecology	0329
Macroecology	0420
Paleoecology	0426

### ENGINEERING

Aerospace engineering	0538
Artificial intelligence	0800
Automotive engineering	0540
Biomedical engineering	0541
Chemical engineering	0542
Civil engineering	0543
Computer engineering	0464
Computer science	0984
Electrical engineering	0544
Engineering	0537
Geological engineering	0466
Geophysical engineering	0467
Geotechnology	0428
Industrial engineering	0546
Mechanical engineering	0548
Mining	0551
Naval engineering	0468
Nanotechnology	0652
Nuclear engineering	0552
Ocean engineering	0547
Operations research	0796
Packaging	0549
Petroleum engineering	0765
Plastics	0795
Robotics	0771
System science	0790

### ENVIRONMENTAL SCIENCES

Conservation biology	0408
Environmental economics	0438
Environmental education	0442
Environmental engineering	0775
Environmental geology	0407
Environmental health	0470
Environmental justice	0619
Environmental law	0439
Environmental management	0474
Environmental philosophy	0392
Environmental science	0768
Environmental studies	0477
Land use planning	0536
Natural resource management	0528
Water resources management	0595
Wildlife conservation	0284

### GEOSCIENCES

Aeronomy	0367
Atmospheric chemistry	0371
Atmospheric sciences	0725
Biogeochemistry	0425
Biological oceanography	0416
Chemical oceanography	0403
Continental dynamics	0406
Geobiology	0483
Geochemistry	0996
Geographic information science and geodesy	0370
Geology	0372
Geomorphology	0484
Geophysics	0373
Hydrologic sciences	0388
Marine geology	0556
Meteorology	0557
Mineralogy	0411
Paleoclimate science	0653
Paleontology	0418
Petroleum geology	0583
Petrology	0584
Physical geography	0368
Physical oceanography	0415
Planetology	0590
Plate tectonics	0592
Remote sensing	0799
Sedimentary geology	0594

### HEALTH AND MEDICAL SCIENCES

Aging	0493
Alternative medicine	0496
Audiology	0300
Dentistry	0567
Epidemiology	0766
Gerontology	0351
Health care management	0769
Health sciences	0566
Immunology	0982
Kinesiology	0575
Medical ethics	0497
Medical imaging	0574
Medicine	0564
Mental health	0347
Nursing	0569
Nutrition	0570
Obstetrics	0380
Occupational safety	0354
Occupational therapy	0498
Oncology	0992
Ophthalmology	0381
Osteopathic medicine	0499
Pathology	0571
Pharmaceutical sciences	0572
Pharmacology	0419
Physical therapy	0382
Public health	0573
Public health education	0500
Speech therapy	0460
Surgery	0576
Toxicology	0383
Veterinary medicine	0778

**MATHEMATICAL AND  
PHYSICAL SCIENCES**

Acoustics	0986
Analytical chemistry	0486
Applied mathematics	0364
Astronomy	0606
Astrophysics	0596
Atomic physics	0748
Chemistry	0485
Condensed matter physics	0611
Electromagnetics	0607
High energy physics	0798
High temperature physics	0597
Inorganic chemistry	0488
Low temperature physics	0598
Materials science	0794
Mathematics	0405
Mechanics	0346
Molecular chemistry	0431
Molecular physics	0609
Nanoscience	0565
Nuclear chemistry	0738
Nuclear physics and radiation	0756
Optics	0752
Organic chemistry	0490
Physical chemistry	0494
Physics	0605
Plasma physics	0759
Polymer chemistry	0495
Quantum physics	0599
Statistics	0463
Theoretical mathematics	0642
Theoretical physics	0753