Northwestern | Molecular Biosciences

2024-2025 Student Handbook

Quantitative and Systems Biology (QSB)

Master of Science Degree Program

Student Handbook

Quantitative and Systems Biology M.S. Degree Program

Academic Year: 2024-2025 | Last Revised: 2024-05-13

The Quantitative and Systems Biology (QSB) Student Handbook supplements The Graduate School's TGS's policies and procedures. The following pages contain information about program-specific policies, procedures, and regulations. Students are subject to the regulations in effect at the time of matriculation. It is each student's responsibility to be aware of these and The Graduate School's regulations. Note that this information applies to the current academic year and is updated periodically. Northwestern University and the QSB program Northwestern University reserve the right to change without notice any statement in this publication concerning, but not limited to, rules, policies, tuition, fees, curricula, and courses. Archives of these policies and procedures for each academic year are retained in The Graduate School. Failure to read this information does not excuse a student from knowing and complying with its content. In addition to TGS and program policies, graduate students are subject to and should be aware of University policies pertaining to students.

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PERSONNEL

Director: Greg Beitel, Ph.D.

Advisory board:

Amy Rosenzweig (Chair of Molecular Biosciences (MBS))
Jiping Wang (Professor, Statistics)
Bill Miller (Director of Master of Science in Biotechnology Program; Professor, Chemical and Biological Engineering).

Admissions committee:

Greg J. Beitel (QSB Chair; Professor, MBS), Alec Wang (Associate Professor, MBS), Yuan He (Assistant Professor, MBS)

Curriculum committee:

Greg J. Beitel (QSB Chair; Professor, MBS)
Carole LaBonne (MBS Chair; Professor, MBS)
Rich Carthew (Professor, MBS)
Jason Brickner (Professor, MBS)

Thesis committees: The QSB director will appoint thesis committees consisting of at least three members: the student's QSB mentor plus two additional faculty members, one of whom will be chair of the committee. Any faculty member with an appointment in MBS can serve as a member or chair of a thesis committee. At least two members of the committee, including the chair, must be members of the Northwestern University Graduate Faculty**.** The committee is required to confirm that all requirements for degree completion have been met.

Program Assistants:

For QSB student question about class registration and the program in general:

Abbi Witherspoon
Department of Molecular Biosciences
Pancoe 4-403
abbi.witherspoon@northwestern.edu
Ph: 847-467-0073

ADVISING

Research/Thesis Advisor

Students will be matched with a faculty advisor when a student is admitted to the program. The faculty advisor will serve as the student's advisor for thesis research and as the student's primary academic advisor who will help the student decide what classes would best prepare them for the area of research they are pursuing. However, prior to registering for their courses, students will discuss and confirm their choice of courses with the QSB Director. The QSB Director is also available to discuss course choices with students at any time. A research assistant professor or postdoctoral fellow may serve as the day-to-day mentor in cases where the faculty advisor runs a large lab along as prior approval of the QSB Director and the student is obtained.

It is of particular importance that students contact the QSB Director if the student is experiencing problems with any of their courses. It is much easier to fix problems mid-quarter than late in the quarter, and quarters are very short. Thus, students with concerns should seek advice as soon as possible.

Changing Advisors

Since changing advisors will negatively impact the student's research experience, it is expected that students will only change advisors under highly unusual circumstances. Reasons for changing advisors could include, but are not limited to: the student's advisor being unable to continue in an advisory role due to unforeseen issues such as, but not limited to, medical issues or sudden departure from Northwestern; the student or the advisor finding the working arrangement unworkable. All requests for advisor change will be handled by the QSB Director and the student's thesis committee on a case-by-case basis.

THESIS COMMITTEE

Each student's thesis committee will be comprised of the student's advisor and two additional MBS faculty that will be assigned by the QSB Director. One of the committee members who is not the student's advisor will be assigned by the QSB Director to chair the committee. **Once a thesis committee has been assigned to the student, the student needs to enter the committee member information into The Graduate Student Tracking System** (GSTS http://gsts.northwestern.edu/). A guide for using GSTS can be found by clicking here.

Students will meet with their committees in December to approve their proposed research plan, April-May for an assessment of progress and guidance on preparing the thesis, and in July-August for a final thesis examination. Each student will be responsible for scheduling meetings of the student and the committee. Note, these meetings should be scheduled two to three months in advance because faculty members can be hard to schedule, particularly in the summer. Students who do not meet their committees at the required time are required to make up these meetings as soon as possible after the normal time. Failure to have thesis committee meeting or examination will prevent students from completing the degree on the normal schedule.

If unforeseen circumstances arise and a committee member cannot perform their functions, if a committee member resigns, or if there is an unresolvable conflict between a student and their committee member, the QSB Director will appoint a replacement committee member.

LEARNING OBJECTIVES & ASSESSMENT

Graduate Program Goals/Mission Statement: The mission of the one-year QSB program is to train students in quantitative and systems biology approaches and techniques that will enable them to succeed in top Ph.D. and M.D. programs or to directly enter research careers in industry or academia.

Learning objective(s) *Students should be able to…*	Milestone/ Requirement/Capacity	Assessment Strategies and Criteria* *How do we know this objective has been achieved?* *What criteria do we have to measure success?*
… quantitatively analyze data	Pass the courses IBiS410 or ES_APPM 421, and IBiS 432 or equivalent	See syllabi of these courses
… write scripts and/or basic programs to analyze data sets using current computer languages/environments including R, Matlab, and Python	Pass the courses NICO 401, IBiS410 and/or ES_APPM 421, and IBiS 432 or equivalent	See syllabi of these courses
… contribute original research to scholarly community.	Master's thesis	Assessment Strategy: Committee assesses dissertation prospectus using collaboratively-constructed rubric, demonstrating levels of achievement. Criteria: Student submits an original thesis; defines appropriate methodology; generates original results; writes a clear presentation and analysis of data; suggests future directions; delineates sources
… articulate broader impacts of research	Pass the course QSB 401; thesis committee meetings; dissertation writing; public seminar presentation	Student receives feedback from advisor, and peers
… create and communicate professional development plan	Develop and present an individual development plan to program director and thesis committee	Student shares plan with QSB Director by the first day of classes of the fall quarter, and with their thesis committee at the first meeting in December; Student seeks appropriate resources in response to professional development plan, such as identifying career paths of program alumni

COURSE LOADS, CHARGES, & FULL-TIME STUDENT STATUS

Unless otherwise allowed by TGS, students must complete 9 credit units of letter-graded (ABC, not P/NP), graduate level courses by the end of spring quarter. Partial credit classes such as NICO 401 (0.67 credits) and NICO 402 (0.33 credits) can be summed as part of the 9 credit units. Thus, the NICO 401/402 sequence counts as the equivalent of a one-unit course for the fall quarter.

Required and a recommended selection of optional courses for the QSB program are shown in the section below. Additional courses offered at Northwestern can potentially be taken as electives if they are eligible for TGS graduate credit and approved by the QSB director.

To maintain visa status, international students must take 3 credits of classes per quarter, but do not need to maintain 3 credits at all times in the quarter. In particular, full-time student status is achieved by the combination of NICO 401, which runs in the first two weeks of September, and NICO 402 (0.33 credits), which

runs in the usual academic quarter, despite the student having a course load of 2.33 units during the regular fall quarter class period.

Standard graduate tuition includes up to four credits of classes. A fifth class can be taken with the QSB Director's permission but **note that taking more than four units of courses in a quarter will increase the cost of tuition charged to the student by one unit, which in 2023-2024 was an additional $7,394.**

If a student enrolls in five classes with the anticipation of dropping one class, note that the fifth class must be dropped by 5:00 PM on the date listed in the academic calendar as the last day for tuition adjustment related to enrollment changes (to or from full-time). No reductions are made to bills for dropped or swapped classes after this date. In some cases, this drop date may occur prior to the first meeting of the class.

Zero credit classes, such as IBiS 423 Ethics, are not counted for assessing tuition charges and do not count towards enrollments, so in the fall quarter, students will take a total of five classes (NICO 401, QSB 401, two one-credit TGS courses, and IBiS 423 Ethics) for 3.67 credits and pay regular full-time Master's tuition rates.

For the summer quarter, unless otherwise arranged with the student's advisor and the director of the QSB program, students are expected to continue full-time research through at least the end of the Friday the week before the end of the 10-week summer quarter.

REQUIRED & ELECTIVE COURSES

Students must complete 9 quality letter-graded (ABC, not P/NP), graduate level courses by the end of spring quarter. Required and recommended optional courses are shown below. Additional courses offered at Northwestern can potentially be taken as electives if they are eligible for TGS graduate credit and approved by the QSB director.

Students must also take the "Bioethics" and "Rigor and Reproducibility in Research" non-credit training course (IBiS 423 and 421, respectively), or if scheduling conflicts arise, equivalent activities as determined by the QSB Director.

QSB courses for 2020-2021: All courses are 1 credit unless otherwise noted

Fall Quarter (Register for at least three total credits): Two required credit courses and two electives selected from the list below or the electives document. All courses are 1 credit unless noted otherwise.

Required courses:

- NICO 401 – Introduction to Programming for Big Data (0.67 credits)
- QSB 401 – Research Techniques, Writing & Presentation
- One of BIOL_SCI 338, IBiS 410 or ES_APPM 421 (Bio338 recommended)

Elective courses (recommended: IBiS410, ES_APPM 472 or ES_APPM 421*)* :

- **ES_APPM 472 Introduction to the Analysis of RNA Sequencing Data**
- NICO 402 – Project for Introduction to Programming for Big Data (0.33 credits)
- BIOL_SCI 338 Modeling Biological Dynamics
- ES_APPM 421 – Models in Applied Mathematics
  - Note that the instructor says course requires that the students are able to solve differential equations, know basic linear algebra and probability and statistics. The instructor will not be teaching the solution techniques, but rather will be showing how to use math to solve real world problems. Thus, the students are expected to know the math (at least most of it), or be willing to learn as needed.
  - Prerequisites: None listed
- IBiS 402 – Eukaryotic Molecular Biology
- IBIS 410 – Quantitative Biology

- STAT 330– Applied statistics for Research 1 (STAT 465 in Spring recommended over STAT 330)
- STAT 420 – Introduction to Statistical Theory & Methodology
  - Prerequisites: A good background in calculus, real analysis (e.g., the concept of a limit), linear algebra, elementary probability theory, and statistical methods.
- Biol_Sci 361 – Protein Structure and Function

Winter Quarter (Register for 3 courses): QSB 499, one or both of Biol courses and one elective selected from the list below or the electives document.

Required courses:
- QSB 499 – Independent study
- Biol_Sci 323 – Bioinformatics: Biological Sequence and Structure Analysis

Elective courses:
- Biol_Sci 378 – Functional Genomics
- IBIS 404 – Principles and Methods in Systems Biology

Spring Quarter (Register for 3 courses): Two required courses and one elective selected from the list below or the electives document.

Required courses:
- QSB 499 – Independent study
- Stats 465 – Statistical Methods for Bioinformatics and Computational Biology
  (with permission of QSB director, STAT 330 or STAT 432 can be substituted for STAT465)

Recommend elective courses:
- IBiS 401 – Molecular Biophysics
- IBIS 432 – Statistics for Life Sciences

Summer Quarter (Register for 2 courses, both required)
Required course: QSB 590 – Independent study with thesis (3 units)
Optional training course: IBIS 421 – Rigor and Reproducibility in experimental design

Optional Internship Fall quarter of 2nd year
Required course: QSB 595 – Internship (3 units)
International students must apply for Curricular Practical Training (CPT) at least one week in advance of CPT start dates (typically Sept. 1) and apply for two quarters of CPT

Optional Internship Winter quarter of 2nd year)
Required course: QSB 595 – Internship (3 units)
International students should include Winter quarter authorization when applying for Curricular Practical Training (CPT) prior to Fall quarter

OTHER COURSEWORK & ACTIVITIES

- **Thesis committee meetings** – students must meet their thesis committees in December, April-May and July-August.
- **Approval of thesis** – students must write and defend their thesis to their committee.
- **Seminar presentation of research** – students must present their thesis research in a public seminar.

- **Research group seminars** – student must attend the group meetings and any required journal/data clubs of their research laboratories once the student arrives in September.
- **Pre-class activities in September** – students are required to participate in training activities as detailed in the schedule of pre-class activities.

- **Individual Development Plan (IDP)** – Before the start of classes in September, each student must complete, with their faculty advisor's signature, an individual development plan that outlines the student's goals for the master's program and for their post-graduation plans.
- **Bioethics workshop** – Students must take the QSB Bioethics workshop during the summer quarter.

- **QSB recruitment** – current QSB students are expected to assist in the recruitment of future QSB students by being available to talk to prospective students and to serve as "buddies" to help newly admitted students get set up with the program.

Applying to Transfer to the IBiS Ph.D. Program

- Students who excel in the QSB program can be considered for admission to IBiS program.
- QSB-to-IBiS transfer applicants will be evaluated relative to the entire pool of IBiS applicants. Because IBiS admissions are highly competitive, it is possible that a minority of QSB students will qualify for admission to the IBiS Ph.D. program (see the QSB website for current statistics on applicant success rates).
- **To have equal consideration with regular IBiS applicants during the admission process, QSB students must apply to transfer to the IBiS program by the standard fall deadline, typically December 15th.** Application to transfer is submitted through The Graduate School (TGS) CollegeNet system. Note that while application to transfer can be submitted after the fall deadline (through March 31), **applications submitted after the fall deadline will be considered after the regular admissions process is completed, by which time the IBiS program may have filled its available slots. For maximal chances of admission to the IBiS program, students are advised to submit their transfer application before the fall deadline.**
- QSB students who are admitted to the IBiS program are expected to complete their master's degree in August and start the IBiS program at the beginning of September along with the rest of the incoming IBiS class.
- QSB transfer students will receive credit for IBiS courses taken through the QSB program (with grade of B or higher) and will be required to complete only those additional courses required by IBiS.
- As is required for IBiS students, QSB students will be required to complete three research rotations in Fall, Winter, and Spring quarters before joining a lab. Although transfer students may ask to join the lab in which they conducted their master's thesis research, this arrangement is neither assumed nor guaranteed.

PROGRESSING THROUGH THE PROGRAM: TIMELINE OVERVIEW

The following information was taken from the Registrar's website before the start of the academic year and not all dates had been specified by the Registrar yet. Moreover, information may become outdated. Please check the Registrar's academic calendar website for current information.

Degree applications can be submitted two quarters in advance. Visit the TGS Site > Academic Policies & Procedures > Graduation to access instructions and the Application for a Degree form via the GSTS platform.

FALL 2024	
Late August	QSB students arrive in Evanston area
September 3	QSB Program starts with orientation at 8:30 AM, Pancoe 1-401 First day of class for NICO 401 at 9:30 AM, Tech L361
September 10	Fall tuition for statement 1 is available online (will include charge for NICO401)

September 19	Registration for classes opens at 9am. Last day of class for NICO 401 Biological Imaging Facility (BIF) image processing workshop. 1-4 PM Rm. Silverman 4-510
September 20	Biological Imaging Facility (BIF) image processing workshop. 9-12 PM, Rm. Silverman 4-510 Reception for QSB students and their labs. 12:30-1:30 PM, Pancoe Cafe
September 24	Fall Quarter classes Begin **Students must submit IDP plans to QSB program**
September 30	**Last day to ADD classes. Students must be registered for three graduate-level classes to fulfill degree completion and visa requirements.** **Internship students must be registered for QSB 595** **Last day to DROP classes WITHOUT BEING CHARGED TUITION**
October 1	Fall tuition for statement 1 is due (payment for NICO401 is due) Students begin scheduling first committee meeting
October 1-25	For internship students completing training in December: file application for degree with TGS using GSTS.
October 10	Fall tuition statement 2 is available online (charges for rest of fall quarter)
October 25	For internship students completing training in December: Last day to submit "Application for Degree" form to TGS for graduation in Fall (use GSTS)
November 1	Fall tuition for statement 2 is due (charges for rest of fall quarter)
November 11	Registration for Winter 2024 opens
November 27	Thanksgiving vacation begins 6pm
December 2	Fall Quarter classes resume WCAS Reading Period begins
December 6	For internship students completing training in December: Last day to submit "Master's completion form" with TGS graduation in Fall (use GSTS).
December	First meeting of student and thesis committee; research plan and IDP must be presented to committee one week prior to first committee meeting
Early December	**QSB students wishing to transfer to the IBiS Ph.D. program and who want to have full consideration must apply to IBiS by the regular new applicant deadline, typically Dec. 15th**. Students who apply to transfer in March will most likely NOT be considered with the main applicant pool and thus all available slots may be filled before QSB transfer applications are considered.

December 9-14	Fall Exams
December 9 ***2023-2024 date**	Deadline to terminate NU-SHIP Health Insurance for coverage end 12/31/2024 For exact dates, check this link: NU-SHIP cancellation
December 10	Winter tuition statement is available online
December 26-30	Winter Recess – University is closed
WINTER 2025	
January 1	Winter tuition is due
January 6	Winter Quarter classes start
January 1-31	Internship students: file application for degree with TGS using GSTS
January 10	**Last day to ADD classes. Students must be registered for three graduate-level classes to fulfill degree completion and visa requirements.** **Internship students must be registered for QSB 595** **Last day to DROP classes WITHOUT BEING CHARGED TUITION**
January 31	QSB students must submit Spring Quarter thesis committee meeting date to QSB office **For internship students: Last day to file the "Application for Degree" form with TGS (use GSTS)**
February 17	Registration for Spring classes opens
March 10	Spring tuition statement is available online
March 17 ***2023-2024 date**	Deadline to terminate NU-SHIP Health Insurance for coverage end 03/25/2024 For exact dates, check this link: NU-SHIP cancellation
March 14	Students must submit the date for their spring quarter thesis committee meeting to the QSB office
Spring 2025	
April 1	Spring Quarter classes start. **Note Tues, April 1, 2025 has a MONDAY schedule** **(Optional): First day to submit Application for Degree (for August graduation) using GSTS to allow a student to participate in June commencement ceremonies. (Note the "Application for Degree" and "Master's completion form" are separate forms, and BOTH must be filed at required times to receive a degree on time).** Note: Students planning to do an internship and who want to participate in the June commencement should **submit an Application for Degree with an August completion date.** Note: If a student commits to the internship during

	the summer quarter, the student must withdraw their application for degree by contacting TGS after commencement ceremony, but before July 9.
March 31	Last day to submit applications to transfer from QSB program to IBiS program
April 1	Spring tuition is due
April 7	**Last day to ADD classes. Students must be registered for three graduate-level classes to fulfill degree completion and visa requirements.** **Last day to DROP classes WITHOUT BEING CHARGED TUITION**
April 8 ***2023-2024 date**	Summer Quarter registration opens
April 22	**(Optional): Last day to submit Application for Degree for August graduation that allows a student to participate in June convocation ceremonies. (Note the "Application for Degree" and "Master's completion form" are separate forms, and BOTH must be filed at required times to receive a degree on time).**
April – May	Spring Quarter thesis committee meeting. Meeting goals are to highlight progress to date on research and discuss outline for thesis
May 1	**Last day to notify Prof. Beitel that you are considering doing the optional internship with an NU core**
May 10	Summer tuition statement is available online
May 30	Students must submit thesis examination date to QSB office
June 1	Summer tuition is due
June 4	WCAS Reading Period begins **If not already filed and not doing an internship, submit an Application for Degree for August graduation**
June 9-13	Spring Exams
June 13	Commencement (tentative)
June 23	Summer Quarter classes begin Summer Quarter change of registration/drop/add late registration opens
SUMMER 2025	
July XX	**Last day to DROP classes WITHOUT BEING CHARGED TUITION**

July 11	**Last day to submit "Application for Degree" form with TGS using GSTS to receive a degree at end of Summer Quarter.** Note: QSB students participating in the optional internship do NOT file for graduation in August, but instead file in the term that they will complete the internship. **(Note the "Application for Degree" and "Master's completion form" are separate forms, and BOTH must be filed at required times to receive a degree on time).**
July 11	**For students doing an internship and who filed an "Application for Degree" for August graduation, this is the last day to withdraw application.**
July 15-August 15	Thesis examination and public presentation of research
August 1	**International students who are doing an internship must apply for Curricular Practical Training at least one week in advance of the CPT start date with Northwestern's Office of International Students and Scholar Services. Applying one month in advance is strongly recommended.** Click here for the OISS webpage on CPT. When applying for CPT, students should apply for authorization for both Winter quarters unless a student is certain that they will only do one quarter of internship
August 22	**Last day to submit "Master's Degree Completion" form to TGS using GSTS for August graduation (does not apply for internship students). (Note the "Application for Degree" and "Master's completion form" are separate forms, and BOTH must be filed at required times to receive a degree on time).** **Unless otherwise arranged with the student's advisor and the QSB director, students are required to conduct full-time research through the end of Aug. 19th.** Internship students: Register for QSB 595
August 27	**Summer quarter ends**
FALL 2025	
September 14 *Approximate*	**Internship students: Last day for QSB 595 registration**
November 1 *Approximate*	Internship students graduating in December: Submit "Master's Degree Completion" form for December graduation (use GSTS)
December 6 *Approximate*	**Internship students graduating in December: Last day to submit "Master's Degree Completion" form for December graduation (use GSTS)**
WINTER 2026	
February 1 *Approximate*	Internship students: Submit "Master's Degree Completion" form for December graduation (use GSTS)

March 13 *Approximate*	**Last day for internship students to submit the "Master's Degree Completion" form for March graduation (use GSTS)**

Students can view the full calendar by visiting the Registrar's website and selecting the correct calendar year.

SATISFACTORY ACADEMIC PROGRESS

The Graduate School (TGS) sets the minimum standard for satisfactory academic progress (see here). Students who are placed on academic probation by TGS and unable to remediate during TGS's probationary period will be excluded at the end of the second quarter of probation by TGS. Read about the policy by clicking here for more details.

The QSB program has additional criteria for maintaining satisfactory academic progress: Students will receive written feedback from their committee at the end of each thesis committee meeting. Students must also be deemed by their thesis committees as making satisfactory progress at the time of the meeting. Students determined to have made unsatisfactory progress for one quarter will result in the student being considered on probation. Students having two consecutive quarters of unsatisfactory progress will be dismissed from the program. If a student feels that their committee has inappropriately decided that the student has not made sufficient progress and is dismissed from the program, the student may appeal to the QSB Director. If the QSB Director also finds that the student has not made sufficient progress, the student may appeal to TGS. Click here to read more about the process.

Student must complete the QSB program requirements, with the exception of submitting thesis revisions, in four consecutive quarters, unless they are granted an exception for particularly severe medical or personal circumstances.

Failure to maintain satisfactory standing in classes or to make satisfactory progress on the student's thesis research as detailed below will result in the student being dismissed from the program.

TEACHING REQUIREMENTS

There are no teaching requirements for the QSB program.

WRITING THE RESEARCH PLAN/FIRST COMMITTEE MEETING

At the student's first committee meeting in December (scheduled by the student), the student will present a written plan of their research that will also serve as working draft of the final written thesis. The research plan will be prepared as part of the QSB 401 course and will be due three days before the date of the last day of the NU final exam period.

The Research Proposal is expected to be about 8 pages, not including preliminary data (if any) and references. The format of the document follows guidelines for an NIH pre-doctoral fellowship application. The proposal should be single-spaced, on standard-size (8½" x 11") paper with one-inch side, top and bottom margins and a font size no smaller than 12. All sections should be referenced appropriately. Good proposals are clear, precise, and succinct.

The student will send their research plan to the committee at least one week in advance of their first committee meeting. The Research Plan should be organized as follows:

First Committee Meeting Research Plan:	
Title Page:	List the title of the proposal, the student's name, and thesis lab. (Printed on separate page.)
Table of contents	Should be set up to auto-update as changes are made
Summary	The summary should be a brief synopsis (One or two paragraphs, about one-half page long) of the proposed research that is accessible to a general audience. It should state the essential scientific background of the proposal, the specific aims/objectives, the methods or procedures to be used, and the potential significance of the research.
Specific Aims	The specific aims page is one page long and provides a detailed background and a clear, concise point-by-point summary of the aims of the work proposed (The specific aims page should fit on one page should have several introductory paragraphs followed by the specific aims).
Background and Significance	Outline the background of the present proposal, critically evaluate existing knowledge, and specifically identify the gaps which the project is intended to fill. State the importance of the research described in this proposal by relating the specific aims to longer-term objectives (Approximately three pages).
Statement of hypothesis(es)	Concisely state the hypothesis(es) to be tested or tool(s) to be developed.
Experimental Design and Methods	Discuss in more detail the experimental design and the procedures to be used to accomplish each of the specific aims of the project. For each specific aim, include the following subsections (approximately three pages plus preliminary data): **Specific Aim #** ○ ***Approach:*** Describe the protocols to be used and provide a tentative sequence or timetable for the investigation. Include the means by which the data will be analyzed and interpreted. Describe any new methodology and its advantage over existing methodologies. ○ ***Expected Results:*** Outline the results you expect to get for the aim ○ ***Preliminary data:*** If any preliminary data is available, include it here. ○ ***Potential difficulties and alternative approaches:*** Briefly discuss potential difficulties and limitations of the proposed procedures and provide alternative approaches to achieve the aims.
Expected impact	Expected impact of proposed research (Several sentences to 0.5 page).
References	For citing references, use the format of the journal Cell. In-text citations are listed as (author, year) and in the References section, referenced items are listed alphabetically. Detailed formatting notes are shown below, but the citation program you use should allow you to select and use the "Cell" format (No length limitations).

CITATIONS

- In-text citations should be written in Harvard style and not numbered, e.g., "Smith et al., 2015; Smith and Jones, 2015."
- Use the style shown below for the reference section. "et al." should only be used after ten authors.
- Article in a periodical: Sondheimer, N., and Lindquist, S. (2000). Rnq1: an epigenetic modifier of protein function in yeast. Mol. Cell *5*, 163–172.

- *Article in a book:* King, S.M. (2003). Dynein motors: Structure, mechanochemistry and regulation. In Molecular Motors, M. Schliwa, ed. (Weinheim, Germany: Wiley-VCH Verlag GmbH), pp. 45–78.
- *An entire book:* Cowan, W.M., Jessell, T.M., and Zipursky, S.L. (1997). Molecular and Cellular Approaches to Neural Development (New York: Oxford University Press).

SECOND COMMITTEE MEETING

All QSB students must arrange a second thesis committee meeting in the Spring Quarter. Students will present their thesis committee with their current results and plans for summer research. At least one week prior to the thesis committee meeting, student will send their committee a second committee meeting document which is essentially the research plan updated with current results and should be organized as follows:
The second committee meeting document should contain the following sections:

Second Thesis Committee Meeting Document	
Title Page:	List the title of the proposal, the student's name, and thesis lab (Printed on separate page).
Table of contents	Should be set up to auto-update as changes are made
Summary	The summary should be a brief synopsis (One or two paragraphs, about one-half page long) of the proposed research and results to date that is accessible to a general audience. It should state the essential scientific background of the proposal, the specific aims/objectives, the methods or procedures to be used, results to date and the potential significance of the research.
Specific Aims	The specific aims page from the first committee should be used but updated to reflect changes to the specific aims. The specific aims page is one page long and provides a more detailed background and a clear, concise point-by-point summary of the aims of the work proposed. The specific aims page should have several introductory paragraphs followed by the specific aims. Two specific aims are typical.
Background and Significance	Outline the background of the present proposal, critically evaluate existing knowledge, and specifically identify the gaps which the project is intended to fill. State the importance of the research described in this proposal by relating the specific aims to longer-term objectives (Approximately four to eight pages).
Results/Experimental Design and Methods	The length of this section will vary with results and nature of the data, likely 5-10 pages with figures. Include a separate section for each specific aim. For aims that are not yet started, use (with appropriate updates) the Experimental Design and Methods section from the first committee meeting document. For aims with results, format as follows: Format: Specific Aim #. 1. *Approach* 2. *Results* a. Summary of results to date. b. Use figures and graphs to show results 3. *Planned work to include in thesis* 4. *Alternative approaches:* Briefly discuss potential difficulties that have arisen and provide alternative approaches to achieve the aims

Discussion	Discuss the significance/expected impact of results. Several sentences to several pages depending on the results. Discuss how the results to be obtained by the end of thesis will add to current results.
References	For citing references, use the format of the journal Cell. In-text citations are listed as (author, year) and in the References section, referenced items are listed alphabetically. Detailed formatting notes are shown below, but the citation program you use should allow you to select and use the "Cell" format. (No length limitations.

THESIS & THESIS EXAMINATION

All QSB students must submit their master's thesis and have a thesis examination by August 16. They must also present a public talk on their thesis by August 23 (scheduled by the QSB program). Thesis revisions must be completed by August 30.

Students participating in the optional internship program and thus graduating at the end of the Fall or Winter quarter must still submit their master's thesis and have a thesis examination per the above deadlines, with the final thesis being submitted by August 30th.

WRITING THE THESIS

The final written Thesis is expected to be approximately 40 pages in length and build from the Research Plan presented at the first committee meeting.

The document will consist of the following sections:

Thesis Document	
Title Page:	List the title of the proposal, the student's name, and thesis lab (Printed on separate page).
Table of contents	Should be set up to auto-update as changes are made.
Summary	The summary should be a brief synopsis (One or two paragraphs, about one-half page long) of the proposed research and results to date that is accessible to a general audience. It should state the essential scientific background of the proposal, the specific aims/objectives, the methods or procedures to be used, results to date and the potential significance of the research.
Chapter 1: Background and Significance	Outline the background of the present proposal, critically evaluate existing knowledge, and specifically identify the gaps which the project is intended to fill. State the importance of the research described in this proposal by relating the specific aims to longer-term objectives (Approximately four to eight pages).
Chapter 2 (or more): Results with Experimental Design and Methods	The length of this chapter(s) will vary with results and nature of the data. Include a separate chapter for each specific aim.
Chapter #: Discussion	Discuss the significance/expected impact of results. Several sentences to several pages depending on the results. Discuss future directions to extend the project. (Several pages)
Chapter #:	For citing references, use the format of the journal Cell. In-text citations are listed

References	as (author, year) and in the References section, referenced items are listed alphabetically. Detailed formatting notes are shown below, but the citation program you use should allow you to select and use the "Cell" format. (No length limitations.
Optional Chapter(s): Appendixes	If there is data that doesn't fit in a sensible chapter, but is still worth the host lab having recorded, or if results were obtained on a project that was later abandoned, they may be included as an appendix.

The thesis will be evaluated by the student's thesis committee during the thesis examination. It is expected that the committee will request minor revisions, even when the committee otherwise finds the thesis and examination successful. These revisions need to be completed prior to the student submitting a degree completion form in mid-August and must be approved by the student's thesis supervisor by obtaining their signature on the thesis examination form. If a student's thesis document is deemed inadequate, the student will be given the opportunity to revise it. Revisions must be completed within 6 months of the student's thesis defense date.

DEGREE COMPLETION & GRADUATION

Student must complete the QSB program requirements, with the exception of submitting thesis revisions, in four consecutive quarters, unless they are granted an exception by the QSB Director, who will consider requests on a case-by-case basis and only when there are extenuating circumstances.

The QSB program does not require any administrative steps in order to graduate beyond The Graduate School's filing requirements.

OPTIONAL INTERNSHIP PROGRAM

QSB student may choose to do an optional Internship which consists of up to two quarters of QSB 595 Internship in an NU core facility, an NU research lab or and external research lab or company. Students doing an internship enrollment in QSB 595 are not charged tuition (QSB 595 is a 0 credit class). **Please note that students are not typically paid during an internship.** However, if the unit hosting the internship chooses to pay the intern, that is allowed for both US and international students. **Internships in NU core facilities are not paid positions.** QSB students who are considering participating in the optional internship program with an NU core facility must notify Prof. Beitel of their intent by May 1st.

Possible venues of internships are as follows:

- One of four Northwestern core facilities at (arranged by the QSB program)
  - Next Generation Sequencing Core
  - Proteomics Core
  - High Throughput Analysis Lab
  - Center for Advanced Molecular Imaging
- An academic research lab, which can be the student's thesis research lab (arranged by student)
- A biotech company (arranged by student)

International students must apply for Curricular Practical Training (CPT) authorization with NU OISS at least one week prior to the start of the internship. **Note that an internship done under CPT authorization does not reduce the 36 months of Optional Practical Training OPT) authorization that a student is eligible for after completing the QSB program.**

FINANCIAL SUPPORT

The QSB program does not provide any financial support for students in the program. Students are expected to bear the full cost of tuition and living expenses. More information can be found on the TGS website.

Students are welcome to travel to conferences, with their advisors' approval, but the QSB program does not provide funding for attending conferences, symposia, workshops or other forms of meetings or training programs. Students wishing to go to a meeting or workshop must arrange funding for the activity themselves. While a student's advisor may choose to pay for the student to attend a conference, such funding is at the discretion of the advisor, is not a program requirement, and would be paid from the advisor's lab funding, not QSB funds. Students can also choose to pay the cost of a meeting themselves or find alternative funding sources.

CONFLICT RESOLUTION

If there is a dispute between the student's thesis advisers or committee members, the student should discuss the situation with the QSB Director who will attempt to resolve the situation. If the QSB Director cannot resolve the situation, the student and/or QSB Director will bring the issue to TGS.

NON-DISCRIMINATION STATEMENT

Northwestern University prohibits discrimination on the basis of actual or perceived race, color, religion, creed, national origin, ethnicity, caste, sex, pregnancy, sexual orientation, gender identity, gender expression, parental status, marital status, age, disability, citizenship status, veteran status, genetic information, reproductive health decision making, height, weight, or any other class of individuals protected from discrimination under federal, state, or local law, regulation, or ordinance or any other classification protected by law in the matters of admissions, employment, housing or services or in the educational programs or activities it operates, as required by Title IX of the Education Amendments of 1972; Title III of the Americans with Disabilities Act of 1990, as amended in 2008; Section 504 of the Rehabilitation Act of 1973; Title VI and VII of the Civil Rights Act of 1964; the Age Discrimination Act of 1975; the Age Discrimination in Employment Act of 1967; and any other federal, state, or local laws, regulations, or ordinances that prohibit discrimination, harassment, and/or retaliation.

The University has designated the Associate Vice President for Civil Rights and Title IX Compliance to coordinate the University's compliance with federal and state civil rights laws regarding protected characteristics, including Title IX and those other laws and regulations references above:

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