

**Master of Science Degree Program**

# **Quantitative and Systems Biology (QSB)**

## **Student Handbook**

Version 2019-11-11

# Student Handbook

## *Quantitative and Systems Biology (QSB)*

For the academic year: 2019-2020

Last Revised 2019-10-22

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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 reserves the right to change without notice any statement contained on the TGS or QSB websites or this handbook 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:

Carole LaBonne (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)

Erik Andersen (Associate Professor, MBS)

Rich Carthew (Professor, MBS)

Vinzenz Unger (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. For a committee meeting to be valid, at least two members the Northwestern University Graduate Faculty must participate.

Program Assistants:

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

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If Ms. Gaines is not available:

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## 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.

**It is of particular importance that students contact their advisor and/or 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 advisory 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, they should enter the committee members 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. Note that, if necessary, students who are doing internships can schedule their final thesis examination during September. 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. 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) <i>Students should be able to...</i>	Milestone/ Requirement/Capacity	Assessment Strategies and Criteria* <i>How do we know this objective has been achieved? What criteria do we have to measure success?</i>
... quantitatively analyze data	Pass the courses IBiS410, Biol_Sci 354, STAT 432	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 IBiS410, Biol_Sci 354, STAT 432	See syllabi of these courses
... contribute original research to scholarly community.	Master's thesis	<b>Assessment Strategy:</b> Committee assesses dissertation prospectus using collaboratively-constructed rubric, demonstrating levels of achievement. <b>Criteria:</b> 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	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

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 2019 was an additional \$6,649.**

**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 Masters tuition rates.

## 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 2019-2020: All courses are 1 credit unless otherwise noted**

**Fall Quarter (Register for at least three total credits):** Two required courses and two electives selected from the list below or the electives document.

#### *Required courses:*

- NICO 401 – Introduction to Programming for Big Data (0.67 credits)
- QSB 401 – Research Techniques, Writing & Presentation
- IBIS 423 - Ethics in Biological Research (0 credit)

#### *Recommend elective courses:*

- NICO 402 – Project for Introduction to Programming for Big Data (0.33 credits)
- IBiS 402 - Eukaryotic Molecular Biology
- IBIS 410 – Quantitative Biology
- STAT 330– Applied statistics for Research 1
- Biol\_Sci 361 - Protein Structure and Function
- Chem\_Eng 376 – Principles of Synthetic Biology

**Winter 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
- Biol\_Sci 354 - Quantitative Analysis of Biology

*Recommend elective courses:*

- Biol\_Sci 323 – Bioinformatics: Biological Sequence and Structure Analysis
- Stats 465 – Statistical Methods for Bioinformatics and Computational Biology
- IBiS 406 – Cell Biology
- IBiS 407 – Genetics and Epigenetics
- Biol\_Sci 378 – Functional Genomics

**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
- IBIS 432 – Statistical methods for bioinformatics and computational biology (requirement also fulfilled by taking STAT 330 in Fall quarter)

*Recommend elective courses:*

- IBIS 404 – Principles and Methods in Systems Biology
- IBiS 401 – Molecular Biophysics

**Summer Quarter (Register for 2 courses, both required)**

*Required course:* QSB 590 – Independent study with thesis (3 units)

*Required training course:* IBIS 421 – Rigor and Reproducibility in experimental design

## 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 Masters 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 PROGRAM

- **Students who excel in the QSB program can be considered for admission to the IBiS program.**
- QSB-to-IBiS transfer applicants will be evaluated relative to the entire pool of IBiS applicants. Because IBiS admissions is highly competitive, it is possible that a minority of QSB students will qualify for admission to the IBiS Ph.D. program.
- QSB students wanting to transfer to IBiS do not need to apply before the IBiS December application deadline; **QSB students can [apply to transfer via The Graduate School \(TGS\) CollegeNet system](#) by March 31st.**
- 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 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 choose 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

FALL 2019	
<b>September 1</b>	Students are required to be on campus ( <i>Sept. 1st OR first Tuesday after Labor Day</i> )
<b>September 4</b>	First day of class for NICO 401
<b>September-Week 2</b>	Students begin scheduling first committee meeting
<b>September 10</b>	Fall tuition for statement I is due
<b>September 19</b>	Registration for classes opens at 9am.
<b>September 24</b>	Regular Fall Classes Begin
<b>September 30</b>	<b>Last day to DROP classes WITHOUT BEING CHARGED FOR TUITION</b> <ul style="list-style-type: none"> <li>- Last day to ADD classes. Students must be registered for three graduate-level classes to fulfill degree completion and visa requirements.</li> <li>- Students must submit IDP plans to QSB office</li> </ul>
<b>October 1</b>	Fall tuition statement I is due
<b>October 10</b>	Fall tuition statement II is available
<b>November 1</b>	Fall tuition for statement II is due
<b>November 11</b>	Winter Quarter registration opens
<b>December- Week 1</b>	First meeting of student and thesis committee; research plan presented to committee
<b>December 7</b>	Fall classes end
<b>December 10</b>	Winter tuition statement is available
WINTER 2020	
<b>January 1</b>	Winter tuition is due
<b>January 6</b>	Winter Quarter classes start
<b>January 30</b>	Students must submit Spring Quarter thesis committee meeting date to QSB office
<b>February 24</b>	Registration for Spring classes opens
<b>March 10</b>	Spring tuition statement is available
<b>March 15</b>	Students must submit Spring Quarter thesis committee meeting date to QSB office
<b>March 31</b>	Last day to submit applications to transfer from QSB program to IBiS program

Spring 2020	
April 1	<ul style="list-style-type: none"> <li>- Spring Quarter classes start</li> <li>- Spring tuition is due</li> <li>- <b>(Optional): First day to submit Application for Degree</b> (for August graduation) <b>that allows a student to participate in June commencement ceremonies.</b> Visit the TGS Site&gt;Academic Policies &amp; Procedures&gt; Graduation to access instructions and application for a degree form.</li> </ul> <p><b>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.</b> (Note: If a student actually commits to the internship during the summer quarter, the student must withdraw their application for degree by contacting TGS after the commencement ceremony, but before July 9th.</p>
April 13	Summer Quarter registration opens
April 24	<b>(Optional): Last day to submit Application for Degree</b> (for August graduation) <b>that allows a student to participate in June convocation ceremonies.</b>
April - May	Spring-quarter thesis committee meeting: Progress to date on research, outline for thesis
May 10	Summer tuition statement is released
May 30	Students must submit thesis examination date to QSB office
SUMMER 2020	
June 1	Summer tuition is due
July 9	<b>For students doing an internship and who filed an Application for Degree with an August graduation date, this is the last day to withdraw their application</b>
JULY 10	<p><b>Last day to submit Application for Degree for August graduation.</b>  QSB students participating in the optional Internship/CPT program do NOT file for graduation in August, but instead, file at the end of the term that they will graduate. The Application for a Degree form available in the TGS Forms tab in <b>GSTS</b>.</p>
July-August 15	Thesis examination and public presentation of research
August 21	<b>Last day to submit Master's Degree completion form for August graduation.</b> The Master's Degree Completion form is completed using the TGS Forms tab in <b>GSTS</b> .
August 22	<b>Students doing internships need to register for QSB 595</b>
FALL 2020	
September 14 <i>Approximate</i>	<b>Last day for QSB 595 registration</b>
December 6 <i>Approximate</i>	<p><b>Last day to submit Master's Degree completion form for December graduation.</b>  The Master's Degree Completion form is completed using the TGS Forms tab in <b>GSTS</b>.</p>
SPRING 2021	
March 13 <i>Approximate</i>	<p><b>Last day to submit Master's Degree completion form for March graduation.</b> The Master's Degree Completion form is completed using the TGS Forms tab in <b>GSTS</b>.</p>

## SATISFACTORY ACADEMIC PROGRESS

The Graduate School (TGS) sets the minimum standard for satisfactory academic progress (see <https://www.tgs.northwestern.edu/about/policies/satisfactory-academic-progress.html>). 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

At the student's first committee meeting December or January, 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 approximately 8 pages in length, 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 not smaller than 12. All sections should be referenced appropriately. Good proposals are clear, precise, and succinct.

The Research Plan should contain the following sections:

- **Title Page:** List the title of the proposal, the student's name and thesis lab. (Printed on separate page.)
- **Summary:** The summary should be a brief synopsis of the proposed research. It should state the scientific background of the proposal, the specific aims and objectives, the methods or procedures to be used, and the potential significance of the research. (The summary and specific aims should fit on one page.)
- **Specific Aims:** Provide a clear, concise point-by-point summary of the aims of the work proposed. (The summary and specific aims should fit on one page.)

- **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).
- **Experimental Design and Methods:** Discuss in more detail the experimental design and the procedures to be used to accomplish the specific aims of the project. For each specific aim, include the following subsections (approximately three pages plus preliminary data):
  - **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.
- **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).

## THESIS & THESIS EXAMINATION

Students graduating at the end of the summer quarter must submit their Master's thesis and have a thesis examination by Aug. 14. They further must present a public talk on their thesis by Aug. 23 (this talk will be scheduled by the QSB program). Thesis revisions must be completed by Aug. 30 for a degree to be granted at the end of the summer quarter.

For students participating in the optional internship program and thus graduating at the end of the Fall or Winter quarter must submit their master's thesis and have a thesis examination by Sept. 30<sup>th</sup> and thesis revisions must be complete by Oct. 15<sup>th</sup>. Despite the later thesis deadlines, students participating in internships must nonetheless present a public talk on their thesis by Aug. 23 with the other QSB students (this talk will be scheduled by the QSB program).

## 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 a summary of what was accomplished in the research, a table of contents, an introductory chapter that summarized the problem being investigated and the relevant background literature, one or more results chapters, a discussion chapter that puts the students results in context of the field and discusses future directions for the project, a chapter of references and one or more optional appendixes that contain results or analyses that were not included in the main text.

Students will present an outline of their thesis to their thesis committee at their second thesis committee meeting. The student is expected to prepare the outline and final thesis in a timely manner to allow the faculty member to review and provide comments on the documents prior to the documents being submitted to the thesis committee.

The thesis will be evaluated by the student's thesis committee during the thesis examination. It is expected that it will common for 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 opportunity to revise it. Revisions must be completed by 18 months following the student's admission to the program.

## 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.

## 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 the approval of their advisors, however 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.