Case Western Reserve University

Systems Biology and Bioinformatics

Graduate Program

Student Handbook

Version 7

September 2023

Systems Biology and Bioinformatics

Graduate Program Handbook

January 2023

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1. Preface

This Handbook provides an overview of the Systems Biology and Bioinformatics (SYBB) Graduate Program at Case Western Reserve University. The handbook describes the special features, requirements and expectations of the SYBB program. The policies described in this apply to incoming students for the 2022-2023 academic year and beyond. Students should be familiar with requirements and guidelines of the university, the School of Graduate Studies and the SYBB program. Many, but not all, of these requirements are described in this document. There are several other useful documents and websites that describe the opportunities and requirements associated with graduate study at CWRU.

Policies of the School of Graduate studies, along with links to important forms and dates can be found at case.edu/gradstudies

School of Medicine resources and information can be found on the Office of Graduate Education website. case.edu/medicine/admissions-and-programs/graduate-programs

The Graduate Student Council (GSC) web site, Graduate Student Council - CampusGroups at Case Western Reserve University, provides additional resources and information for enrolled graduate students.

2. Program Overview

The Case Western Reserve University School of Medicine established the first PhD and MS programs in Systems Biology and Bioinformatics (SYBB) in the State of Ohio in 2011. Based in the School of Medicine, with the Department of Nutrition as its administrative home, the faculty cohort includes faculty from multiple departments and schools across the CWRU campus to provide a diverse training environment for our students.

The SYBB program at CWRU offers trainees the opportunity to combine experimental with computational or mathematical disciplines to understand complex biological systems. The goal of this program is to produce scientists who are familiar with multiple disciplines and equipped to conduct interdisciplinary research. The SYBB program trains scientists who are able to generate and analyze experimental data for biomedical research and to develop physical or computational models of the molecular components that drive the behavior of a biological system.

The specific academic requirements of the SYBB Program are intended to provide students with a required core curriculum in Systems Biology and Bioinformatics and a set of electives designed both to assure minimum competencies in our three fundamental

core competencies and equip trainees for their particular thesis/dissertation research discipline. Each trainee will be guided in their course of study by a mentoring committee to ensure the completion of training in the program competencies as well as the maintenance of a focus on molecular systems theory.

Fundamental Core Competencies

The specific academic requirements of the SYBB Program are intended to provide students with a required core curriculum in Systems Biology and Bioinformatics, and a set of electives designed to assure minimum competencies are met.

Each trainee will be guided in their customized course of study by a mentoring committee to ensure the completion of training in the program competencies as well as maintenance of a focus on molecular systems theory.

These competencies are:

- Evaluation of the scientific discovery process and of the role of bioinformatics in it in detail, including data generation steps and understanding the biology
- Application of computational and statistical methods appropriate to solve a given scientific problem
- Construction of software systems of varying complexity based on design and development principles
- Effective teamwork to accomplish a common scientific goal.
- Building knowledge in local and global impact of bioinformatics and systems biology on individuals, organizations, and society
- Effective communication of bioinformatics and systems biology problems to a range of audiences, including, but not limited to, other bioinformatics professionals

Program Tracks

The Case Western Reserve University (CWRU) graduate program in Systems Biology and Bioinformatics (SYBB) has two tracks:

- **Molecular and Computational Biology –** This track embraces the pursuit of basic science research employing the application and development of computational approaches to address difficult questions derived from large "big data" datasets. This track equips students in both acquisition of data using omics approaches and extends this work through computational approaches. Graduates in this track will find ample opportunities within the pharmaceutical industry, contract research organizations and academic career paths.

- **Translational Bioinformatics –** The translational bioinformatics track trains students to work at the interface of 'omics and clinical medicine. From integrating genomic data into electronic medical records, to developing tools to analyze and communicate genomic risk to patients, students trained in this track work to integrate bioinformatics tools and technologies into clinical workflows. Graduates of this track will find opportunities within industry as well as in more varied academic and clinical settings.

Program Administration and Coordination: The SYBB program is guided by a steering committee chaired by Cheryl Cameron, Graduate Program Director for the SYBB Ph.D. program, Assistant Professor of Nutrition (Primary), Assistant Professor of Pathology (Secondary). The Steering Committee members are: Mark Chance, Vice Dean for Research, Professor of Basic Science, Director, Center for Proteomics & Bioinformatics; Mehmet Koyuturk, Associate Professor of Computer and Data Sciences Department (Primary) and Center for Proteomics & Bioinformatics (Secondary); David T. Lodowski. Assistant Professor of Nutrition (Primary), Center for Proteomics and Bioinformatics (Secondary) and Pharmacology (Secondary); William Bush, Assistant Professor of Population and Quantitative Health Sciences (Primary); Gurkan Bebek, Graduate Program Director for the SYBB M.S. program, Assistant Professor of Nutrition (Primary) Center for Proteomics and Bioinformatics (Secondary), Computer and Data Sciences Department (Secondary) and Mark Cameron, Associate Professor of Population and Quantitative Health Sciences (Primary). The coordinator for the SYBB program is Katie Gaffen.

Admission to the SYBB program is offered through the School of Medicine's Biomedical Research Training Program (BSTP) or the Medical Science Training Program (MSTP) and in rare instances through direct admission to our program. Our preferred route of application for PhD applicants is through the BSTP or MSTP PPI or umbrella programs.

3. PhD Program

A. Academic Requirements for the PhD

All PhD students in the Systems Biology and Bioinformatics program will fulfill the overall academic requirements for PhD study at Case Western Reserve University; students entering with a Bachelor's degree will satisfactorily complete a minimum of 36 semester hours of courses (which may include independent study/research, course 601 - pre-dissertation research credits). All course work must be at the 400 level or higher, and at least 24 semester hours of coursework must be graded. The Systems Biology and Bioinformatics PhD program offers a customized curriculum uniquely tailored to student's interests and research needs; the student in concert with their mentoring committee

designs a set of classes which address both interests and research needs for accomplishment of dissertation research. This includes three core classes, which for both the Translational Bioinformatics and Molecular and Computational Biology tracks includes: Bioinformatics for Systems Biology (SYBB 459), Bioinformatics Data Science (SYBB 412) and Current Proteomics (SYBB 555).

In addition to the coursework credits requirements, students must successfully pass the candidacy examination, and obtain a minimum of 18 dissertation research credits (SYBB 701). Students are also required to register for the SYBB journal club (SYBB 501) each semester and will either present their own work or a journal article once a year. Students are also required to attend the Department of Nutrition seminar series, which includes one faculty seminar speaker and one invited external speaker each month. For students admitted with advanced standing (students admitted with an approved previous master's degree), the classwork requirements are reduced slightly to the completion of at least 18 semester hours of 400-level or higher course work, 12 credits of which must be graded. The dissertation research credit requirement remains the same for students with advanced standing. Additional requirements for all doctoral students include a course in Research Rigor and Reproducibility (IBMS 450), a course in the Responsible Conduct of research (IBMS 500), a qualifier exam, a PhD Dissertation and an oral defense consistent with CWRU requirements. Note that after the fourth year in the program, PhD students are required to also begin attending the RCR+4 (Responsible Conduct in Research year 4 and beyond training) talks to extend their responsible conduct in research training.

Advanced Standing

Students entering with a bachelor's degree will complete a minimum of 36 semester hours of courses. For students entering with an approved Master's degree, completion of at least 18 semester hours of 400-level or higher course work is required and at least 12 semester hours of this course work must be graded.

B. Tuition and Stipend

Full time registered SYBB PhD students are eligible for and receive tuition, health insurance and stipend support. Stipends and tuition are funded by NIH training grants, NIH individual research grants, NSF grants and university resources. Regardless of entry mechanism, SYBB students who are not funded externally will receive at least the same amount of stipend support as BSTP program students (BSTP stipend for the 2022-2023 year is $35,000). After the first year, the source of funds for tuition and stipend support is the responsibility of the research mentor and his/her home department. Students are highly encouraged to seek support through the submission of individual training grants.

Three potential funding opportunities for PhD students are:
NSF Graduate Research Fellowship Program (GRFP)

http://www.nsfgrfp.org
Application opens in August and is due in November.

DOE Computational Science Graduate Fellowship (CSGF)
http://www.krellinst.org/csgf/
Application opens in October and is due in January.

NIH F31- Ruth L. Kirschstein Predoctoral Individual National Research Service Award
https://researchtraining.nih.gov/programs/fellowships/F31
Applications are accepted in April, August and December.

C. Mentoring Committee

Entering students will be assigned a faculty mentor by the SYBB steering committee upon acceptance of the trainee into the SYBB program. In consultation with the mentor, a committee consisting of at least two SYBB trainers is formed to guide the student's matriculation during the first year or until the student joins his/her dissertation research laboratory. The student's overall planned program of study (PPOS) integrating these directives will be completed and approved by the SYBB Graduate Program Director at the end of the first year. The mentoring committee guides the coursework choices of the student such that they will have completed training in the SYBB fundamental core competencies required for their thesis research by the end of year two. Once the student has chosen a dissertation research mentor, the research mentor becomes the head of the student's mentoring committee if he/she is not already a member of the committee. The research mentor will also be assigned to be the advisor of record in the Student Information System (SIS). Upon passing to PhD candidacy, the student's dissertation committee will replace the mentoring committee in this advisory capacity; note that it is the policy of the SYBB program that the research advisor cannot serve as the chair of the dissertation committee. There is no expectation that mentoring committee members remain on the dissertation committee.

D. Planned Program of Study

An official Planned Program of Study (PPOS) is required to be submitted in SIS for each graduate student by the end of the second semester by the school of graduate studies. **The PPOS must be submitted no later than the end of the second semester of graduate study to avoid a Registration Hold.** SYBB students draft a PPOS during the second semester of their first year in consultation with their mentoring committee. The Planned Program of Study which consists of the courses and other requirements for the PhD degrees must be established in consultation with the student's mentoring committee and then must be approved by the SYBB Graduate Program Director. After approval by the SYBB GPD, the student will submit their PPOS via the Student Information System (SIS) for faculty/research advisor and School of Graduate Studies approval. A revised program of study must also be approved and submitted *via* SIS when any change in the original plan occurs.

Submission Process
The Student Information System User Guides at https://case.edu/registrar/sisresources page provides guides to all common SIS activities and a training manual on creating a planned program of study. Submit your PPOS via the https://sis.case.edu/.

Individual Development Plan
Students are also required to submit and discuss an IDP with their mentor by the middle of the second semester of their first year in the program. The IDP will be reviewed by the mentor and student at least annually. An IDP must be submitted through the IDP portal provided by the school of graduate studies at https://med-ed.case.edu/IDP/Default.aspx.

E. Laboratory Rotations for Undecided Direct Admit and BSTP PPI Students

Students will generally participate in three or more laboratory rotations of six to eight weeks in length. A student may request to be admitted to a laboratory at any time after matriculation, but it is suggested that students rotate with at least three laboratories prior to deciding. SYBB PPI students will rotate through three laboratories as per the funding agreement with the dean for first year support prior to selecting a dissertation research laboratory. The student, the selected research mentor, the mentor's department chair and the SYBB steering committee/GPD must approve the laboratory selection in writing. Approval can only be granted upon receipt of the signed Mentor Agreement Form.

F. Bioinformatics Journal Club and Works in Progress presentations

The SYBB Journal Club (SYBB 501) is designed to assist SYBB students in the development of effective presentation skills and critical reading assessment of literature and research. Each student is required to attend the journal club and present one paper or works in progress talk per year after his/her initial semester in the program. Attendance at departmental seminars is also required and is part of the attendance policy for the SYBB journal club. Works in progress talks provide students an opportunity to share and discuss their research in order to gain feedback. It is expected that the students in the audience provide questions/feedback to presenters. Immediately after presenting journal club students are provided a private assessment of their presentation and presentation skills from the faculty in attendance.

G. Dissertation Advisory Committee

Prior to the Qualifying Exam, the student will form a Dissertation Advisory Committee to conduct the qualifying exam and to guide the dissertation research plan. The committee must be chaired by a tenured or tenure-track faculty member and must include (at least) three other CWRU faculty members. The committee must include: the research mentor, at least one faculty member with expertise in relevant experimental work and at least one faculty member with expertise in relevant computational and mathematical analyses.

Members of the dissertation advisory committee may fulfill more than one requirement so long as the committee has at least four members. This committee will serve to evaluate the student's candidacy to the PhD and becomes the Dissertation committee after admission to candidacy to provide needed guidance during the course of the student's dissertation research, regularly attending the bi-yearly dissertation progress meetings required by the SYBB program. The dissertation committee also serves to evaluate the final dissertation defense of the PhD.

H. Qualifying Exam and Advancement to Candidacy

During the second semester of the student's second year, the student will generate and defend an NIH or NSF style proposal based on their proposed dissertation research as their qualifier exam; successful oral defense of this proposal and completion of core requirements will result in recommendation for formal PhD candidacy. Candidates not successful at this stage may have a second opportunity to defend their proposal only at the discretion of both the SYBB steering committee and the Dissertation Committee. Once a student passes to advance to candidacy, the Advancement to Candidacy form must be filled out immediately and filed with the School of Graduate Studies. Forms can be found at https://case.edu/gradstudies/current-students/forms. At this point, successful student will formally identify a university faculty member (IN most cases this is the research mentor, but in rare instances could be another faculty member) who will serve as the doctoral student's Research Advisor/Mentor and formally notify the Dean of Graduate Studies.

Qualifying Exam Guidelines

The exam consists of a written NIH style proposal detailing the student's dissertation research project, which is followed by an oral defense that will primarily deal with the proposed research but may also delve into the student's general biological knowledge and application of systems theory and bioinformatics techniques to biological questions. Proposals will follow the format/requirements of a standard F31 proposal. The link to proposal requirements is: http://grants.nih.gov/grants/guide/pa-files/PA-11-111.html. The proposal (as submitted to committee) will to include: Abstract, Relevance, Specific Aims (1 page) and Research Strategy (6 pages). The student's mentor and the dissertation committee may provide feedback to the student as he/she is developing the proposal, but it is expected that the proposal is the student's work.

No less than four weeks prior to the Qualifying exam, the student must schedule a pre-qualifying exam meeting with the Dissertation committee to ensure that the project proposal will be sufficient and appropriate for a Qualification exam. At minimum specific aims should be presented at this meeting; it is expected that all Dissertation Committee members be present in person or via teleconference during this pre-meeting as student (and possibly mentor) will be apprised of the feasibility of the project for both the qualification exam as well as the following Dissertation research.

No less than three weeks prior to the scheduled oral exam, the student will deliver either electronic or paper copies of the proposal to the committee, who will read prior to the oral defense. The Oral Qualifying Exam will be conducted by the candidate's dissertation advisory committee in the presence of the student's advisor. The student's advisor does not participate in the actual examination, but should be present for the examination, as the advisor is allowed to make a statement of support of the student after the oral presentation/defense, as well as answer questions about the student's research project.

The general format for the oral exam is a 30-45 minute talk presenting preliminary results and detailing the experimental plan going forward; the student is not limited to the experimental plan presented in the written proposal as there may be multiple projects which the student is undertaking. **It is the policy of the School of Graduate Studies and the SYBB program that all committee members be physically present for the Qualification exam and Dissertation defense meetings.** The committee will then question the student about the results and implementation of the experimental plan presented and should evaluate the student's proposed project. *While a general examination of biological applications of systems theory and bioinformatics are not the goal of the examination, students should be aware of these and their application to the proposed project along with a thorough understanding of the biology of the project*.

Upon successful passage to candidacy, it is expected that students will submit the fellowship proposal to the NIH for consideration; this should be based upon the qualifying exam project and should implement the feedback on the document/proposal. The Department of Nutrition administration staff will provide assistance with completion and submission of the application package. Students are encouraged to apply for fellowships through the NSF, DOE and other funding bodies throughout their stay in the SYBB program.

Requirement for bi-annual committee meetings and progress reports

Upon advancement to candidacy, students are expected to meet with their dissertation committees at least twice a year, informing the committee as to their progress and results. After these meetings, the Chair of the Dissertation Advisory Committee will report the student's research progress and dissertation progress via a one page written report and cover page detailing details pertaining to the progress to degree. Starting in 2018 this cover page will be filed with the School of Graduate Studies. These reports are appended to the student's annual progress report, demonstrating that committee meetings have occurred and that progress toward the degree is occurring. To ensure a reasonable time to degree, beginning in Year 5, students are required to have committee meetings every four months, and should a student's tenure in the program extend beyond year five, the Graduate program will assess the student's progress by having the GPD or other trainer sit in on these meetings with the possibility that we may add additional committee members to assist with satisfactory progress to degree.

I. Annual report of student progress

Students are expected to at the end of each school year submit a yearly progress report to the SYBB graduate director. This form will be sent out at the end of April, and will be due no later than May 31. Upon receipt of the report, the GPD will meet with the student to discuss progress to degree.

J. Course 701 Requirements

A student who has advanced to candidacy must take SYBB 701 research credits starting the semester immediately following the successful Candidacy exam. Students who have advanced to candidacy must register for 1-9 credits of SYBB 701 each fall and spring semester (or up to 6 credits for the summer when needed). Students who have not advanced to candidacy may begin registering for up to a total of 6 credit hours of course 701 with departmental approval by completing the Predoctoral Standing form. Forms can be found at https://case.edu/gradstudies/current-students/forms. ***No student will be given departmental or instructor permission to register for SYBB 701 unless proper Advancement or Predoctoral status has been approved by Graduate Studies.*** **Once a student begins registration of 701 credit hours, the student must register for at least one credit hour of 701 every semester until graduation.** A minimum of 18 credit hours of SYBB 701 is required to graduate. Students have five years to complete their degree from their first registration of SYBB 701. Extension beyond this five year clock is only given with a petition for and approval of the School of Graduate Studies.

K. Dissertation Requirements

PhD candidates must submit a written dissertation as evidence of their ability to conduct independent research at an advanced level. The dissertation must represent a significant contribution to existing knowledge in the student's field, and at least a portion of the content must be suitable for publication in a reputable professional journal or as a book or monograph. Students must prepare their own dissertations. Joint dissertations are not permitted. The written dissertation must conform to regulations concerning format, quality, and time of submission established by the Dean of Graduate Studies. General instructions can be obtained from the School of Graduate Studies. https://case.edu/gradstudies/current-students/electronic-theses/. Please pay close attention to newly added accessibility guidelines. Dissertations should not contain proprietary or classified material. When the research relates to proprietary material, the student and adviser are responsible for making preliminary disclosures to the sponsor in advance to permit timely release of the dissertation. In rare cases an embargo on the dissertation of up to one year may be granted, but the publication of the dissertation is an absolute requirement for the granting of the PhD. These arrangements must be disclosed when the dissertation is submitted to the School of Graduate Studies.

SYBB program guidelines for format and content of the dissertation
Research for the dissertation is to be carried out under the direct supervision of a university faculty member. See appendix (Below) for a comprehensive guide to writing the dissertation.

L. Final Oral Examination (Dissertation Defense)

Each doctoral candidate is required to pass a final oral examination in defense of the dissertation. A student passes the final oral examination if no more than one voting member dissents.
A SYBB policy is that you must have a pre-defense committee meeting no less than 30 days prior to your dissertation defense date, and *no* oral defense may be scheduled prior to this meeting. Only the majority of the members of your committee need be present for this pre-defense meeting. For PhD students, the Notification for Scheduling the Final Oral Exam for the PhD form: http://case.edu/gradstudies/media/caseedu/grad-studies/documents/Notification-for-Scheduling-the-Final-Oral-Exam-for-the-PhD.pdf may be filed only after this meeting, **at least three weeks prior to the scheduled defense date.** By signing this form, the **adviser is indicating that the work is ready to defend**. The defense must be published on the University Calendar and open to the campus community. The candidate will provide each committee member with a copy of the completed dissertation at least two weeks prior to the examination, and a bound final version should go to the SYBB director for archival purposes.

M. Publication Requirements

A minimum of one manuscript published or accepted for publication first author publication is required prior to the Dissertation Defense. Co-first authorship is acceptable for this requirement. Any deviations of this policy must be negotiated in advance of scheduling the final defense with both the student's Dissertation Committee and the GPD/SYBB steering committee and must be granted in writing.

N. Graduation Instructions for Doctoral Candidates

SYBB students need to prepare and apply well in advance for graduation. In order to graduate, students must complete the Application for Graduation process in the Student Information System (SIS) by the established deadline(s). Students who fail to meet the established deadlines must re-apply to graduate. The deadlines posted are firm.
Additionally, students must complete all of the required forms in the PhD graduation packet. This packet contains all the necessary forms and instructions for graduation. For more information and the graduation packet, go to: https://case.edu/gradstudies/current-students/graduation/doctoral-graduation.
Important dates and deadlines for graduation can be found at https://case.edu/gradstudies/current-students/dates-deadlines. Students must be registered during the semester in which they graduate and candidates must meet all of

the deadlines set forth in the Graduate Studies calendar. Students must satisfy all financial obligations to receive their degree.

O. **Suggested Timeline for PhD Degree by End of year 5**

Year	Fall Semester	Spring Semester
1	▯ Establishment of mentoring committee ▯ Laboratory Rotations ▯ Identification of Research Mentor ▯ Course Work	▯ Laboratory Rotations(if still necessary) ▯ Identification of Research Mentor/Advisor (beginning of semester) ▯ Development /submission/ of PPOS ▯ Course Work ▯ Pre-Qualification Dissertation Research (601) ▯ Qualification Exam Preparation ▯ Journal Club Presentation
2	▯ Qualifying Exam Preparation ▯ Pre-Qualification Dissertation Research (601) ▯ Course Work ▯ Journal Club Presentation ▯ Begin Identification of Dissertation Committee members ▯ Predoctoral Standing if applicable	▯ Finalize Dissertation Committee membership ▯ Qualifying Exam Presentation ▯ PhD Dissertation Research ▯ Course Work ▯ Journal Club Presentation ▯Predoctoral Standing if applicable
3	▯ PhD Dissertation Research ▯ Journal Club Presentation	▯ PhD Dissertation Research ▯ Dissertation Committee Meeting ▯ Works in Progress Presentation
4	▯ PhD Dissertation Research ▯ Journal Club Presentation	▯ PhD Dissertation Research ▯ Dissertation Committee Meeting ▯ Works in Progress Presentation
5	▯ PhD Dissertation Research ▯ Journal Club Presentation	▯ PhD Dissertation Research ▯ Dissertation Committee Meeting ▯ Works in Progress Presentation ▯ Dissertation Defense ▯ Graduation

4. MS Degree

A. Academic Requirements for the MS degree

In addition to the PhD degree, the SYBB program also offers a research intensive MS as well as a classwork based MS degree. Candidates for the MS degree must complete at least 30 total credits and will fulfill the overall academic requirements for MS study at Case Western Reserve University. MS students will have the option to complete a course of study with thesis (Plan A) or without thesis (Plan B). Our preferred route to the MS is the thesis (Plan A) as this provides a portfolio of work/projects to show to potential employers.

Master's Thesis (Plan A)

This is the preferred route for students obtaining an SYBB MS degree. The School of Graduate Studies' minimum requirement to complete a Master's degree under Plan A is 30 credit hours. Of these credit hours, students must complete at least 21 hours of coursework, of which at least 12 semester hours of coursework must be graded along with (at least) 9 hours of SYBB 651 thesis registration. At least 18 semester hours of coursework, not including thesis, must be at the 400 level or higher. Students are also required to register for the SYBB journal club every semester they are registered as a student and are expected to present on a yearly basis. **Please note, once a student begins registration of SYBB 651, the student must register for at least one unit of SYBB 651 every semester until graduation.**

For completion of Plan A Master's degrees, an oral examination (defense) of the Master's thesis is required. These examinations are conducted by a committee of three University faculty members. The candidate's thesis adviser usually serves as the chair of the examining committee. The student along with the thesis advisor will identify the other two members of the examining committee and the examining committee must agree unanimously that the candidate has passed the thesis examination, and that the written thesis is a sufficient summary of the research project and in final form. Because theses are made public immediately upon acceptance, they should not contain proprietary or classified material. When the research relates to proprietary material, the student and advisor are responsible for making preliminary disclosures to the sponsor sufficiently in advance to permit timely release of the thesis, and these plans should be disclosed when the thesis is submitted to the School of Graduate Studies.

Master's Comprehensive (Plan B)

The minimum requirement to complete a Master's degree under Plan B is also 30 hours. In addition to coursework, students must successfully complete a comprehensive project based examination. At least 18 semester hours of coursework must be at the 400 level or higher and at least 12 semester hours of coursework must be graded. Students are also required to register for the SYBB journal club every semester they are registered as a student, and are expected to present on a yearly basis.

The comprehensive project based examinations are administered by a member of the SYBB steering committee. The examination may consist of a written report, an oral examination or both. A student must be registered during the semester in which any part of the comprehensive examination is taken. If not registered for other courses, the student will be required to register for one semester hour of EXAM 600, Comprehensive Examination, before taking the examination.

SYBB Requirements for MS program

The Systems Biology and Bioinformatics MS program includes a set of required core courses emphasizing molecular systems biology. For the Translational Bioinformatics and Molecular and Computational Biology tracks required courses include: **Bioinformatics Data Science (SYBB 412), Bioinformatics for Systems Biology (SYBB 459) and Current Proteomics (SYBB 555).** Students are required to complete at least 7 additional courses as outlined by the student's mentoring committee (for at least 15 additional credits). Each semester enrolled students are required to register for and participate in the SYBB Journal Club (SYBB 501). Students are also required to attend works in progress presentations and Center for Proteomics and Bioinformatics/Nutrition Department Seminars. Upon completion of the first semester, students will be required to present for the Journal Club or works in progress presentations at least once per year.

B. Tuition

Students enrolled in the SYBB program are responsible for their own tuition and fees. However, students are encouraged to apply for grants/funding to defray costs if possible. Tuition rates and fees are available on the Student Accounts website: https://case.edu/studentaccounts/tuition-fees/graduateprofessional-tuition-fees/school-of-graduate-studies.

C. Faculty Mentors and Mentoring Committee

Entering students will be assigned a mentor by the SYBB Graduate Program Director upon admission to the SYBB program. After the first semester, the MS student along with their mentor will recruit at least one more faculty mentor from the list of SYBB trainers to guide their MS studies. The mentoring committee will recommend a course of study uniquely tailored to the student's SYBB track and student's interests and expertise. The mentors will guide the coursework choices of the student such that they will have completed training in the fundamental core competencies required for the thesis research. Once the student has chosen a research mentor, the research mentor will also become the advisor of record in SIS and heads the student's mentoring committee.

D. Planned Program of Study

An official Planned Program of Study (PPOS) is required for each graduate student by the end of the second semester. **The PPOS must be submitted no later than the end of the second semester of graduate study to avoid a registration hold.** Entering students are assigned a mentoring committee of two faculty members to guide their first year. The mentoring committee will recommend a course of study to be approved by the steering committee. SYBB students draft a PPOS during the second semester of their first year in consultation with their mentoring committee which will be approved by the end of the second semester for MS students. These mentors will guide the coursework choices for the student such that they include appropriate coverage of the core competencies in genes and proteins, bioinformatics and quantitative modeling and analysis such that the student will have completed training in the three major areas necessary for successful accomplishment of thesis research.

Upon approval of the SYBB Graduate Program Director, the student will submit their PPOS via the Student Information System (SIS) for major faculty/research advisor and School of Graduate Studies approval. A revised program of study must also be approved and submitted *via* SIS when any change in the original plan occurs.

Submission Process
The Student Information System User Guides at https://case.edu/registrar/sisresources page provides guides to all common sis activities and a training manual on creating a planned program of study. Submit your PPOS via the https://sis.case.edu/.

Individual Development Plan
Students are also required to submit and discuss an IDP with their mentor by the middle of the second semester of their first year in the program. The IDP will be reviewed by the mentor and student at least annually. An IDP must be submitted through the IDP portal provided by the school of graduate studies at https://med-ed.case.edu/IDP/Default.aspx.

E. Laboratory Rotations

Plan A MS students have the option to rotate in SYBB trainer laboratories to find a research mentor for their thesis. A student may request to be admitted to a laboratory at any time after matriculation. The student, the research mentor, the Department Chair of the mentor, and the Graduate Program Director must approve the laboratory selection in writing. Research mentors are expected to fund the research of the MS student, but are not expected to defray tuition or provide a stipend.

F. Final Oral Examination (Thesis Defense)

Each Type A Master's candidate is required to pass a final oral defense of their thesis. All members of a student's thesis committee must approve the award of the MS degree based both upon this thesis defense and the content and format of the written MS thesis**. A SYBB policy is that you must have a pre-defense committee meeting no less than 30**

days prior to your thesis defense date to ascertain your readiness to defend, and no oral defense may be scheduled prior to this meeting. Only the majority of the members of your committee need be present for this pre-defense meeting. The candidate must provide each committee member with a copy of the completed thesis at least two weeks prior to the examination.

G. **Masters Graduation**

SYBB students need to prepare and apply well in advance for graduation. In order to graduate students must complete the Application for Graduation process in the Student Information System (SIS) by the established deadline. Students who fail to meet the established deadlines must reapply to graduate. The deadlines posted are firm.
Additionally students must complete appropriate MS graduation packet. This packet contains all the necessary forms and instructions for graduation. http://case.edu/gradstudies/current-students/graduation/. Students must be registered in the semester in which they graduate, and candidates must meet all of the deadlines set forth in the Graduate Studies calendar. Students must satisfy all financial obligations to receive the degree.

5. **Graduate School Calendar**

For more details on deadlines for graduation see:
http://case.edu/gradstudies/current-students/dates-deadlines/

The School of Graduate Studies maintains a calendar of due dates for each academic year. Items included in the calendar include:

- Application for graduation
- Deadline to submit materials for graduation
- Registration information
- Graduate studies orientation
- University holidays
- Class schedule

6. **Commonly Used forms**

Forms needed for graduation and other official PhD and MS business can be found at:
http://case.edu/gradstudies/current-students/forms/

- Advancement to Candidacy (PDF)
- Drop/Add (PDF)
- Fellowship Course Application (PDF)
- Notification for Scheduling the Final Oral Exam for the PhD (PDF)
- Leave of Absence (PDF)
- Petition for an Extension (PDF)

- Petition for Course Repeat (PDF)
- Petition for Transfer of Credit (PDF)
- Petition for Transfer of Department (PDF)
- Predoctoral Standing (PDF)
- V-Fund Application Form (PDF)

7. Electronic Thesis or Dissertation Guidelines

ALL PhD and Master's Plan A students are required to submit dissertations or theses electronically to the School of Graduate Studies via OhioLINK.
https://case.edu/gradstudies/current-students/electronic-theses/

Committee Approval Sheet
A Committee Approval Sheet must be included as the second page of your PDF document. This form should only have the typed names of your committee, not signatures.

Publishing
It is a requirement of Case Western Reserve University to publish all doctoral dissertations through UMI/ProQuest. Please note that electronic dissertations will be submitted to UMI/ProQuest on behalf of CWRU by OhioLink. The doctoral graduation packet contains a form which contains detailed information about electronic publishing.

Copies
Although you will submit your thesis/dissertation electronically, you may need to make printed copies for the members of your defense committee as well as one for the SYBB program. It is the student's responsibility to deliver to each committee member a copy of the thesis/dissertation at least two weeks prior to the defense examination date.
Some students wish to have copies bound for their own use. Contact the University Bookstore (368-1661) for information on its binding service.

SYBB MS Thesis and PhD Dissertation Guidelines

Your Master's thesis or PhD Dissertation provides both documentation of the experimental and theoretical aspects to your research project as well as serving as proof that you have gained expertise in the subject matter. The thesis demonstrates that you can apply what you have learned to the process of finding answers/providing analysis to clinical or biological problems. The School of Graduate Studies has specific requirements for order and format of these documents. They can be found here: https://case.edu/gradstudies/current-students/electronic-theses/ (much of the information on order/formatting are taken from here).

Preparation to write a Master's Thesis/ PhD Dissertation:

1. Keep in mind that these documents are actually a publication and should be treated with the utmost seriousness; Master's students will work closely with their MS Thesis advisor to get a copy distributed to the rest of your committee prior to the thesis defense. This could take several months and several rounds of rough drafts and revision prior to being ready for dissemination to the rest of the committee.
2. A SYBB policy is that you must have a pre-defense committee meeting no less than 30 days prior to your dissertation defense date, and no oral defense may be scheduled prior to this meeting. Only the majority of the members of your committee need be present for this pre-defense meeting.
    1. For PhD students, the Notification for Scheduling the Final Oral Exam for the PhD form (Notification for Scheduling the Final Oral Exam for the PhD) may be filed only after this meeting.
    2. For masters students, you may not "apply to graduate" in SIS prior to approval at this meeting.
3. A final draft of the thesis/Dissertation is to be provided to your committee no less than ten (10) days prior to the oral defense.
4. Thesis will be written in grammatically correct English. Do not expect your committee to provide grammatical or spell-checking services; the role of the thesis committee is to provide **technical** and**/**or **scientific** guidance in the writing of the thesis and consequent defense. There are university services to assist with copyediting and writing; Educational Services for Students (ESS) works with non-native English speakers; GSS Peer Editing is available to all students.
5. Format:
    1. Typeface and Font
        1. Any standard typeface is acceptable; font size should be 12. The font size may be reduced for captions on figures and tables.
    2. Margins

    1. The margins on the left side of all pages must be 1.5 inches. Top, bottom and right margins should be 1 inch. All photographs, charts, tables, graphs, drawings, etc. must fit within these specified margins. Double-check margins for accuracy.
3. Spacing
    1. Double-space all text. Long quotations, captions, footnotes, and endnotes may be single-spaced.
4. Pagination
    1. The numbering of pages should, at the very latest, begin with the Table of Contents. Roman numerals (iii, iv, v…) are acceptable for the front pages. However, Arabic numbers (3, 4, 5…) should begin no later than the first page of regular text. You should number consistently throughout the document (i.e. page numbers should be all at the top or all at the bottom).
5. Proofing
    1. You must have the format of your thesis/dissertation checked and approved by the School of Graduate Studies before you upload to OhioLink. You can do this by emailing a copy of the entire PDF file to etdsubmit@case.edu. Include your department or program name and the words "format check" in the subject line. Notice of approval (or corrections) will be sent back via email. Any ETD uploaded to OhioLink without prior approval will be deleted.
6. Copies of the final dissertation:
    1. Although you will submit your thesis/dissertation electronically, you may need to make printed copies for the members of your defense committee. It is the student's responsibility to deliver to each committee member a copy of the thesis/dissertation at least ten days prior to the defense examination date. Some departments may also require a copy of the thesis/dissertation for deposit in the department. Students should consult their advisers or department chairs concerning departmental requirements.
    2. Some students wish to have copies bound for their own use. Contact the University Bookstore (368-2650) for information on its binding service.

Thesis and dissertation outline

Before beginning to write it is a good idea to plan out an outline delineating chapters of the thesis. Required sections and a suggested order in the finished thesis are presented below. Your advisor or committee may have additional guidance for order or additional sections dependent upon your particular project.

The graduate school has mandated the following order for both master's theses and PhD dissertations:

1. Title page
    1. The title page must contain the following information: Title, Name, Degree, Department, University Name, Month and Year of Graduation. The month of graduation will either be January, May or August. See the sample title page.
2. Committee Approval Sheet
    1. A Committee Approval Sheet must be included as the second page of your PDF document. This form should only have the typed names of your committee, not signatures. See the sample committee approval sheet.
3. Copyright page (only if copyrighting)
    1. Authorship automatically and implicitly confers a copyright to the author, without any additional fee. However, a copyright can be registered with the U.S. Copyright Office, which will provide additional legal protections for your rights regarding your dissertation, for an additional fee. Graduate Studies is no longer processing these requests. If you do choose to copyright, please insert a "copyright page" into your document. If you are not copyrighting, then leave out this page.
4. Dedication page (optional)
5. Table of Contents -- Table of contents with chapters/sections and subsections of each chapter/section
6. List of Tables
    1. If you use tables, you must include an itemized/numbered list of each. Please separate these lists on different pages.
7. List of Figures
    1. If you use figures and/or illustrations, you must include an itemized/numbered list of each. Please separate these lists on different pages.
8. Preface (optional)
9. Acknowledgements (optional)
10. List of Abbreviations (optional)
11. Glossary (optional)
12. Abstract
    1. Dissertation abstracts must not exceed 350 words, thesis abstracts 150. See the sample abstract.
13. **Body Text**
    1. Introduction

1. What is the problem addressed?
2. What is the Hypothesis?
3. What are your objectives in the study?
4. Why is this research important / what is the expected impact?
5. Summary of the approach (Experimental Design)
6. What tools/methods will be employed?

2. Background. (may possibly be part of the introduction section)
3. Literature review on the problem you are addressing
    1. Describe previous approaches
        1. Attempts and methodology
        2. This includes a discussion as to shortcomings of previous attempts
        3. Reader should know alternate approaches to solving your problem and their shortcomings from reading this section
    2. This should make clear why your approach is better and different
4. Theory necessary to understand experimental design and results
    1. This could include software algorithms, mathematical formula, etc.
        1. An explanation should accompany these (what variables mean, how derived, etc.)
5. Methods
    1. Full methods such that a reader could replicate your results are required
6. Results
    1. Here is where you list your measurements, describe any difficulties, errors and so on. From this section, the reader should know what worked, what didn't and what data you plan to use for the remainder of the thesis.
7. Discussion and Analysis of results
    1. Based on the results, how did you examine the data and what did you gain from the analysis?
    2. This will tie in the computational/analytical results and their analysis with the underlying science/problem which was introduced in the introduction
    3. How do your findings fit with the previous work introduced in background/literature review?
    4. Does your work help interpret previous findings made by others?
8. Conclusions
9. Highlight major findings of your work,
    1. Applications
    2. Broader implications of your work
    3. Impact/future directions

14. Appendix/Appendices
    1. Class notes, unpublished work, etc. should be added as an appendix if cited in the thesis.
    2. Additional information that adds to the meaning of the dissertation can also be included
        1. (datasets)
15. Bibliography References

1. Citation styles that are commonly used are acceptable, for instance the *APA citation style*. You must include a complete bibliography at the end of the ETD that includes all works cited. Please follow the format most commonly used by your department.
2. Use of a reference manager is strongly encouraged; it will save you considerable time during revision and re-writing.

A note on Figures/Tables

Figures should have numbers referenced in the text, and it may be helpful to use a numbering scheme that consists of chapter and figure number (i.e. fig 2.1 would be the first figure in chapter 2.) to delineate figures. Figures should have a descriptive title as well as a caption describing what you want your reader to see/take away from the figure.

In the Thesis/Dissertation, figures are to be presented on their own page with adequate resolution and size such that the figure spans the entire page width. The figure legend should either be on its own on the facing page, or just below the figure on the same page, provided there is room.

8. School of Graduate Studies Resources

Visit the Office of Graduate Studies website (http://case.edu/gradstudies/) for information on the following topics:

University Guidelines on Authorship and Policy on Copyright
Academic Integrity Standards
Graduate Student Grievance Procedure
Maintenance of Good Standing
Maintenance of Quality Point Average
Residency Requirement
Time Limitation
Leave of Absence from Graduate Study
Withdrawal and Reinstatement
Transfer of Credit
Course Repeat Policy
Changes in Registration
Waiver of the Registration Requirement
Exceptions to Regulations
Graduate Studies Paperwork
Graduate Student Travel Award
V-Fund