Washington University in St. Louis

Biology & Biomedical Sciences

ACADEMIC PROGRAM GUIDELINES

Program in Computational and Systems Biology
Overview

The goal of the Computational and Systems Biology Program is to train the next generation of scientists in technology intensive, quantitative, systems level approaches to molecular biology. We aim to graduate students who are as comfortable operating the latest high end instrumentation as they are manipulating the mathematical formalisms that are required to make sense of their data. It is our hope that the students who join the Computational and Systems Biology Program will apply these approaches to unraveling the complex genetic circuits that control the cell.

Technological advances are having a major impact on molecular biology. Advances in experimental techniques means that large amounts of sequence, expression, and localization data are now routinely gathered by individual investigators. In addition terabytes of these kinds of data are stored in various public and private databases. Concurrently, access to large scale computing resources has become more and more common in molecular biology laboratories. Students in the Computational and Systems Biology Program will learn to leverage these advances in both experimental and computational resources.
# Outline of Typical Ph.D. Student's Program

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SEMESTER</th>
<th>MAJOR ACTIVITIES</th>
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<tbody>
<tr>
<td>1</td>
<td>Fall</td>
<td>Arrive between June and Aug 15. Orientation 3rd week of Aug(^a). Meet with adviser and steering committee; plan rotations and coursework; begin first rotation. Take core curriculum course: Computational Molecular Biology (BME 537) and one elective(^b).</td>
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<tr>
<td></td>
<td>Spring-Summer</td>
<td>Winter: Second rotation. Spring: Third rotation. Take core curriculum course: Genomics (Bio 5488) Take one advanced elective courses(^b). Take special topic/journal club courses as interest dictate(^c).</td>
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<tr>
<td>2</td>
<td>Fall</td>
<td>Choose thesis adviser and begin thesis research. Complete advanced elective requirements. Choose qualifying examination proposal. Take special topic courses as interest dictate. Select Journal Club as interest dictate. Teaching Assistantship (Fall or Spring Semester).</td>
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<tr>
<td></td>
<td>Spring-Summer</td>
<td>Take special topic/journal club courses as interest dictate. Take course in ethics. Submit topic for qualifying exam by June 15(^d). Complete qualifying exam by August 31.</td>
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<tr>
<td></td>
<td>Spring-Summer</td>
<td>Take journal club courses as interest dictate. Thesis research continues.</td>
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<tr>
<td>4-5</td>
<td></td>
<td>Take journal club course as interests dictate. Meet once a year with thesis committee. Thesis research continues. Complete and defend thesis.</td>
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\(^a\)Some students arrive early to begin rotation in summer. Students with little research experience are encouraged to take this opportunity.

\(^b\)Advanced electives may be chosen from the list on page 5.

\(^c\)Special topic courses are 1 or 2 credit courses that emphasize student oral presentations. Both journals clubs (1 credit) and topic courses that include some didactic material (may be 2 credits) will count toward a total 5 credit requirement. Two of the five credits must be earned in special topic courses. A special topic course in ethics must be completed by the end of the second year.

\(^d\)The qualifying exam consists of a written and oral presentation of a research proposal not on the thesis topic and an oral examination on the proposal and background knowledge appropriate for a Ph.D. candidate in the field.
GUIDELINES TO THE PROGRAM IN COMPUTATIONAL BIOLOGY

Outline of Typical MSTP Student's Program

<table>
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<tr>
<th>Ph.D. YEAR</th>
<th>SEMESTER</th>
<th>MAJOR ACTIVITIES</th>
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</table>
| 1          | Late Summer/Fall | Orientation.  
Meet with MSTP and Steering Committee to plan course work<sup>a</sup>.  
Take core curriculum course, Computational Molecular Biology (Bio 5495)  
Take Seminar in Computational Molecular Biology (Bio5496)  
Choose thesis advisor and begin thesis research.  
Teaching Assistantship (Fall or Spring).  |
|            | Spring-Summer   | Take core curriculum course, Introduction to Genomics (Bio 5488)  
Take Seminar in Computational Molecular Biology (Bio5496)  
Submit topic for qualifying exam by June 15<sup>d</sup>  
Complete qualifying exam by August 31.           |
| 2          | Fall            | Take courses as interests dictate.  
Choose a thesis committee and meet to propose thesis by December 31.                     |
|            | Spring-Summer   | Take courses as interests dictate.  
Take Biomedical Research Ethics  
Thesis research  
Meet with thesis committee annually            |
| 3-4        |                 | Take courses as interests dictate.  
Thesis research  
Meet with thesis committee annually  
Defend thesis and return to Medical School         |

<sup>a</sup>Curriculum may be modified and additional coursework required at the program’s discretion.
2. Advising

Timely and good advice often can be very important to graduate students. Students in the Program in Computational and Systems Biology should take advantage of advice from a number of sources, both informally from faculty and students and more formally from appointed advisors that meet with the student at appropriate intervals.

2.1. Faculty Advising

Steering committees provide advising for first-year and second-year students who have not yet designated a laboratory they wish to join. Each student will be assigned an adviser either on the committee or from a group of advising volunteers. To register or to drop or add courses, students must obtain their adviser's signature. In addition to individual advising sessions, each student will meet briefly with the Steering Committee once per semester to discuss progress and address any questions the student may have.

The committees will meet no less than once a semester with any student who has not yet completed a thesis proposal, although an individual adviser can be appointed to advise each student. These meetings will usually occur just before the beginning of each semester.

Once a student has completed a thesis proposal, advising will no longer be required, since the thesis committee takes over this responsibility. However, students should feel free to consult their previously assigned advisers as they see fit.

3. Computational Biology Curriculum

The curriculum is designed to meet the needs of students with a wide variety of backgrounds. Each student’s needs and interests (in consultation with an advisory committee) will determine the specific courses taken by any student.

3.1. Core Courses

All students in the program will take two required core courses:

- Bio5495/BME 537  Computational Molecular Biology
- Bio 5488  Genomics

These are graduate level courses designed by the Computer Science department for students without an undergraduate CS degree whose graduate work will involve significant computational activities. Some students will be required to take additional, preparatory CS classes. For all students, at least one of their graduate courses must be in Computer Science.
3.2. **Advanced Elective Courses**

A combination of 3 courses must be taken from the approved Advanced Electives and Special Topics course list.

In consultation with their advisor, students choose a minimum of 3 advanced electives or special topic. Because students will be expected to demonstrate substantive command of molecular biology, applied mathematics, and computer science in their qualifying exam, the advanced electives will typically be chosen in areas in which the student does not feel adequately prepared or will emphasize areas of primary interest for the student. The interdisciplinary nature of the program allows considerable flexibility in choosing these courses, and sometimes more than two courses may be recommended, depending upon the student's needs.

Common choices for these electives include the following:

- Bio4181 Population Genetics
- Bio4183 Molecular Evolution
- Bio5312 Macromolecular Interactions
- Bio 5477 Modeling Biomolecular Systems II
- Bio548 Nucleic Acids and Protein Biosynthesis
- Bio5491 Advanced Genetics
- Chem562 Statistical Thermodynamics
- Math475 Statistical Computation
- Math493 Probability
- Math494 Mathematical Statistics
- Phys529 Statistical Mechanics
- CS504N Programming Concepts and Practice
- CS547T Intro to Formal Languages and Automata Theory
- CS530 Database Management Systems

Advanced electives take several formats. In addition to attendance at lectures, they frequently require that students prepare mock research proposals similar to an NIH postdoctoral fellowship proposal. In some courses, students form "study sections" to evaluate (anonymously) the proposals based on their relative scientific merit and provide constructive criticisms that can be used to strengthen the proposals.

3.3. **Special Topics Courses**

A combination of 3 courses must be taken from the approved Advanced Electives and Special Topics course list.

Students enroll in a minimum of an additional 1-2 special topics courses. Special topics course formats vary, but typically involve student presentation of a series of papers that follow the development of recent discoveries in a field. Critical analysis of current concepts and approaches in the field is emphasized through class discussion. A variety of Division special topics courses are available for students.
3.4. **Journal Clubs and Seminars**

Although students in the program are required to take only a total of five credits of Special Topics courses plus Journal Clubs for credit and a grade, all graduate students are encouraged to begin attending relevant journal clubs in their first year of study, and to continue participating on a regular and active basis throughout their graduate careers, whether or not they are registered for credit. Indeed, many students participate every semester in a journal club (many are available). The main advantages of the journal clubs are their ability to provide close student-faculty interactions in a format that is less didactic than the core courses, to allow students to study current research topics in great depth, to provide students with a mechanism of learning speaking skills, and to provide a mechanism whereby students and faculty can work together to design courses dealing with topics at the cutting edge of biology, particularly in new areas of inquiry forming at the interfaces between more traditional disciplines. New journal clubs will no doubt emerge on specialized topics within Computational and Systems Biology; one already exists and is well attended by students within the Division as well as students from Computer Science and Biomedical Engineering (see Bio5496/CS6805 Computational Biology Journal Club.)

3.5. **Requirements for MSTP Students**

Because MSTP students enter the program having completed two years of graduate education, the following adjustments will be made to the program requirements: 1) MSTP students must take Bio 5495 Computational Molecular Biology and Bio 5488 Genomics; 2) the Advanced Elective requirement is waived; 3) the Special Topics/Journal club requirement is reduced to 2 units, which will be satisfied by taking two semesters of Bio 5496 Seminar in Computational Biology. While these are the minimum requirements, MSTP students are encouraged to take additional coursework, including journal clubs, to strengthen their fund of knowledge. The Computational and Systems Biology Program reserves the right to require additional coursework for individuals who it deems to have significant deficiencies in essential knowledge.

4. **Research Laboratory Rotations**

Laboratory rotations are a major component of the first year training program. Rotations provide the most effective means of exposing students to available research opportunities and thesis mentors. Furthermore, they provide intensive introductions to experimental design and data analysis, logical development of a project based on initial experimental findings, and presentation of results to one's colleagues in lab meetings or other venues. Because of the interdisciplinary nature of the Computational and Systems Biology Program and the diverse nature of the students in it, we feel that it is important for students to know well the activities within both "dry" computational labs and also "wet" experimental labs. Therefore students will be required to do at least one rotation in each environment.

To accommodate students interested in future research in industry, and since industry has been one of the primary employers of computational biology researchers, we have established an internship agreement with the largest local employers of computational biology scientists. Arrangements with other companies are likely in the future.
At the beginning of the first semester, students, with the advice of their advisors and the Steering Committee, plan laboratory rotations. In general, students complete three laboratory rotations, each three months long, by the summer of their first year in the program, at which time they select a thesis mentor. The Faculty Research book provides a description of research opportunities available for rotations. Students are urged to discuss possible rotation projects with as many potential advisors as possible before making their selections. Students are prohibited from conducting rotations in laboratories where they have been previously employed. However, previous employment would not prevent the student from pursuing thesis work in such a laboratory. Also, before deciding on a particular laboratory, the student should develop an outline of the proposed work with the faculty member. The Division Office provides students with a Rotation Form for this purpose. The form should be completed by the student with the rotation mentor's help and returned to the Division Office at the start of each rotation. A second part of the form is completed at the end of the rotation to provide the Steering Committee with an evaluation of the rotation experience.

The purpose of the rotations is to broaden the student's research experience and to expose the student to available opportunities before a thesis preceptor and problem are selected. It should be recognized by both student and rotation mentor that significant research accomplishment is not a requirement for a successful rotation, nor should the rotation be prolonged significantly beyond the normal three-month period to meet particular research objectives. Students may choose to end a rotation at any time, should they find it desirable to move on to the next rotation.

During the rotation, the student should take advantage of the one-on-one relationship with the faculty member to discuss science as it is carried out in the lab, and to evaluate together the approach to research. Students should explore these contacts carefully during rotations, mindful that selection of a good mentor who will provide the personal instruction required to master experimental science is the most important decision they will make in graduate school.

5. Teaching Experience

Effective communication of information and concepts is a critical skill for biomedical research scientists. While much of the teaching that scientists engage in is through one-on-one interactions with individuals in the laboratory, all scientists must be able to deliver lectures to a wide audience (from peers in the field to neophytes with a limited understanding of the nuances of the topic), and scientists in faculty positions will often teach courses to undergraduate and graduate students. Therefore, DBBS students must demonstrate the ability to effectively communicate complex ideas and concepts to groups of individuals at various levels of understanding. To develop these critical communication skills, DBBS students will:

- Complete the TA orientation and three approved workshops offered by the Teaching Center by the end of the 2nd year of graduate studies
- Serve as a Teaching Assistant in a DBBS-approved graduate or undergraduate course for 1 or 2 semesters. The TA assignment will include giving lectures and/or leading lab sessions. The TA is usually completed in the 2nd year of graduate studies.
- Deliver a minimum of four oral presentations at journal clubs, seminars, scientific conferences, and retreats. Presentations given as part of a TA assignment, lab meetings or thesis committee meetings will not satisfy this requirement.
6. Qualifying Exam

Before students advance to candidacy for the Ph.D. degree, they must pass an intensive oral qualifying examination. The purpose of the qualifying examination is twofold. First, the examination will determine if the student has acquired sufficient knowledge and ability to think critically to qualify for candidacy. Second, the exam will provide the student with an opportunity to practice collecting material and preparing a research proposal. The exam enables faculty to assess the student's ability to formulate experimental solutions to a current research problem in computational biology.

6.1. Timing of the Qualifying Examination

Each student should complete a qualifying examination within his or her chosen program by no later than August 31 of the second year in the program for Ph.D. students (August 31 of the first year for MSTP students). Students are encouraged to undertake the qualifying examination earlier, especially if their teaching assignments are in the fall. The minimal requirements to take the exam are completion of the two core courses and completion of or current enrollment in one advanced course.

6.2. Qualifying Examination Committees

The exam is administered by a committee of three faculty. A program steering committee member will be assigned as the committee chair and the student must then select two additional DBBS faculty. These additional members must be approved by the chair. The steering committee member seeks to ensure uniform standards of performance by the student and fairness on the part of the committee. The remaining members of the examination committee are chosen to provide specific expertise relevant to the student's proposal, and the breadth needed to assess a student's command of general knowledge in Computational Biology.

A student's thesis adviser will not be appointed to the examining committee.

6.3. Format of the Qualifying Examination

The Computational and Systems Biology QE consists of two parts, a written proposal and an oral defense of that proposal. Students may take their QE when core courses have been successfully completed.

**The written proposal**

The topic of the proposal should be related to work in your thesis lab. The topic can be, but does not have to be, your actual thesis work. It is not necessary to have settled on a thesis project in order to take your QE. Do not delay your QE because you have yet to decide on a thesis topic. If you have a thesis project lined up, great, you can use it, otherwise choose a topic related to the work going on in your lab.

The main purpose of the QE is to demonstrate that you can think critically about the work in your thesis lab. We are interested in determining whether you can think in a sophisticated way about the strengths and weaknesses of your proposal. You are being tested on your ability to
GUIDELINES TO THE PROGRAM IN COMPUTATIONAL BIOLOGY

identify an important problem and explain how your proposal will address this problem. In the past we have found that students are very good at telling us what they will do, but often do not make a good case for why they are doing a certain project. The new format of the QE is meant to emphasize the “Why” of the proposal over the “What”. In light of this change about 75% of the proposal should focus on the Background, and Significance. In the final 25% of the proposal you should propose one Specific Aim and describe how you would address it.

In the Background and Significance sections be sure to address the following:

- What are the major unanswered questions in your field?
- Why is it important that we understand the problem you are proposing to address? Do not simply list morbidity statistics of diseases associated with your biological question. Tell us where the key gaps in our knowledge are and how filling these gaps will advance the field.
- What are the key experiments/analyses that have been performed previously? Do not just list facts from papers. Synthesize the previous literature, from within and outside of your lab, and tell a coherent and critical narrative about how the field got to where it is today. Address the strengths and weaknesses of previous work.
- Give your own assessment of where the field needs to go. What is it that previous experiments/analyses have likely missed and what needs to be done to find these missing pieces?

In the Specific Aim section be sure to address the following:

- State your aim. Be sure to distinguish between a specific aim and a task. An aim is something you are trying to learn, a task is something you are trying to do. Be sure your specific aim is really an aim. For example:
  “To purify the SSN6 repressor complex” is a task, not an aim.
  “To understand the mechanism by which SSN6 represses transcription” is an aim.
  “To find all of the genes up-regulated in melanoma” is a task, not an aim.
  “To understand the molecular basis of metastasis in melanoma” is an aim.
If you are proposing to develop a new technology then you can break this rule and make your aim a task. For example:
  “To develop a method for identifying every phosphorylation site in the proteome” is a task that could work as an aim.
- If you have a clear hypothesis, state it, and the predictions that follow from it. If you can, state clearly both H\textsubscript{0} and H\textsubscript{A}.
- Describe the tasks you will perform to carry out the experiments/analyses
- State the possible results you might see and what you would conclude in each case. Describe how your results would allow you to complete your specific aim.

The written proposal should be 15-20 pages long, single spaced, 11 point font, 1 inch margins. The page total includes figures. References do not count towards the page total.
GUIDELINES TO THE PROGRAM IN COMPUTATIONAL BIOLOGY

The oral defense

Prepare a presentation that will last ~45 minutes. In the oral presentation you should spend 50% of your time on Background, Significance and Innovation and 50% of your time on describing your Specific Aim. You will need to demonstrate mastery of the literature and think critically about the state of the field. Focus on telling the committee why the experiment you are proposing fills a critical gap in the field. Describe the experiments and analyses clearly and go over potential results and their interpretations. What results would support your hypothesis? What results would rule out your hypothesis?

Logistics.
1. Choose a topic and write a very brief outline
2. Talk to Barak to get your topic approved. Barak will help you choose a QE chair and two other committee members.
4. Schedule the oral exam – you should schedule for a 2-hour block. If you need a room in DBBS, ask Jeanne to help you schedule one.
5. Once a date has been set – complete page 2 of the QE form and return to your DBBS Coordinator
6. Turn in your written proposal 1-week prior to the examination

PLEASE REMEMBER TO KEEP YOUR COORDINATOR UP TO DATE. RETURN THE QE FORM TO HER WHEN YOU HAVE A DATE SET.

6.4. Consequences of Failing the Qualifying Examination

If the examiners fail the student, separate reports from individual committee members specifying reasons for the failure will be forwarded to the program steering committee for disposition. The steering committee can recommend either that a student retake the examination or that the student not continue to candidacy for a Ph.D. in the Division of Biology and Biomedical Sciences. A decision to dismiss the student or take other action will be made by the steering committee. An examining committee will limit its deliberation and decision to the narrow issue of whether or not the student passes the examination in question. If the student feels that the action of the steering committee has been incorrect due to a procedural flaw in the examination process, the student may submit a written petition to the Chair of the Programs and Student Affair (PSA) Committee and, if warranted, the PSA Committee will hear that appeal.

The steering committee may recommend that a student retake the exam. The re-examination must take place within three months of the date of the failed examination. A new examining committee, which may include one or more members from the first committee, will be appointed. The steering committee will decide whether a new proposal should be prepared or the original proposal used again and will give the second examining committee specific instructions on subject areas that should be emphasized in the questioning.
GUIDELINES TO THE PROGRAM IN COMPUTATIONAL BIOLOGY

7. Thesis

7.1. Selection of Thesis Mentor

As students near completion of their final rotations, they begin the process of selecting a thesis mentor. In this process, students meet with all faculty members in whose laboratory they have a serious interest in doctoral research. These one-on-one discussions serve to narrow a student's choice of mentors to one (or possibly two) and obtain a firm commitment from that faculty member. Nearly all students join the laboratory of their first choice and because virtually all of the first year students join their thesis labs by the middle of the summer, they begin making significant original research contributions early in their graduate careers.

7.2. Thesis Research Project

During the second year, most of each student's effort is directed toward the initial phases of his or her dissertation research. Because this initial research is often critical in determining timely completion of graduate study, students have frequent meetings with their mentors to discuss results and plan future experiments. Interactions of students with each other and with postdoctoral fellows provide a further important source of advice and ideas, and also strongly reinforce the interdisciplinary nature of the training program.

Students are strongly encouraged to present a written thesis proposal to their thesis committee during their second year. This policy encourages students at an early stage in their research to formulate a clear purpose and rationale for the project, an outline of the methods to be used, an assessment of feasibility, an idea of the potential outcome, and alternative plans for high risk portions of the project. Furthermore, it is made clear to students that timely presentation of the thesis proposal does not require accumulation of large amounts of preliminary data, nor does it constitute a test that students must pass in order to continue with their research.

During years three (3) through five (5) students devote themselves almost entirely to dissertation research. Students are required to meet with their thesis research advisory committee at least once per year. Each student receives detailed feedback from his or her committee during the meeting itself, and from a written summary of specific recommendations made by the committee. In years four and five, projections are made about the estimated date that the thesis research will be completed; the student's plans for postdoctoral training are usually discussed in the latter part of this period. Six months before the student expects to graduate, a detailed thesis outline prepared by the student must be approved by the thesis committee.

7.3. Timing of the Thesis Proposal

Students are encouraged to present a thesis proposal during their second year, but should complete the proposal no later than December 31 of their third year (second year for MSTP students) in the Division. If the student anticipates that he or she will not be able to meet this deadline, the thesis advisor must write a letter to the Steering Committee by November 1, explaining the situation and indicating when the student can be expected to propose. Final approval of the thesis proposal by the thesis committee must take place by the end of the student’s third year, or the student will no longer remain in good academic standing and could lose registration privileges for the following semester as well as his or her stipend.
7.4. **Thesis Proposal**

The thesis proposal should include a statement of purpose and rationale for the project, an outline of the methods to be used and an assessment of their feasibility, a summary of the work performed already, an idea of the potential outcome, and alternative plans for high risk portions of the project. Thesis proposals require a cogent, but scholarly written assessment of the field and a testable hypothesis with possible branch points to be in the hands of the committee one week prior to an oral presentation. Although these are all essential components of a proposal, it is not intended that the proposal be lengthy, and preliminary data, while desirable, need not be profuse or conclusive. **A single-spaced proposal, with references, of five-ten pages is appropriate.** The thesis proposal meeting provides a student with guidance in selecting appropriate research goals and is not a test that the student must pass or fail. When the thesis proposal has been approved and has been reported to the graduate school, the Dean writes the student informing that he or she has been advanced to doctoral candidacy.

7.5. **Purpose of the Thesis Committee**

The purpose of the thesis committee is to advise the student in his or her thesis research and to provide the student with a readily accessible source of advice and constructive criticism during the dissertation research. To achieve these goals, it is imperative that thesis committees meet early in a student's term and that they meet with the student at least once a year to offer suggestions and ascertain progress. The student should choose his or her thesis committee in the second year. The thesis committee should actively monitor the student's progress toward completion of a thesis by no later than the end of the student's fifth year, and preferably sooner. A thesis committee's ultimate responsibility is to act in the student's best interest, by ensuring that the research undertaken will lead to an acceptable dissertation and a Ph.D. degree.

7.6. **Composition of the Thesis Committee**

The committee consists of five Divisional faculty members in addition to the student's thesis preceptor. The University requires that the final dissertation defense committee be composed of four tenure track faculty from the student's program and two other tenure track faculty from any of the other programs, or from Washington University departments outside the Division. Additional non-tenure track faculty members may be appointed to the committee because of their expertise in a given area. The student and their preceptor nominate the committee members subject to approval by the Program Director. A quorum of four members including the thesis adviser is needed for any pre-defense meeting. The student and preceptor nominate these committee members subject to approval by the Program Director. The committee members are selected for their expertise in areas on which the research will touch, and for their willingness to contribute advice and meet at least once per year. The committee is chaired by a faculty member other than the thesis preceptor, and the chairperson should be designated in advance of the proposal, based on his or her willingness to be responsible for the committee's activities. The student and preceptor should view the committee system as a source of objective criticism and expert advice. At the time of the thesis defense, the thesis committee serves as the defense committee. The addition of committee members or changes of committee composition should be made no later than six months before the defense date.

7.7. **Thesis Committee Meetings**
GUIDELINES TO THE PROGRAM IN COMPUTATIONAL BIOLOGY

During the thesis proposal, emphasis should be given to the student's understanding of the research proposed and the likelihood that it will allow the student to produce a thesis in a timely manner. Toward this end, it is customary for the thesis adviser, although present, not to participate in the discussion except where specifically requested to do so by a thesis committee member. For both the proposal and for subsequent thesis committee meetings, the committee will meet briefly to prepare its recommendations with the student absent. On occasion, the committee may also choose to meet with the student in the absence of the thesis adviser.

After the thesis proposal, thesis committees will meet with students no less than once a year. Scheduling of the meetings should be done by the student. In the event that a student does not schedule timely meetings, the thesis committee chairperson will schedule thesis committee meetings. The thesis committee may choose to meet more often than once per year, if it finds more frequent meetings appropriate. After each meeting, the thesis committee chairperson will be responsible for ensuring that recommendations of the committee are communicated to the student.


The program is designed with the goal that students complete their thesis research and prepare, present, and defend a Ph.D. dissertation four to five years from the time they begin the program. The dissertation must be based upon an original investigation that results in a significant contribution to knowledge in Computational Biology. Subject to approval of the thesis committee, the dissertation may include reprints of published work of which the student is an author, but where published material is included, a prefatory introduction should describe the extent of the candidate's contribution to both the experimental work and the preparation of the manuscript. When published material constitutes a significant fraction of the dissertation, it is desirable that a separate Introduction that describes the background to the research and a Discussion that describes its significance be written for the dissertation itself.

In order to assure that the dissertation will meet with general approval of the thesis committee, and to provide the required notice to the graduate school of the oral defense, the student will present an outline of the dissertation to the thesis committee six months before the defense date, and meet with the committee to discuss the outline and gain its approval. Once a date for the defense has been set, the Division Office should be notified promptly.

The thesis committee must read and approve the dissertation prior to the oral defense. To allow adequate time for remedy of potential problems, a complete draft of the dissertation must be given to the thesis committee at least two weeks prior to the date of the defense. Unless otherwise requested by the student and adviser and agreed to by the thesis committee, the format of the defense will be a public seminar followed by a closed session with the entire thesis committee.

9. Students' Responsibility to Meet Program Requirements

Graduate students in the Program in Computational Biology are responsible for completing the requirements of the program in a timely fashion. In particular, the requirements for courses, preliminary examinations, thesis proposals, and thesis committee meetings are important components of graduate training and should be regarded seriously. In the event that a student
has trouble meeting any requirement, he or she should request consideration of the situation by the Steering Committee, which may agree to waive or delay the requirement.

10. Transfer From and To Outside Programs

Students are free to transfer to the Program in Computational and Systems Biology from any other program in the Division of Biology and Biomedical Sciences provided they are “in good academic standing”. Students who transfer will be expected to meet all of the normal requirements of the programs, although special exceptions may be granted in rare cases by the Steering Committee. Students in the Program in Computational and Systems Biology also are free to transfer from the program to another program, with the approval of both program directors and provided a qualifying examination committee or program steering committee has not recommended against the student continuing in the Ph.D. program. Transfer is accomplished most easily during the first year, but can be done at later times if necessary.

11. Publications

There is no specific requirement for publication to receive the Ph.D. However, high quality, peer-reviewed publications are an important determinant for a student’s career. Similarly, the process of writing and submitting a manuscript and responding to reviewer critiques is an essential part of a student’s training. Therefore, the publication record is one of several important and appropriate measures to be used by a thesis committee in evaluating a Ph.D. candidate. It is generally expected that students will have submitted and/or published one or more first author manuscripts in peer-reviewed journals at the time of the defense.

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