



Graduate Student Handbook

Overview of the Bioinformatics Graduate Programs

With the advent of multiple genome sequences, biological research has become much more quantitative, using tools from physical, mathematical, and computational sciences to generate and analyze large-scale datasets in an attempt to understand the behavior of biological systems. The highly interdisciplinary field of bioinformatics has developed around these new approaches.

The mission of the Institute of Bioinformatics is to educate and train graduate students in bioinformatics research and its applications to attain mastery and leadership in this new interdisciplinary field. The institute offers Ph.D. and M.S. degrees in Bioinformatics, and it also offers Graduate Certificate in Bioinformatics to students already enrolled at UGA. Students matriculating in the graduate programs in bioinformatics will be directed and mentored by faculty members from multiple departments and disciplines.

The bioinformatics graduate program consists of faculty members whose research interests cover a wide spectrum of bioinformatics research in the areas of microbial, fungal, plant, and animal genomics, structural genomics, biomedical (e.g., cancer) genomics, glyco-genomics, proteomics, transcriptomics, and pharmacological informatics, using computational, statistical, and experimental technologies. Students should refer to the detailed research descriptions of the faculty members in the IOB.

While in the bioinformatics Ph.D or M.S. program, students will fulfill all the requirements of the Graduate School for a graduate degree. Student progress in the program will be monitored by the Graduate Coordinator and the IOB Graduate Affairs Committee. Upon arrival at the university, students will be assigned a curriculum advisor for guidance and mentoring. Because this program is interdisciplinary, students will be advised to take prerequisite courses in areas where the student does not have the necessary background. Students will select their major professor and establish an advisory committee by the end of their first year in the program.

The advisory committee will meet with the students no less than once a year and will be responsible for mentoring the student's research and training, approving the student's program of study, administering the written and oral comprehensive examination, approving the subject for the dissertation, approving the completed dissertation, and approving the student's defense of his or her research.

Ph.D. students will take their comprehensive examinations at the beginning of their third year under the supervision of the major professor under the Graduate School guidelines. Successful candidates for the PhD degrees then typically concentrate on their research projects, and, after completing their research, they write a dissertation and defend it at a final oral examination.

M.S. students are required to take an oral examination conducted by the advisor committee and to defend his/her thesis and have it approved by the committee. All students will receive training and experience in written and oral communication skills and training in the responsible conduct of research.

Doctor of Philosophy (Ph.D.) in Bioinformatics:

1. Curriculum Requirements:

All students who enter the Ph.D. program in the Fall 2009 semester or later are required to follow the new curriculum described below. Students who entered the IOB program prior to the Fall 2009 semester will have the option to graduate either under the new curriculum requirements or the old ones. However, students must satisfy all requirements of one curriculum or the other. No mixing and matching of requirements will be allowed.

An overview of the IOB PhD curriculum is shown in the table below.

Prerequisites	Core (All Required)	Biology Elective (Pick 1)	Math/Stat Elective (Pick 1)
Intro Molecular Genetics Intro Biochemistry Intro to Statistics and Probability Knowledge of a programming language Intro Calculus	BINF 8210 BINF 8211 STAT 6630 CSCI 6490	Any graduate biology course approved by student's dissertation committee	STAT 6640 Math 6780 Others See below
Applied Bioinformatics Elective (Pick 1)	General Electives (Pick 3)		Other Required Courses
GENE 8940 MIBO 8270L Others See Below	Any graduate course approved by the dissertation committee, but not program Pre-requisites.		BINF 8001 BINF 8060 BINF 8900L INF 8970 BINF 8990 (2x) BINF 9000 BINF 9300 (2x)

1. Diagnostic Exam

All students entering the program will take a diagnostic exam before classes begin. This exam will test the level of knowledge in three areas: molecular biology/genetics, computer skills, and mathematics/statistics. The purpose of the exam is to evaluate incoming students' strengths and weaknesses in order to assist with course selection. If a student's knowledge does not meet the prerequisite requirements in any area, he/she will be required to take appropriate remedial courses.

2. Remedial Courses

The IOB offers two remedial courses for students who enter the program lacking prerequisite courses. These courses will not count toward degree requirements. Other prerequisite courses can be taken in other departments.

BINF 4005/6005: Essential computing skills for biologists. This course covers the most essential computing skills for modern biologists such as Unix system commands, Perl/BioPerl language and simple programming, Matlab, parallel computing on Linux clusters, and basic algorithmic concepts. An emphasis will be on hands-on computer work.

BINF 6040: Essential Biology for Quantitative Scientists. The essential elements of biology necessary for a scientist with a background in the quantitative sciences to begin working in the biological sciences. Core biological concepts will be presented with the goal of getting computer scientists, physicists, and mathematicians started in understanding biology and finding productive areas of research inquiry.

3. Core Courses

All students are required to take a core of four bioinformatics courses:

BINF 8210: Computational Methods for Bioinformatics: This course is a broad survey of bioinformatics methods. Each subject area is taught by a guest lecturer with expertise in that area.

BINF 8211: Computational Applications in Bioinformatics: The goal of this course is to teach students to write computer programs that conduct bioinformatic analyses. Organized as a series of case studies in which students write programs to solve real research problems. Previous knowledge of a programming language is assumed.

Statistics 6630: Statistical Methods in Bioinformatics I: The goal of this course is to teach students to think mathematically and statistically in the context of sequence analysis and other bioinformatics problems. Organized as an introduction to mathematical statistics in which statistical concepts are demonstrated in bioinformatic methods. The focus is on underlying concepts and thought processes rather than a comprehensive study of bioinformatic methods.

CSCI 6490: Algorithms for Computational Biology: This course studies discrete algorithms for solving computational biology problems and algorithmic principles driving advances in bioinformatics. The content of the course is introduced with emphasizing the ideas underlying algorithms instead of offering a collection of unrelated bioinformatics problems.

4. Biology Elective

Students are required to take one biology course. Any graduate biology course approved by the dissertation/thesis committee and the graduate coordinator are permissible. Courses equivalent to program prerequisites will be not be allowed as electives.

5. Math/Stat Elective

Students are required to take one elective in statistics or mathematics. Good choices for most students are STAT 6640 or MATH 6780, described below. However, other courses in the Statistics or Mathematics departments can be substituted with permission of the graduate coordinator and the student's committee. Generally, such courses should require substantial mathematical manipulation and thus some introductory level courses are not appropriate. Courses equivalent to program prerequisites will be not be allowed as electives. As a general rule, any graduate statistics course that can be counted as a core or elective course for a Statistics graduate student would be permissible as an IOB Math/Stat elective. Likewise, any graduate math course that a Mathematics Ph.D. student could count for their degree would be permissible as a Math/Stat elective.

Statistics 6640: Statistical Methods in Bioinformatics II: This course continues the study of the probabilistic and statistical basic of bioinformatic methods. The emphasis in this course is on application of methods of statistical inference in bioinformatic analyses.

Mathematics 6780: Mathematical Biology. The course will provide students with mathematical and computational tools necessary to model, analyze and manipulate a variety of biological and ecological systems.

6. Applied Bioinformatics Elective

Students are required to take one elective in a course that focuses on applying bioinformatic analyses to real data. Examples include GENE 8940 and MIBO 8270L. Requests to add other courses to this list may be made in writing to the Curriculum Committee. Any such course must have a strong emphasis on applications to real data.

7. General Electives

Students are required to take three other electives. Any selection of electives that is approved by the Graduate Coordinator and the student's committee are acceptable. However, students will not be allowed to count courses that are equivalent to program prerequisites.

8. Additional Electives

Student advisory committees may specify additional requirements designed to extend the breadth or depth of the student's knowledge in the area of his/her specialization. These additional requirements may include both graduate and specialized undergraduate courses deemed appropriate by the student's advisory committee. It is expected that such additional requirements will be instituted mainly for students whose focus is more computational because these programs traditionally require more courses than biological disciplines.

9. Other Required Courses

In addition to the above courses, all students are required to take the following courses:

- a. BINF 8001 (Professors on Parade) during their first fall semester in the program.
- b. BINF8060 (Mandatory Seminar)
- c. BINF 8900L (Lab Rotation) during their first two semesters. Students who enter the program already committed to a lab will not rotate, but should still register for the course (formally, these students are doing their rotations all in one lab).
- d. BINF 8990 (Colloquium/Journal Club). Students must take this twice.
- e. BINF 9000 (Doctoral Research) is taken to fulfill credit load requirements after the completion of courses.
- f. BINF 9300 (Doctoral Dissertation). This should be taken in the student's final semester.

10. Requirements For 8000 Level Courses

Graduate School rules require that students with a master's degree take at least 16 credits of 8000-9000-level courses, while students without a master's degree must take 16 credit hours of 8000-9000-level courses and an additional four hours of courses open only to graduate students. Doctoral research (9000), independent study courses, and dissertation writing (9300) may not be counted in these 20 hours. The requirements for BINF 8210, 8211, 8900L, and 8990 add up to 14 credits. Thus, students who enter without a master's degree must take an additional six credits of 8000-level courses in their electives. Those who enter with a master's degree must take an additional two credits of 8000-level courses.

11. Program Prerequisites

It is assumed that students entering the program have taken introductory courses in molecular genetics, biochemistry, calculus, and statistics and probability. It is also assumed that the students are able to program in some programming language. Students who lack in any of these areas must take appropriate courses in their first year in the program. These courses may not be counted towards degree requirements.

12. Lab Rotations

Students who are not committed to a major professor upon entering the program will rotate through several labs in order to find a major professor. Students will spend half of a semester in each of up to three different labs, participating in research work in that lab. Rotations will occur in the second half of the first semester and in the second semester of the first year. See the IOB webpage for a list of IOB faculty and links to their web pages. The Introduction to Bioinformatics course will occur in September, when faculty will give short presentations about their research. All students should register for BINF 8900L in their first two semesters in the program. If a student is already committed to a lab, then this course will be taken in place of research credit (these students are not required to rotate).

13. Advisory Committee

Upon arrival at the University, students will be assigned a curriculum advisor for guidance and mentoring.

Because this program is interdisciplinary, students will be advised to take prerequisite courses in areas where the student does not have the necessary background.

By the end of their first year in the program, students will select their major professor and establish an advisory committee. The major professor must be a full member of the Institute of Bioinformatics and the Graduate Faculty. The advisory committee must consist of the major professor and at least three other faculty members. At least two members of the advisory committee must be full or associate members of the IOB. The advisory committee will also be composed of representatives of both the biological and the quantitative sciences. At least one member of the advisory committee will represent the student's focused area of study e.g. computer science, plant biology, microbiology, etc., from outside the institute. This member of the committee will provide input from outside bioinformatics and ensure that the program of study is consistent with the practices of the most related outside discipline.

The advisory committee will meet with the students no less than once a year and will be responsible for mentoring the students research and training, approving the students program of study, administering the written and oral comprehensive examination, approving the subject for the dissertation, approving the completed dissertation, and approving the students defense of his or her research. Students will take their comprehensive examinations at the beginning of their third year supervised by the major professor under the Graduate School guidelines.

14. IOB Comprehensive Examination

The comprehensive exam will be composed of a written part and an oral part.

Click [here](#) to download a detailed description about IOB comprehensive examination.

15. Admission to Candidacy

The student should initiate an application for admission to candidacy once all requirements, except the dissertation prospectus and the dissertation, have been completed. The Application for Admission to Candidacy for Doctoral Degrees form must be filed with the Graduate School at least two semesters before graduation.

16. Dissertation Planning and Prospectus

Dissertation planning will involve exploratory research leading to the preparation of a dissertation prospectus. BINF 9000 Doctoral Research course may be taken at this time. The prospectus must be presented to the advisory committee for approval. The prospectus must be presented to the advisory committee. This presentation should be open to both faculty and graduate students within the institute. The prospectus must be approved by all but one members of the advisory committee and so indicated by a letter from the major professor to the Graduate Coordinator. This letter must contain signatures from the entire committee. Students must be enrolled for at least one semester after passing the prospectus.

17. Dissertation Approval and Defense

The student's dissertation must represent originality in research, independent thinking, scholarly ability, and technical mastery of a field of study in bioinformatics. The dissertation must also demonstrate competent style and organization (see [Graduate School](#) for guidelines for theses and dissertations). While working on his/her dissertation, the student must enroll for a minimum of 6 hours of BINF 9300 Doctoral Dissertation course spanned at least 2 semesters. Students may not register for this course until they have been admitted to candidacy. Once the student's major professor approves the final version of the dissertation, it will be distributed to the other members of the advisory committee, and a dissertation defense scheduled no sooner than three weeks after the distribution. This exam requires that all members of the advisory committee be present and is open to faculty members and graduate students. All but one of the members of the advisory committee must approve the student's dissertation and defense. These results are recorded on the Approval Form for Doctoral Dissertation and Final Oral Examination.

Master of Science (M.S.) in Bioinformatics: Curriculum Requirements

Because of its interdisciplinary nature, the bioinformatics M.S. degree program admits students from diverse backgrounds and leads to multiple careers paths, depending upon the background and interests of the students. Thus, the curriculum ensure to provide flexible training of a diverse student body while maintaining the rigor of the program.

All students are required to take BINF 8001 (Introduction to Bioinformatics) in their first Fall semester in the program. All students are required to take BINF 8900L (Bioinformatics Lab Rotation) in their first two semesters in the program. Students who enter the program committed to a lab should take this course in place of research credits, but are not required to rotate. Master students are required to take BINF 8990 (Bioinformatics Colloquium) once.

In addition, 6 hours of BINF 7000 Master Research course and 3 hours of BINF 7300 Master's Thesis course work are required for students with the thesis option. In the absence of a thesis, students will take 9 hours of 8000-level courses in an area of specialization to be approved by their committee as well as prepare a final technical report on a topic assigned by the student's advisor.

Core Courses for M.S. Program

Every M.S. student needs to take the following five core courses and complete any prerequisites for these courses.

Prefix	Number	Title	Credits
BCMB	8210	Computational Methods for Bioinformatics	3
BCMB	8211	Advanced Methods for Biological Data Analysis II	3
GENE	8940	Genome Analysis	2
STAT	6630	Statistical Bioinformatics I	3
CSCI	6490	Algorithms for Computational Biology	4

Elective Courses for M.S. programs

a) *Foundation courses for biologists:*

STAT 6310 Statistical Analysis I (3 hours)
CSCI 7010 Computer Programming (4 hours)

b) *Foundation courses for quantitative scientists:*

BCMB 6000 General Biochemistry and Molecular Biology (3 hours)
BIOL 6040 Essential Biology for the Quantitative Scientists (3 hours)

c) *Specialization in Applied Probability:*

STAT 6510 Mathematical Statistics I (3 hours)
STAT 6520 Mathematical Statistics II (3 hours)
STAT 8700 Applied Stochastic Processes (3 hours)
STAT 8730 Sequential Analysis (3 hours)

d) *Specialization in Computer Algorithms:*

CSCI 4470/6470 Algorithms (4 hours)
CSCI 8470 Advanced Algorithms (4 hours)
CSCI 8610 Topics in Theoretical Computer Science (4 hours)
CSCI 4140/6140 Numerical Methods and Computing (4 hours)
CSCI 8140 Parallel Processing and Computational Science (4 hours)
CSCI 8150 Advanced Num. Methods and Sci. Comp. (4 hours)

e) *Specialization in Database and Software Systems:*

CSCI 6350 Global Information Systems (4 hours)
CSCI 6370 Database Management (4 hours)
CSCI 6800 Human-Computer Interaction (4 hours)
CSCI 8350 Semantic Web (4 hours)
CSCI 8351 Semantic Web Servers and Processes (4 hours)
CSCI 8370 Advanced Database Systems
CSCI 8380 Advanced Topics in Information Systems (4 hours)
CSCI 8820 Computer Vision and Pattern Recognition
CSCI 8950 Machine Learning (4 hours)

f) *Specialization in Ecology:*

ECOL(PBIO) 6580 Foundations of Ecology (2 hours)
ECOL 8310 Population Ecology (4 hours)
ECOL 8325-8325L Modeling Population Ecology (4 hours)
ECOL 8580-8580L Theory of Systems Ecology ((4 hours)

g) *Specialization in Genomics and Proteomics*

PBIO(BIOL) 4550/6550 Bioinformatics Applications (3 hours)
BCMB 8140 Genomics and Bioinformatics (3 hours)
BCMB 8300 Advanced Proteomics (3 hours)
MIBO(BCMB) 8270-8270L Composition, Organization, and Evolution of Genomes (3 hours)
PBIO 6510 Genome Evolution Across the Tree of Life (3 hours)

h) *Specialization in Microbiological Processes:*

MIBO 6090 Prokaryotic Biology (3 hours)
MIBO 8110L Electronic Exploration of Prokaryotic Biology (3 hours)
MIBO 8600 Fundamental Processes of Prokaryotic Cell Biology (3 hours)
MIBO 8610 Prokaryotic Physiology and Diversity (3 hours)

i) *Specialization in Microbiological Interactions:*

MIBO 6220 Bacterial Pathogenesis (3 hours)
MIBO 6300 Environmental Microbiology and Biotechnology (3 hours)
MIBO 6500 Bacterial Symbioses (3 hours)
MIBO 8610 Prokaryotic Physiology and Diversity (3 hours)

j) *Specialization in Plant Genomics:*

PBIO 6510 Genome Evolution Across the Tree of Life (3 hours)
PBIO 6720-6720L Plant Variation and Evolution (4 hours)
PBIO 8100 Plant Genetics (4 hours)
PBIO 8111 Plant Development (4 hours)
GENE 8940 Genome Analysis (2 hours)
GENE 8950 Molecular Evolution (3 hours)

k) *Specialization in Statistical Genetics:*

STAT 6320 Statistical Analysis II (3 hours)
STAT 6810 Probability Distributions (3 hours)
STAT 6820 Statistical Inference (3 hours)
STAT 8090 Statistical Analysis of Genetic Data (3 hours)

1) *Specialization in Toxicology:*

PHRM 6910 Introduction to Toxicology (3 hours)

BIOS 8100 Case Studies in Nonlinear Biostatistics (3 hours)

EHSC 8510 Environmental Risk Assessment and Communication (3 hours)

EHSC 8220-8220L PBPK Models (4 hours)

1. **Lab Rotations:**

Students who are not committed to a major professor upon entering the program will rotate through several labs in order to find a major professor. Students will spend half of a semester in each of up to three different labs, participating in research work in that lab. Rotations will occur in the second half of the first semester and in the second semester of the first year. See the IOB webpage for a list of IOB faculty and links to their web pages. The Introduction to Bioinformatics course will occur in September, when faculty will give short presentations about their research. All students should register for BINF 8900L in their first two semesters in the program. If a student is already committed to a lab, then this course will be taken in place of research credit (these students are not required to rotate).

2. **Advisory Committee**

Upon arrival at the university, students will be assigned a curriculum advisor for guidance and mentoring. Because this program is interdisciplinary, students will be advised to take prerequisite courses in areas where the student does not have the necessary background. Students will select their major professor and establish an advisory committee by the end of their first year in the program. The major professor must be a full member of the IOB and the Graduate Faculty. The advisory committee must consist of the major professor and at least two other faculty members. At least two members of the advisory committee must be full or associate members of the IOB. The advisory committee will also be composed of representatives of both the biological and the quantitative sciences.

3. **Master's Thesis**

Students are required to take an oral examination conducted by the advisory committee and to have his/her thesis approved by the committee.

The thesis is a report of the student's investigations under the supervision of his/her major professor and requires the approval of the major professor and the advisory committee. The thesis must demonstrate competent style and organization, and communicate technical knowledge. The thesis often includes original research in bioinformatics. It must demonstrate mastery of a particular area of bioinformatics. The student's advisory committee assures that the quality of the thesis meets the standards of the IOB and the Graduate School. The candidate must register for BINF 7300 Master's Thesis for at least 3 hours of credit while working on the thesis.

4. Graduation Requirements

Before the end of the second semester in residence, a student must submit to the Graduate School, through the graduate coordinator, the following forms: (i) a Program of Study Form and (ii) an Advisory Committee Form. The Program of Study Form indicates how and when degree requirements will be met and must be formulated in consultation with the student's major professor. An Application for Graduation Form must also be submitted directly to the Graduate School.

5. Thesis Defense

After all course work has been completed and the thesis has been approved by the student's major professor, the thesis is submitted to the other members of the advisory committee at least two weeks before the thesis defense date. The thesis defense is an oral examination conducted by the student's advisory committee, and constitutes the second part of the master's final examination. All members of the advisory committee must be present at the defense. The advisory committee members including the major professor must vote on whether the student passed the defense and record their votes on the Approval Form for Master's Thesis, Defense, and Final Examination. To pass the exam, at least two of the three votes must be passing.

Graduate Certificate in Bioinformatics: Curriculum Requirements

Graduate students in any department at UGA can receive the Graduate Certificate in Bioinformatics by taking bioinformatics coursework. Students seeking a Certificate must be currently enrolled and in good standing in a graduate program at the University of Georgia, Athens.

The requirements for the certificate in Bioinformatics are:

1. **BINF 8210:** *Computational Methods in Bioinformatics*
2. **BINF 8211:** *Computational Applications in Bioinformatics*
3. **STAT 6310:** *Statistical Analysis I*
OR
STAT 6630: *Statistical Methods in Bioinformatics I*
4. A graduate level course in Biology.
5. A computer science course from the list below:

CSCI 6490: *Algorithms for Computational Biology*

CSCI 7010: *Computer Programming*

CSCI 6140: *Numerical Methods and Computing*

CSCI 6150: *Numerical Simulations in Science and Engineering*

CSCI 6370: *Database Management*

CSCI 4470/6470: *Algorithms*

CSCI 4490/6490: *Algorithms for Computational Biology*

CSCI 4500/6500: *Programming Languages*

CSCI 4560/6560: *Evolutionary Computation and Its Applications*

CSCI 4850/6850: *Biomedical Image Analysis*

CSCI 8140: *Parallel Processing and Computational Science*

CSCI 8150: *Advanced Numerical Methods and Scientific Computing*

CSCI 8370: *Advanced Database Systems*

CSCI 8470: *Advanced Algorithms*

CSCI 8850: *Advanced Biomedical Image Analysis*

How to Apply for a Certificate:

Before you apply, please notify the Graduate Coordinator of the Institute of Bioinformatics once month before the end of the semester in which you intend to apply for the Certificate.

To apply for the Certificate, send a letter to the Graduate Coordinator of the institute of Bioinformatics that includes the following: Your name; your student Identification (810) number and the course completed to fulfill the Certificate requirement.

For each course, include only the course prefix and number (e.g. BINF 8210) and the semester in which the course was completed. Include a copy of your transcript that shows the grades for the course used for completion of the Certificate. For courses recently completed whose grades are not included on your transcript, include a brief letter from the instructor stating that you have

received a grade B or higher. This information must be received within three days following the grade role deadline to receive the Certificate within that semester.

Please note: The Certificate is not a fiscal document that we would be mail to you, but an notation added to your transcript, which would say “*COMPLETION OF A CERTIFICATE IN BIOINFORMATICS*”.

Graduate School Requirements:

The [Graduate School](#) sets forth additional requirements concerning residence, time limits, programs of study, acceptance of transfer credits, and admission to candidacy, minimum GPAs, dissertation, and examinations. The students should refer to the [Graduate School Bulletin](#) for details.