



BICB Graduate Program handbook

2018-2019

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Brief History

The establishment of the University of Minnesota Rochester campus provides the unique opportunity to build on existing capacity in both the Rochester area and on the Twin Cities campus to meet educational needs in this scientific field in Minnesota. In December 2007, the BICB Academic Planning Committee consisting of faculty and administrators from the founding institutions, University of Minnesota Rochester, University of Minnesota Twin Cities, Mayo Clinic, The Hormel Institute and IBM submitted a proposal to the University of Minnesota Graduate School to establish new M.S. and Ph.D. graduate programs in Biomedical Informatics and Computational Biology (now named Bioinformatics and Computational Biology). The program was approved by the University of Minnesota Board of Regents in July 2008 with legislative funding and support driven by the recommendations of the Governor of Minnesota's appointed Rochester Higher Education Development Committee.

The BICB graduate program admitted its first students in Fall 2008. BICB graduated its first student with a Master's degree in Fall 2010, and its first student with a Ph.D. in Spring 2012. Cray Inc. and the National Marrow Donor Program joined BICB as partners in this collaborative program in 2012, with the Brain Sciences Center joining in the spring of 2013.

Program Overview

The Bioinformatics and Computational Biology (BICB) program was established in 2007 as a result of legislative funding and support driven by the recommendations of the Governor of Minnesota's appointed Rochester Higher Education Development Committee (RHEDC). The committee recommended the collaborative development of an institution that focuses on health science, bioscience, engineering, and technology. This institution was the University of Minnesota Rochester. The goal was to establish a world-class academic and research program that provide applications to economic activities via innovation, translational research, and clinical experiences at the University of Minnesota Rochester by leveraging the University of Minnesota's academic and research capabilities in partnership with Mayo Clinic, Hormel Institute, IBM, National Marrow Donor Program (NMDP), the Brain Sciences Center and other industry leaders. The vision is to advance informatics and computation and to support a strong life science industry in Minnesota.

The importance of bioinformatics, computational biology, and health informatics in life and health sciences has dramatically increased with the rise of genomics and proteomics and the need for informatics tools to manage health care. A strong representation of expertise in these fields has therefore become essential for any research university or clinical enterprise. With the rapid growth of data in the life and health sciences, there is a mounting need to train scientists who are experts in these quantitative sciences and familiar with the language of the life and health sciences. This need is reflected in job opportunities in academia, industry, and clinics for scientists trained in this interdisciplinary environment.

Degree Programs

The Bioinformatics and Computational Biology (BICB) graduate program is an interdisciplinary, all-University graduate program between the University of Minnesota Twin Cities and the University of Minnesota Rochester. The administrative home of the program is the University of Minnesota Rochester. The College of Science and Engineering is the partnering college on the Twin Cities campus.

The Bioinformatics and Computational Biology program offers the Ph.D. and Master of Science (M.S. Plan A and Plan B) degrees and a Minor with a full suite of academic offerings and research opportunities in this fast growing field to give you the skills and knowledge needed to lead the way to tomorrow's tools for the quantitative analysis of biological and clinical data.

- top-ranked faculty from eight world-class institutions
- state-of-the-art knowledge in a fast-growing field
- integrated education in the life and computational/mathematical sciences
- collaborative research opportunities
- professional development
- world-class supercomputing resources
- semi-annual research symposia

Its graduate faculty include researchers from the University of Minnesota Twin Cities, the University of Minnesota Rochester, the Hormel Institute, the Mayo Clinic, IBM, National Marrow Donor Program (NMDP), and the Brain Sciences Center. Students are in residence on either the Rochester campus or the Twin Cities campus. The program is suitable for full-time and part-time students.

The BICB Ph.D. program accepts applications in the Fall. BICB MS program accepts applications throughout the year.

Courses

The BICB program is composed of courses that are mostly taught out of Twin Cities departments or Mayo Graduate School. These courses are divided into core and elective courses. Below is a list of courses. This list is not exhaustive. If you and your adviser identify a course that is not on the list but is essential for gaining competency in your area of specialty, contact the Director of Graduate Studies to find out which of the areas the course would fall under. Most BICB courses and seminars listed below are Pass/Fail (where applicable).

Core Courses

1. BICB 8510 Computation and Biology (2 crs; up to 2 repetitions totaling up to 4.0 crs)
This course will be taught in modular form and will provide first-year graduate students with an overview of topics in molecular biology and genetics; mathematics, statistics and biostatistics;

programming in FORTRAN and C/C++; programming in Perl; data management; and data mining. The modules will be offered based on the needs of each incoming class of BICB graduate students.

2. BICB 8990 Seminar on Current Topics (1 crs; up to 4 repetitions totaling up to 4.0 crs)
Sections in this seminar will vary depending on instructor.
3. BICB 8991 Independent Study (1-2 crs; up to 2 repetitions totaling up to 4.0 crs)
This course may be used by graduate students for reading courses with appropriate faculty or to conduct other independent studies. Ph.D. graduate students may only register for this course prior to passing the preliminary oral exam. M.S. graduate students may register for this course at any time.

Elective Courses

1. BICB 8940 Education and Pedagogy Seminar (1 crs; up to 4 repetitions totaling up to 4.0 crs)
This seminar will meet weekly in the fall semester. It will give students and faculty the opportunity to discuss effective teaching methods, advising methods, etc., with an emphasis on interdisciplinary training and training across multiple institutions.
2. BICB 8970 Leadership Seminar (1 cr; 2 repeats allowed)
This leadership seminar will focus on clinical and translational research and entrepreneurship. It will meet every other year and will feature invited speakers who are involved in clinical and translational research.

Mayo Clinic Courses and UMTC MOT Courses

1. BICB 5620 Topics in Biomedical Informatics and Computational Biology (0.5-4 crs; up to 6 repetitions totaling up to 24.0 crs) Each section of this course corresponds to a Mayo Clinic 5xxx or 6xxx course. Contact DGS before enrolling
2. BICB 8620 Topics in Biomedical Informatics and Computational Biology (0.5-4 crs; up to 6 repetitions totaling up to 24.0 crs)
Each section of this course corresponds to a Mayo Clinic 8xxx course. Contact DGS before enrolling.
3. BICB 8670 Topics in Management of Technology (0.5-4.0 crs; up to 6 repetitions totaling up to 24.0 crs)
Each section of this course corresponds to a MOT course. Contact DGS before enrolling.

Other Courses

1. BICB 8920 BICB Colloquium (1 cr; up to 2 repetitions totaling up to 2.0 crs)
This is a weekly seminar for BICB graduate students that introduces students to current topics in the research area. The seminar features outside speakers and will utilize existing seminar series when appropriate, such as the CBCB seminar series. Ph.D. students must take two semesters of this seminar; M.S. students must take one semester.
2. BICB 8930 Journal Club (1 cr; up to 4 repetitions totaling up to 4.0 cr)

This seminar will meet weekly for 60 minutes during both fall semester and spring semester. The seminar is required of 1st and 2nd year Ph.D. graduate students and 1st year M.S. graduate students. This seminar consists of discussions of journal articles that are led by 2nd year Ph.D. graduate students. The journal articles will be chosen by the 2nd year students in consultation with their advisors/co-advisors

3. BICB 8932 Proposal Writing Seminar (1.0 crs; no repeats allowed)

This seminar is required for all 2nd year Ph.D. graduate students. Its purpose is to teach students how to write proposals and to guide them through the writing of their preliminary written exam. This seminar will meet during the spring semester.

4. BICB 8994 Directed Research (1-3 crs; up to 2 repetitions allowed totaling up to 6.0 crs)

This course may be used by Ph.D. graduate students to engage in research projects prior to passing the preliminary oral exam. These research projects may lead to thesis research or could be independent of the planned Ph.D. or M.S. thesis research. M.S. graduate students may register for this course at any time.

5. BICB 8960 Internship Course (1-6 crs; up to 6 repeats allowed totaling up to 12.0 crs)

All students are required to complete 120 hours of internships. Students may register for up to 6 credits per semester. Students are not required to register for credit for internships. However, they must provide documentation of completion of internships that are kept on file as outlined in Appendix B.

Other Program Credits

1. BICB 8333 FTE: Master's (No Grade Associated)

2. BICB 8444 FTE: Doctoral (No Grade Associated)

3. BICB 8666 Doctoral Pre-Thesis Credits (1-6 crs; 2 repeats allowed; DGS consent for 3rd/4th registrations; No Grade Associated)

4. BICB 8777 Thesis Credits: Master's (1-18 crs; 10 repeats allowed; No Grade Associated)

5. BICB 8888 Thesis Credits: Doctoral (1-24 crs; 10 repeats allowed; No Grade Associated)

Ph.D. Degree Program

The [degree completion steps](#) detail the twelve administrative steps that must be completed. Before you contact the Graduate School for specific questions, contact the DGS or DGS Assistant of the program.

Every Ph.D. graduate student will have a temporary advisor assigned when entering the program. The student is expected to decide on a research area by the end of the first year and to choose a permanent advisor by the end of the first year. The time limit for earning a Ph.D degree is eight years. Students who are unable to complete the program within eight years may petition for an extension of up to 24 months.

You and your adviser will determine the course work you will need to take to gain competency in your specialty. The BICB program is designed to allow for maximum flexibility. There are a few courses and seminars, however, every Ph.D. student takes: four semesters of Journal Club (BICB 8930), two semesters of Colloquium (BICB 8920), two semesters of Computation and Biology (BICB 8510), one semester of Proposal Writing Seminar (BICB 8932), one semester or quarter seminar (1 credit) of Ethics, and one semester (1 credit) of Entrepreneurship and Leadership (e.g., BICB 8970). (The requirements for BICB 8510 and BICB 8932 may be waived upon request if the student is very advanced when entering the program.)

A degree program is a list of coursework that you submit to the Graduate School as the basis for your degree. It may not contain all courses and seminars you complete during the course of your degree but must contain all required courses and seminars. The [Degree Program Form](#) is available online. List only graduate level courses (one 4000 level course is permitted). Graduate Education policy requires that a minimum of 2/3 of the course credits included in the degree plan are taken A/F and that students should maintain an overall GPA of 3.000 for courses included on the degree plan at the time of degree clearance. You must file your degree program at least one semester prior to taking your preliminary oral exam. Assign members to the preliminary oral exam committee at least one month prior to submitting your preliminary written exam to the program (typically, two members of your preliminary oral exam committee will also review your preliminary written exam). Once the degree program is approved, any changes must be petitioned to the Graduate School by submitting a [Petition Form](#).

Core Areas & Electives

The minimum course credit requirements for a Ph.D. are 24 course credits in core and elective courses and 24 thesis credits (BICB 8888). In addition, students must complete four credits of BICB 8930 Journal Club and two credits of BICB 8920 Colloquium. Students may choose a Minor and the choice of courses must satisfy the Minor requirements.

Ph.D. students are required to gain competency in Core Area 1 and at least two of the Core Areas 2-5 (total of at least 12 credits including Core courses with the BICB designator, such as BICB 8510, BICB 8990, and BICB 8991). The Core Areas are:

1. Biochemistry, molecular and cell biology
2. Database, data mining, and computing
3. Informatics, analysis, and machine learning
4. Mathematics, biostatistics and statistics
5. Computational and systems biology

Ph.D. students are required to take Elective courses from the following areas (at least twelve credits, including Elective courses with the BICB designator, such as BICB 8940 and BICB 8970). Courses from the designated Core courses may count as Elective courses in addition to courses designated as Elective courses from the following eight areas:

1. Biochemistry, molecular and cell biology
2. Informatics, database, data mining, and computing
3. Mathematics, biostatistics and statistics
4. Chemistry, chemical engineering, and physics
5. Biophysics and structural biology
6. Imaging, information theory, and signal processing
7. Computational chemistry, medicinal chemistry and drug design
8. Clinical and translational sciences

There is a limit of one 4xxx level course counted in the total course credits. Courses that are used to satisfy course requirements in the Core Areas of the interdisciplinary program cannot simultaneously be used to satisfy credit requirements for a Minor. A maximum of 6 course credits in the Elective courses may be applied towards a Minor and thus count toward satisfying both the Elective and the Minor requirements.

Ph.D. students are required to complete a total of 120 hours of industrial or clinical internships or lab rotation(s) (collectively called internships). Often, internships consist of observing experiments or processes in a lab that produces the data for the student's research. An internship may also include readings of experimentally focused journal articles or other sources to gain a better understanding of the data. The internship is expected to be completed within the first two years and no later than by the end of the third year. If a student participates in an internship experience during the semester, he or she may sign up for BICB 8960 Internship Course (1 credit is equivalent to about 40 hours of participation per semester). Students are not required to register for internships but their participation will be tracked by the program (see [Internships](#)). Internships can be at any of the participating institutions or institutions/organization that are approved by the graduate program. Approved organizations are the University of Minnesota, Mayo Clinic, IBM, and Cray Inc. Organizations will be added as appropriate. The internship requirement can be petitioned in cases of significant relevant prior experience. Details on the internship requirement are provided in [Internships](#).

Ph.D. students are required to take two semesters of BICB 8920 (BICB Seminar) and four semesters of BICB 8930 (Journal Club). These credits do not count as Core or Elective Courses.

Ph.D. students are required to take one semester of BICB 8932 Proposal Writing. This seminar is taken in preparation for their preliminary written exam. This seminar does not count toward Core or Elective courses. This requirement may be waived if a student is sufficiently advanced when entering the program.

Ph.D. students will take at least 1 credit in Ethics and at least 1 credit of Leadership and Management courses (see the Course List) that cover the areas legal and intellectual property issues; academic leadership; science and technology leadership; and Clinical and translational research and entrepreneurship. These seminars or courses may count toward Elective courses.

Courses that are used to satisfy course requirements in the Core Areas of the interdisciplinary program cannot simultaneously be used to satisfy credit requirements for a Minor. A maximum of 9 course credits in the Elective courses may be applied towards a Minor and thus count toward satisfying both the Elective and the Minor requirements. At least 2/3 of the total number of course credits included in any degree program of a Ph.D. graduate student must be taken A-F. [Click here for more information regarding transferring courses from other programs, etc.](#)

Examinations

The **preliminary written examining committee** for the preliminary written exam of a Ph.D. graduate student consists of three faculty members and will be chosen by the DGS/Associate DGS. It will not include the advisor/co-advisor.

The **preliminary oral examining committee** for the preliminary oral exam of a Ph.D. graduate student consists of at least four members, at least three are BICB graduate faculty from at least two different budgetary units, and, if the student has a Minor, one member must represent the student's Minor. If the student does not have a Minor, the fourth member may be from the BICB graduate faculty. The advisor/co-advisor will be members of the preliminary oral examining committee. The advisor or, if the student has co-advisors, one of the co-advisors will chair the committee.

The **final oral examining committee** for the defense of a Ph.D. thesis consists of at least four members, at least three are BICB graduate faculty from at least two different budgetary units, and, if the student has a Minor, one member must represent the student's Minor. If the student does not have a Minor, the fourth member may be from the BICB graduate faculty. The advisor/co-advisor will be members of the final oral examining committee but will not chair the committee. This committee may be different from the preliminary oral examining committee.

Preliminary Written Exam

Ph.D. students will write a research proposal on their thesis research to satisfy the preliminary written exam. The exam will be reviewed by three members of the graduate faculty, at most two of the reviewers may come from the preliminary oral examining committee. An advisor or co-advisor may not be a reviewer. Each reviewer must assign one of the following three grades: Pass, Conditional Pass, and

Fail. The student fails the exam if at least two of the reviewers grade the exam as Fail. The student passes the exam if at least two reviewers grade the exam as Pass. In all other cases, the student conditionally passes the exam. [View criteria >>>](#)

CONDITIONAL PASS FOR THE PRELIMINARY WRITTEN EXAM: The student is asked to rewrite the proposal within six weeks. (See below for rules on rewriting the preliminary written exam.)

FAIL FOR THE PRELIMINARY WRITTEN EXAM: The DGS must call a meeting of the reviewers and the preliminary oral examining committee [including the advisor(s)] to determine by majority vote whether (i) the student should be asked to re-write the proposal (see below for rules on rewriting the preliminary written exam), (ii) the student should be switched to the Master's program (Plan A or B), or (iii) the student should be terminated. If the student is allowed to re-write the proposal, the procedure is identical to a conditional pass and the student shall be given six weeks to resubmit the rewritten proposal.

REWRITING THE PRELIMINARY WRITTEN EXAM: The reviewers are asked to review the rewritten proposal and to determine whether the rewritten proposal is satisfactory. (Different reviewers may be chosen for the review of the re-written proposal but at most two of the reviewers may come from the preliminary oral examining committee.) If the reviewers unanimously recommend passing the student, the student passes. Otherwise, the DGS must call a meeting of the reviewers and the preliminary oral examining committee (including the advisor) to determine by majority vote whether (i) the student should be allowed to re-write the proposal for a second time, or (ii) the student should be switched to the Master's program (Plan A or B), or (iii) the student should be terminated. If the student is allowed to re-write the proposal for a second time, the student shall be given six weeks to resubmit the re-written proposal.

The number of times a proposal can be re-written is limited to two. If the reviewers do not agree to unanimously PASS the student after the student had a chance to rewrite the proposal twice, the DGS must call a meeting of the reviewers and the preliminary oral examining committee (including the advisor) to determine by majority vote whether the student should be switched to the Master's program (Plan A or B) or terminated.

When the DGS calls a meeting of the reviewers and the preliminary oral examining committee [including the advisor(s)], both the DGS and the advisor are eligible to vote. The Associate DGS may substitute for the DGS. Both the DGS and the Associate DGS may be present at the meeting but only one of the two has a vote.

Preliminary Oral Exam

After successful completion of the preliminary written exam, the student can take the preliminary oral exam. The student is responsible for initiating the assigning and updating of the preliminary oral examining committee. This is done electronically. Go to [Assign/Update Preliminary Oral Examining Committee](#) to start the form. Once a date for the preliminary oral exam is set and no later than one week prior the examination, the student must schedule the preliminary oral examination with the

Graduate School [online](#). Note that the degree program form must have been approved and you must hold active status at the time of the examination.

The preliminary oral exam consists of a pre-thesis seminar followed by an examination. The pre-thesis seminar is public and you must submit the title of your presentation at least one week prior to the exam to the program assistant who will announce the presentation to the BICB faculty and students. The examination is not public.

Final Oral Exam

Before the student can take the final oral exam, each designated reviewer must certify that the dissertation is ready for defense. Reviewers must be given at least 14 days to review the thesis. A minimum of 2 major field reviewers and 1 outside reviewer are required. Advisor(s) must serve as reviewers. Obtain signatures on the Reviewers' Report (contained in the Graduation Packet), and submit the Report prior to your defense.

Notify the Graduate School at least one week in advance of the date of your doctoral final exam. The doctoral final examination consists of a public defense of the dissertation followed by a closed session open only to the doctoral candidate and the doctoral final examination committee. To be recommended for the award of the doctoral degree, all committee members, or all committee members save one, must certify that the student passed the doctoral final oral examination. Students are not allowed to retake the final oral examination.

Submit the Doctoral Final Exam Report no later than the last business day of anticipated month of graduation. Submit your dissertation by the last business day of anticipated month of graduation. Consult Graduation Packet for formatting guidelines.

Master's Degree Program

The BICB graduate program offers the master's degrees under two different plans: Plan A, which requires a thesis; and Plan B, which substitutes additional coursework and a capstone experience. Each plan has a minimum of 30 credits. There are degree completion steps for each of the two plans.

Every M.S. graduate student will have a temporary advisor assigned when entering the program. The student is expected to decide on a research area by the end of the first year and to choose a permanent advisor by the end of the first year. The time limit for earning a Master's degree is five years. Students who are unable to complete the program within five years may petition for an extension of up to 12 months.

You and your adviser will determine the course work you will need to take to gain competency in your specialty. The BICB program is designed to allow for maximum flexibility. There are a few courses and seminars, however, every Master's student takes: two semesters of Journal Club (BICB 8930; 1 credit per semester), one semester of Colloquium (BICB 8920; 1 credit), one semester (or quarter) of Ethics (1 credit), and one semester of Entrepreneurship and Leadership (e.g., BICB 8970; 1 credit). These five required credits count toward the completion of the 30 required credits for the M.S. degree.

The examining committee for a M.S. graduate student should be chosen by the end of the first year to allow time for feedback on your thesis work or project. It consists of at least two members from the BICB graduate faculty and, if the student has a Minor, one member from the student's Minor. If the student does not have a Minor, all members of the examining committee may be from the BICB graduate faculty but must represent at least two different budgetary units. The advisor will be the chair of the examining committee. Initiate the online form for assigning members to the master's final exam committee at least one month prior to the final exam.

A degree program is a list of coursework that you submit to the Graduate School as the basis for your degree. It may not contain all courses and seminars you complete during the course of your degree but must contain all required courses and seminars. The Degree Program Form is available online. You should file the form with the Graduate School when you have completed about 10 credits and no later than one semester prior to anticipated graduation. List only graduate level courses (one 4000 level course is permitted). Graduate Education policy requires that a minimum of 2/3 of the course credits included in the degree plan are taken A/F and that students must have a 2.800 GPA for courses included on the degree plan at the time of degree clearance. The Graduate School requires that at least 60% of the coursework for the official degree programs (excluding thesis credits) are completed as registered University of Minnesota Graduate School students. Once the degree program is approved, any changes must be petitioned to the Graduate School by submitting a [Petition Form](#).

Core Areas & Electives

M.S. students (Plan A and Plan B) are required to gain competency in Core Area 1 and at least one of the Core Areas 2-5 (total of at least 9 credits, including Core courses with the BICB designator, such as BICB 8510, BICB 8990, and BICB 8991). The Core Areas are:

1. Biochemistry, molecular and cell biology
2. Database, data mining, and computing
3. Informatics, analysis, and machine learning
4. Mathematics, biostatistics and statistics
5. Computational and systems biology

M.S. students will take at least five credits of Elective courses (including Elective courses with the BICB designator, such as BICB 8940 and BICB 8970, and required seminars, such as BICB 8920 and BICB 8930). The Elective courses are from the following eight areas:

1. Biochemistry, molecular and cell biology
2. Informatics, database, data mining, and computing
3. Mathematics, biostatistics and statistics
4. Chemistry, chemical engineering, and physics
5. Biophysics and structural biology
6. Imaging, information theory, and signal processing
7. Computational chemistry, medicinal chemistry and drug design
8. Clinical and translational sciences

There is a limit of one 4xxx level course counted in the total course credits. Courses that are used to satisfy course requirements in the Core Areas of the interdisciplinary program cannot simultaneously be used to satisfy credit requirements for a Minor. A maximum of 6 course credits in the Elective courses may be applied towards a Minor and thus count toward satisfying both the Elective and the Minor requirements.

M.S. students will take at least 1 credit in Ethics and at least 1 credit of Leadership and Management courses (see the course list) that cover the areas legal and intellectual property issues; academic leadership; science and technology leadership; and Clinical and translational research and entrepreneurship. M.S. students are required to take one semester of BICB 8920 (BICB Seminar) and two semesters of BICB 8930 (Journal Club). These seminars or courses may count toward Elective courses.

This program adopts Graduate School standards: The Graduate School requires a minimum GPA of 2.80 (on a 4.00 scale) for courses included on any official master's degree program form. Courses with grades of A, B, C (including C-), and S may be included in the official degree program, but grades of S are not calculated in the GPA. Students pursuing a Plan A master's degree are required to register for 10 thesis credits (BICB 8777); these registrations are not graded and therefore cannot be used to meet course credit requirements. At least 2/3 of the course credits included on any M.S. degree program form must be taken A-F. Click [here](#) for more information regarding transferring courses from other programs, etc.

Master's Plan A

The administrative degree completion steps are summarized [here](#).

Complete the Graduate Degree Plan at least one semester prior to anticipated graduation. The Plan A Master's degree program includes the writing of a research thesis under supervision of a BICB graduate faculty. The minimum credit requirements for a M.S. Plan A are 20 course credits in the interdisciplinary program and 10 thesis credits (BICB 8777). Students must have a 2.800 minimum GPA for courses that are included on the degree plan at the time of degree clearance.

Students submitting a Master's degree program under Plan A must present a public pre-thesis seminar to the faculty and graduate students of the program no later than in the middle of their third semester (full-time students) or middle of their third year (part-time students). The purpose of the seminar is to invite comments and suggestions on your research plan. The members of the examining committee should be present and the seminar must be scheduled during normal working hours, preferably during the Journal Club. Your presentation should be about 30-40 minutes to allow for questions.

Once the degree program has been approved by the Graduate School and up to one semester prior to your Master's final exam, you can download a Graduation Packet from the Graduate School online. Initiate the online form for assigning members to the master's final exam committee at least one month prior to the final exam. Submit the Application for Degree Form (included in the Graduation Packet) to One Stop by the first business day of the anticipated month of graduation. You will receive a Thesis Reviewer's Report Form that needs to be signed and submitted prior to the final examination. This form generates the Final Examination Report Form (sent to your committee chair by the Graduate School after the Graduate School received the signed Thesis Reviewer's Report form). Remember to leave your committee enough time to read your thesis (at least two weeks), and allow for time to obtain the Final Examination Report. The final examination consists of a thesis defense that is open to the public followed by an oral examination that is closed to the public. A majority vote of an examining committee is required to pass the Master's final examination. After your thesis defense and the final oral examination, submit the signed Final Examination Report form to the Graduate School no later than by the last business day of the anticipated month of graduation. Submit a digital copy of your thesis by the last business day of anticipated month of graduation. Consult your Graduation Packet for formatting guidelines. The cover page of your thesis must be signed by your advisor(s).

Master's Plan B

The administrative degree completion steps are summarized [here](#).

Complete the Graduate Degree Plan at least one semester prior to anticipated graduation. Students must have a 2.800 minimum GPA for courses that are included on the degree plan at the time of degree clearance.

The Plan B Master's degree program includes a capstone experience for which students must complete one to three written reports or projects, totaling together about 120 hours of independent work. Suitable projects to satisfy this requirement must be identified by the student in consultation with the advisor and the examining committee, and approved by the advisor no later than at the end of the third semester. Written reports from appropriate coursework can be used to satisfy this requirement. The minimum credit requirements for a M.S. Plan B are 30 course credits in the interdisciplinary program.

Up to one semester before your Master's final exam, you can download a graduation packet online. This packet contains the Graduate Application for Degree form and the Final Examination Report form. Submit the Graduate Application for Degree to One Stop by the first business day of anticipated month of graduation. Initiate the online form for assigning members to the master's final exam committee at least one month prior to the final exam.

After the examining committee accepts the capstone paper(s) or projects as satisfying the capstone experience, schedule the final oral exam. Bring the Final Examination Report with you to the final exam. You will be asked to give a sort presentation on the project or report you did for your capstone experience. This is followed by the examination. The Master's final exam is not public. A majority vote of an examining committee is required to pass the Master's final examination.

Submit the signed Final Examination Report by the last business day of anticipated month of graduation.

Examining Committee & Exams

The examining committee for a M.S. graduate student should be chosen by the end of the first year. It consists of at least two members from the BICB graduate faculty and, if the student has a Minor, one member from the student's Minor. If the student does not have a Minor, all members of the examining committee may be from the BICB graduate faculty but must represent at least two different budgetary units. The advisor will be the chair of the examining committee.

The student is responsible for initiating the assigning and updating of the preliminary oral examining committee. This is done electronically. Go to [Assign/Update Examining Committee](#) to start the form. Before you schedule your final oral exam, make sure that your degree program is approved and that you hold active status at the time of the examination. The Master's (Plan A) final exam consists of a public presentation followed by an oral examination, which is not public. The Master's (Plan B) final exam, which is not public in its entirety, consists of a presentation to your committee on your final project followed by an oral examination.

Minor

If a BICB graduate student pursues a Minor in a different program, courses that are used to satisfy course requirements in the Core Areas cannot simultaneously be used to satisfy credit requirements for a Minor. A maximum of 6 course credits in the Elective courses may be applied towards a M.S. Graduate Minor and a maximum of 9 course credits in the Elective courses may be applied towards a Ph.D. Graduate Minor, and thus count toward satisfying both the Elective and the Minor requirements.

Graduate students who major in other programs may obtain a Minor in the BICB graduate program. For the doctoral Minor, a minimum of 12 credits must be completed from Core Area 1 and at least two of the Core Areas 2-5. Core BICB courses or core seminars may be included in the total of 12 credits. There is a limit of one 4xxx level course counted in the total course credits. For a Master's Minor, a minimum of 9 credits must be completed from Core Area 1 and at least one of the Core Areas 2-5. Core BICB courses or core seminars may be included in the total of 9 credits. There is a limit of one 4xxx level course counted in the total course credits. Other restrictions may apply and the student should consult the DGS of the major program.

Core Areas and Electives

Graduate students choose courses from a list of courses that satisfy requirements in Core Areas and Elective. There are five Core Areas:

1. Biochemistry, molecular and cell biology
2. Database, data mining, and computing
3. Informatics, analysis, and machine learning
4. Mathematics, biostatistics and statistics
5. Computational and systems biology

and Elective courses from the following eight areas:

1. Biochemistry, molecular and cell biology
2. Informatics, database, data mining, and computing
3. Mathematics, biostatistics and statistics
4. Chemistry, chemical engineering, and physics
5. Biophysics and structural biology
6. Imaging, information theory, and signal processing
7. Computational chemistry, medicinal chemistry and drug design
8. Clinical and translational sciences

The courses in the Core/Elective are listed on the Courses page. The advisor(s) together with the DGS will ensure that the student selects appropriate courses.

Annual Review

All students will be reviewed annually. The DGS will solicit transcripts and a progress report of each student during the spring semester. Students meet with the DGS or Associate DGS or appointed faculty members during the summer to review their progress and to discuss the upcoming academic year. M.S. students who are not in good standing will be informed of the result in writing with a copy to the advisor. Ph.D. students, regardless of their standing, will be informed in writing about their progress.

Policies & Other Information

Statement on Sexual Harassment

Sexual harassment is against the law. It is prohibited by Title VII of the 1964 Civil Rights Act and by the Minnesota Human Rights Act. Sexual harassment is broadly defined to include behavior which is not considered overtly sexual. Although not specifically prohibited, consenting sexual relationships between faculty and student, or supervisor and employee, are actively discouraged. The University of Minnesota has had a strongly enforced policy on sexual harassment since 1981 and encourages reporting of violations. Call 612-624-9547 for additional information.

Statement of Equal Opportunity

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

Other general information about graduate programs at the University of Minnesota can be found at the web page of the [Graduate School](#). The Graduate School has also issued a [Graduate Student Handbook](#) with useful information about policies and procedures that are relevant to all University of Minnesota graduate students.

Responsibilities

The University suggests principles for mutual roles and responsibilities in [Mutual Rights and Responsibilities of Faculty and Graduate Students: Guidelines](#).

Grievances

For resolving student academic complaints, please contact the DGS (see also Administrative Policy: [Addressing Student Academic Complaints](#), and the [Student Conflict Resolution Center](#))

Conduct

See the Board of Regents Policy: [Student Conduct Code](#) and related resources (e.g., [Office for Student Conduct and Academic Integrity](#))

Research

For research involving human subjects and animals, see: [Research Involving Human Subjects](#) and [Research Involving Animal Subjects](#)

Opportunities for Student Involvement

BICB has a student representative who attends BICB Faculty meetings

[COGS](#)

[GAPSA](#)

Adding External Members to an Examining Committee

1. The graduate student initiates the process by informing the DGS that s/he would like to add an external member to the committee.
2. The DGS solicits the CV from the suggested member, and verifies with the student's adviser that the suggested member is appropriate for the committee and approved by the adviser.
3. The DGS checks whether the suggested member has the appropriate credentials, which typically is a Ph.D. in a field appropriate to the student's research.
4. The DGS circulates the CV among BICB graduate faculty to solicit comments within a fixed period (say, two weeks). If nobody voices any concerns about the suggested member being a member of an examining committee, the DGS will initiate the process of adding the member to the committee.

Being an external member of an examining committee does not confer any rights other than participating in that committee. i.e., the external member does not become a permanent member of the BICB graduate faculty. Once the student graduates, the external member no longer has a relationship with the program. If serious concerns by other faculty members are voiced, i.e., if faculty have reasons to believe that the academic credentials of the suggested external member are not at the level expected of a member of a BICB examining committee, the DGS will contact the student's adviser to discuss the concerns. If the concerns cannot be resolved through discussions, the DGS will ask the adviser to suggest a different committee member.

BICB Admissions

Information for Prospective Students

The Bioinformatics and Computational Biology graduate program is an all-University, interdisciplinary graduate program. The administrative home is at the University of Minnesota Rochester. Faculty come from the University of Minnesota Twin Cities, the University of Minnesota Rochester, the Hormel Institute, Mayo Clinic, IBM, Cray Inc., National Marrow Donor Program (NMDP) and the Brain Sciences Center. A Director of Graduate Studies (DGS) and an Associate Director of Graduate Studies (A-DGS) are the liaison with departments and partnering institutions.

The program aims to create a paradigm shift in the way interdisciplinary, multi-institutional higher education is delivered. With multiple institutional partners, we provide students the opportunity to work with faculty from academia, a clinical institution, and industry. The program is designed to overcome challenges of geographically dispersed partnering institutions by delivering courses via ITV, video-conferencing, and regular meetings of all faculty and students.

We expect students to gain competency in the areas of computer science, informatics, mathematics, statistics, and the biological and health sciences. While the students' research will focus on development and applications of computational methods, conducting the research in industry or laboratories will prepare students for an interdisciplinary and collaborative work environment and provide hands-on experience with experiments to gain a deeper understanding of the data types that are generated. We expect that most students who pursue a research thesis as part of the degree will become members of a research team to promote this interdisciplinary and collaborative mode of training through co-advising across institutions and disciplines.

The majority of our M.S. students work full time in health care industries or clinics. They pursue the degree part-time to advance their skills to meet the demands for a rapidly changing workplace where complex data have become the basis of clinical decision making. Full-time students are either enrolled in the M.S. or Ph.D. degree to prepare themselves for careers in the private sector or academia. A small number of part-time Ph.D. students work full time in a research environment where they can combine work with pursuing a Ph.D. degree at the same time.

The graduate program is committed to working with students on understanding the financial implications of enrolling into a graduate program. A limited number of one- or two-year UMR BICB fellowships are expected to be available for full-time Ph.D. graduate students upon entry. These are competitively awarded. (Ph.D. students who work full time and are thus part-time students are not eligible for the UMR BICB fellowship.) Students who are applying for the Ph.D. and for whom the program has identified potential adviser(s) are automatically considered for these fellowships. Admission to the Ph.D. program is contingent on identifying both guaranteed funding sources for the first two years and likely funding sources for the following years in addition to a thesis adviser. Funding sources may include the student's own funding and/or company reimbursement policies.) A Ph.D. thesis adviser is expected to provide funding for full-time Ph.D. students after the fellowship funding ends,

unless a different arrangement has been agreed on. Ph.D. students are encouraged to apply for their own funding, and the program offers help with proposal writing during the first-year course where every Ph.D. student is asked to write a proposal to initiate their research. The program does not provide funding for M.S. graduate students and does not ask M.S. advisers to provide funding. For more information regarding work-related policies, see [Graduate Assistant Employee Services](#) in the [Office of Human Resources](#).

Graduate students are admitted to the University of Minnesota after review of applications by the faculty of the program for which the student applied. Students can pursue their degrees on either the Rochester campus or the Twin Cities campus. However, international students typically enroll on the Twin Cities campus while completing their course work due to visa regulations. The Bioinformatics and Computational Biology (BICB) graduate program is one of many graduate programs offered by the University of Minnesota. A list of all majors and degrees offered by the University of Minnesota, the faculty members, requirements, and courses can be found in the [Graduate School Catalog](#).

Tuition and Fees are listed on the University web page [Tuition fact sheet](#).

Prerequisite Coursework

We expect incoming graduate students to have a strong background in the quantitative sciences and varied backgrounds in the life/health sciences. Specifically, we expect incoming students to have taken the following courses at the undergraduate level prior to entering the program:

1. Calculus (1 year)
2. Introductory computer science course and basic programming skills (1 semester)
3. Chemistry (1 year)
4. General biology course (1 semester)

In addition, we expect students to have background in either two of the areas 1-3 or one of the areas 1-3 and one of the areas 4 and 5:

1. Multivariable calculus, differential equations, linear algebra
2. Algorithms and data structure, discrete mathematics
3. Statistics or biostatistics; probability theory
4. Biochemistry, genetics and cell biology
5. Health sciences (pharmacology, physiology, or related areas)

A student might be admitted without meeting the prerequisite requirements, but a plan must be in place to make up deficiencies within the first year. (See below under "How to Prepare Yourself" for further suggestions on how to fill gaps.)

Submitting Your Application

All materials are submitted electronically through the graduate school online application system. Admission decisions are communicated to applicants using this system. The BICB graduate program accepts applications from **December 15 through April 1** for the Ph.D. program for fall semester. A limited number of fellowships are available for Ph.D. graduate students. For full consideration, please submit your application no later than February 15. Applications for the M.S. program are accepted throughout the year for either fall or spring.

A decision for admission notice will be e-mailed to you once your application is carefully reviewed by the program's admission committee and your transcripts and credentials (test reports, diploma copies, etc.) are authenticated by Graduate School officials. If admitted, Ph.D. applicants can expect a decision by April for the following fall semester. Decisions for the M.S. program are made on an ongoing basis.

In addition to completing the online application form you must submit a **personal statement**, which describes your past experiences and career aspirations, and why you wish to pursue graduate studies in biomedical informatics and computational biology. Please indicate the names of the BICB graduate faculty whose interests overlap with yours. If you apply to the Ph.D. program, or wish to pursue a research thesis for the M.S. program, we strongly encourage you to contact these faculty members before you apply. This is particularly important for application to the Ph.D. program as we only admit students to the Ph.D. program for whom we can identify an adviser. Although there is no page limit for the personal statement, we recommend that it be 2-3 pages.

We require the **general GRE test** (no subject test is required), unless significant work experience in a related field can be demonstrated, in which case the applicants should request a waiver in the personal statement. Scores should be sent directly to the U of M Graduate School by the Educational Testing Service (Institution #Code 6874, University of Minnesota). TOEFL scores are generally required of all applicants whose first language is not English. The scores should be sent to the same institution code (6874). See Graduate School web page for further information, in particular for the operational standards for admission and exemptions.

For applications to the BICB Ph.D. program, three letters of recommendation from persons familiar with your academic and professional experience who can comment on your suitability for a research program should be uploaded electronically via graduate school [online application](#) system. You must provide their e-mail addresses in your application.

For applicants to the M.S. program, we request that you name three reviewers and ask them to complete the online evaluation through graduate school [online application](#) system. No letter of recommendation is required, though reviewers can submit them either in addition or in lieu of the evaluation form. You must provide their e-mail addresses in your application.

Unofficial Transcripts of all universities and colleges attended should be uploaded directly to the online application. Please do not mail in paper copies of your transcripts, there is no need for official transcripts or academic records for initial review. If you are admitted, the University will then request official copies of this material. [Click here](#) for more information about transcripts and credentials.

How to Prepare Yourself

Many students have gaps on either the computational side or the life sciences side of this interdisciplinary field. With the large number of free online courses available on the web, there are now ways to prepare yourself without going back to college and taking undergraduate courses. This is particularly attractive to adult learners who plan to return to a university for an advanced degree. If online courses do not work for you, many community colleges offer courses in a cost-effective way that get you started with courses in computer science or biology. The University of Minnesota Informatics Institute maintains a website with additional information on how to prepare yourself for a career in informatics.

If your undergraduate (or other postsecondary) degree is in the life sciences, you will likely have an excellent background in biology but you may not feel comfortable with taking a graduate level course in computer science. MIT Open Courseware through OCW Scholar offers an “Introduction to Computer Science and Programming” course that is free, self-paced, and is aimed at students with little or no prior experience in programming. Follow this course up with a course on Algorithms. There are a number of universities that offer the course for free: MIT Open Courseware offers “Introduction to Algorithms” (6.006), which has course materials available for free on the website. If you want video lectures with the course, take the course at Coursera, which offers the course from both Princeton and Stanford. If you find programming difficult, you may want to take a course in a programming language (Python, R, Perl, or Java) at a local community college or local university. There are also online programming courses available from Extension Services at universities, such as UC Berkeley Extension.

If your undergraduate degree (or other postsecondary) degree is on the computational side, you will likely have an excellent background in computer science, mathematics, or statistics, but may not feel comfortable taking graduate level courses in biology and biochemistry. MIT Open Courseware makes MIT’s chemistry courses freely available. To prepare yourself for biochemistry, you need some background in organic and general chemistry. To learn the language of modern biology, MIT’s “Introduction to Biology” course is a good start. This course is enhanced with video lectures. To learn more about genomics and computational biology, the “Genomics and Computational Biology” course from MIT is still relevant, although already ten years old. Another course of interest may be the “Genomic Medicine” course from MIT, which was taught in 2004. The three biology courses are all multi-media enhanced, that is, they include video and/or audio lectures. A more recent course in “Molecular Biology and Genetics in Modern Medicine” from MIT covers basic concepts in molecular biology and genetics in a clinical context. This course is not multi-media enhanced. Coursera offers a course on “Introduction to Genetics and Evolution” from Duke University, and a course on “Introduction to Genome Science” from the University of Pennsylvania.

Explore the full range of massive online open courses (MOOCs). They are available through iTunes U, Academic Earth, Coursera, MIT Open Courseware, Udacity, and EdX. New players in this field continue to enter the market. Many of these enhance the courses with Discussion Forums, which work well when students take the courses synchronously, such as on Coursera. Because of the large number of students simultaneously enrolled in these courses (often, in the thousands), questions asked by students get answered very quickly and the dialogue can be followed by others who may have similar questions.