

Master of Science Degree Program in Bioinformatics

Graduate Student Handbook

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1.0 Introduction to RIT and the Thomas H. Gosnell School of Life Sciences

Rochester Institute of Technology (RIT) is a national leader in professional and career-oriented education. Talented, ambitious, and creative students of all cultures and backgrounds from all 50 states and more than 100 countries have chosen to attend RIT. Founded in 1829, RIT is a privately endowed, coeducational university with nine colleges emphasizing career education and experiential learning. With approximately 15,700 undergraduates and 3,200 graduate students, RIT is one of the largest private universities in the nation. RIT offers a rich array of degree programs in engineering, science, business, and the arts, and is home to the National Technical Institute for the Deaf.

RIT has been honored by The Chronicle of Higher Education as one of the “Great Colleges to Work For” for four years. RIT is a National Science Foundation ADVANCE Institutional Transformation site. RIT is responsive to the needs of dual-career couples by our membership in the Upstate NY HERC.

The Thomas H. Gosnell School of Life Sciences (GSOLS) is one of the five academic departments in the College of Science at RIT, occupying ~30,000 square feet of space in the Thomas Gosnell Hall (Bldg. 8), Center for Bioscience Education and Technology (Bldg. 75), and Lewis P. Ross Hall (Bldg. 10). This space is divided into teaching laboratories, research laboratories, support facilities (e.g., Bioinformatics (Epi)center, Bioprep Room and Biology Stockroom), and offices. The scientific instruments available for student use include next-generation sequencing facilities, confocal microscopy, and computer workstations/servers for data analysis.

GSOLS is a student-oriented department with a research focus offering degrees at the undergraduate and graduate level. The School comprises 31 full-time Faculty; approximately 300 full-time students across our undergraduate majors of Biology, Biotechnology and Molecular Biology, Bioinformatics and Computational Biology, and Environmental Science; and 50 graduate students in our two Masters programs in Bioinformatics and Environmental Science. GSOLS is known for the high quality education it provides to its students, its innovative approaches to teaching and learning, and its excellent research and expertise in target areas. The degree programs provide students with an excellent preparation for graduate schools or careers in industry.

2.0 B.S./M.S. and M.S. Degree Programs in Bioinformatics

The B.S./M.S. program is an accelerated dual-degree program with 145 credit hours, allowing undergraduate students to acquire both B.S. and M.S. degrees in as few as five years. Students who have completed 121 credit hours officially switch from the B.S. 'phase' to the M.S. 'phase'. Undergraduate students in the Bioinformatics and Computational Biology Program with a minimum overall GPA of 3.2 may apply to the Bioinformatics Graduate Committee for entry before the completion of their third year of study. Students in the B.S./M.S. are required to take graduate-level courses during their fourth year and complete an approved master's thesis during their final year of study.

The M.S. program is a 30-credit hour program with a thesis requirement. The 30 credit hours include 18 hours of 'core' courses, 6 hours of graduate electives and 6 hours of thesis research. In addition to required courses, students need to pass an oral proposal defense and thesis defense.

The M.S. program provides students with the capability to enter the bioinformatics workforce and become leaders in the field. The curriculum is designed to fulfill the needs of students with diverse educational and professional backgrounds. Individuals entering the programs typically have degrees in biology, biotechnology, chemistry, statistics, computer science, information technology, or a related field. The M.S. program accommodates this diversity by providing a comprehensive bridge program for students who need to supplement their education to make them well prepared for the graduate study. The M.S. program offers two tracks, one for students with backgrounds in life sciences and one for those with backgrounds in computational science. Regardless of the track pursued, students are prepared to become professional bioinformaticists upon graduation. The M.S. program is offered on a full- or part-time basis to fulfill the needs of traditional students and those currently employed in the field.

The M.S. degree in Bioinformatics provides students with a strong foundation in biotechnology, computer programming, computational mathematics, statistics, and database management. Graduates are well-prepared for academia and careers in the biotechnology, bioinformatics, pharmaceutical, and vaccine industries. Based on consultation with individuals within the industry nationwide, the job market is rich with opportunities for those who obtain a graduate degree in bioinformatics, particularly when coupled with research as thesis work.

This following handbook describes departmental policies and requirements for the B.S./M.S. and M.S. programs in Bioinformatics at RIT. Inquiries concerning the programs are invited, and should be directed to the Director, Bioinformatics Graduate Program, Thomas H. Gosnell School of Life Sciences, Rochester Institute of Technology, Rochester, New York 14623.

3.0 Admission and Academic Status

3.1 Admissions

For the B.S./M.S. program, an announcement inviting applications is usually sent to undergraduate students in the Bioinformatics and Computational Biology program in the mid of each January. Although the letter may be sent to all undergraduate students in the program to make them aware this opportunity and plan accordingly, primarily only students with the 3rd year status will be considered for the admission. Undergraduate students with an overall GPA of 3.2 and a GPA in their professional field of study of 3.4 may apply to the Bioinformatics Graduate Committee for entry before the completion of their third year of study. The deadline of the application is the mid of each March.

The following application materials should be sent directly to the Graduate Director.

- a. Up-to-date transcript;
- b. Resume;
- c. Personal Statement describing how the B.S./M.S. program would help your career

The decisions of the application will be made before the mid of each April.

For the first-year students who are accepted into the B.S./M.S. program during the admission process, no separate application is needed. However, students will still need to meet the same requirements as any other B.S. students to matriculate into the M.S. portion.

For the M.S. program, prospective applicants need to complete the on-line application package at <https://join.rit.edu/apply/>. Any inquiries about the application process should be sent to Graduate Admissions, Rochester Institute of Technology, Bausch & Lomb Center – A130, 58 Lomb Memorial Drive, Rochester, NY 14623-5604, phone: 585-475-2229, email: gradinfo@rit.edu.

Although the applications are reviewed on a rolling basis, applicants are strongly encouraged to submit complete applications before February 15th. In most cases, we only offer Fall admissions due to course sequences. Under some circumstances, we can grant Spring admissions if bridge courses are deemed necessary.

Once all of the required application elements are provided to the Graduate Admissions of RIT, the application will be forwarded to the M.S. program for review. A complete application usually includes college transcripts, resume, personal statement, three letters of recommendation, and Graduate Record Examination (GRE) scores. For domestic students, GRE scores can be waived. International students who do not have a degree granted from a U.S. institution, or for whom English is not their primary language, must submit the Test of English as a Foreign Language (TOEFL) score or the International

English Language Testing System (IELTS) score.

Complete applications are reviewed and evaluated by the Bioinformatics Graduate Committee, and the decisions are made on an individual basis. In general, candidates must fulfill the following requirements:

- a. Complete a graduate application.
- b. Hold a 4-year baccalaureate degree (or equivalent) from an accredited university or college in biology, biotechnology, biochemistry, chemistry, computer science, information technology, statistics, or a related discipline.
- c. Submit official transcripts (in English) of all previously completed undergraduate and graduate course work.
- d. Have a minimum cumulative GPA of 3.2 (or equivalent)
- e. Submit two letters of recommendation from academic or professional sources.
- f. International applicants whose native language is not English must submit scores from the TOEFL or IELTS. A minimum TOEFL score of 79 (internet-based) and IELTS score of 6.5 is required. The English language test score requirement is waived for native speakers of English or for those submitting transcripts from degrees earned at American institutions. Updated requirements can be found on <https://www.rit.edu/admissions/grad-deadlines-requirements.php>.

Once completed, an application may take 2-4 weeks to be evaluated by the Bioinformatics Graduate Committee. The admission decision is made by the Committee, and the status of that process may be viewed using the on-line application system of RIT.

3.2 Policy for 3-year bachelor degree holders

Bioinformatics MS program will review applications of 3-year bachelor degree holders from international universities. A student with 3-year degrees must meet ALL of the following conditions:

- a. The college or university is World Higher Education Database (WHED) recognized;
- b. The college or university is National Assessment and Accreditation Council (NAAC) accredited with an "A" grade;
- c. The student has passed in the 1st Class (or equivalent).

If the student does not meet the above requirements, s/he may request a World Education Service (WES) evaluation or need to complete (or be in the process of) postgraduate study. If the 3-year undergraduate degree is currently in progress, s/he may be admitted contingent upon obtaining the degree in the 1st class or equivalent.

3.3 Contingent admissions

Under certain circumstances, it is possible to obtain a contingent admission to the

program. A contingent admission typically results from an arrangement with (1) students who have inadequate training in computer programming, statistics, or biological science; (2) foreign students whose undergraduate studies were not in English. A student can take bridge courses before arrival at RIT or while at RIT.

Several recommended bridge courses for computer sciences are listed below. If students choose to take the online course CS50 from Harvard University, the completion certificate must be provided to the Program as a proof.

Upon arrival at RIT, foreign students, especially those whose primary language is not English and TOFEL/IELTS scores are below the program requirements, must take the English tests given by RIT's English Language Center. If the students fail the tests, the students must follow the recommendations of RIT English Language Center for additional coursework. This may require additional time and financial resources to complete the M.S. degree.

Online course

Coding for Everyone (online course sequence, all courses required, Coursera)
(<https://www.coursera.org/specializations/coding-for-everyone>)

RIT

BIOL-135 (Introduction to Bioinformatics Programming) and/or BIOL-235 (Bioinformatics Languages)
CSCI-141 (Computer Science I) and CSCI-142 (Computer Science II)

University of Rochester

CSC 171: Introduction to Computer Science
CSC 172: Data Structures and Algorithms

Monroe Community College

CSC-101: Introduction to Computer Science
CSC-103: Introduction to Data Structure

SUNY Brockport

CSC203: Problem Solving with Objects
CSC205: Fundamentals of Data Structures

3.4 Non-Matriculated Status

Applicants are permitted to take graduate courses as non-matriculated students if they have a baccalaureate degree from an accredited college or university, and if they possess the necessary background for the specific course in which they wish to enroll. The courses taken for credit can usually be applied toward the Master's degree at the time the student is formally admitted to the graduate program. However, there is a limit of 6 semester credits (two courses), earned as a non-matriculated student, which can be transferred

into the student's graduate record.

It is suggested that any applicant who wishes to enroll into a graduate course as a non-matriculated student should obtain permission from the Bioinformatics Graduate Program Director.

3.5 Readmission

If a student has become inactive (has not completed a course in three consecutive semesters) or has withdrawn from RIT, Institute Policy requires the student to reapply for admission. In general, readmission applications are handled according to the following procedure. The student needs to check the Policy for updates at the RIT Academic Affairs website.

a. Students who left the program with a GPA of 3.0 or better (were in good academic standing) and will return to the program within three terms (including summer but not including intersession) of the time their last course was completed, will be readmitted to the program upon submitting a readmission application.

b. Students who left the program with a GPA of 3.0 or better and return to the program greater than or equal to three terms (including summer but not including intersession) since the last course was completed, must reapply through the Office of Graduate Enrollment Services. All student applications are subject to admission standards at the time of reapplication. The program of study shall be subject to review and may need to be rewritten. Previous waiver and/or transfer credit may be lost, and program deficiencies may need to be made up.

c. Students who left the program with a GPA below 3.0 must meet current admissions standards for readmission. The decision to reaccept the student to the program will be based on all information, including previous graduate level work. Previous waiver and/or transfer credit may be lost and program deficiencies may not be remedied. In addition, the Department will decide which previous courses, if any, will be applicable toward the degree.

d. The Seven-Year Rule. In all cases, students must complete the program within seven years of the date the earliest course counted toward their degree program. A student who has not completed their degree requirements within this seven-year period, must petition the Bioinformatics Graduate Program Director for re-admission via a written letter that outlines why the petitioner was not able to complete the degree in the required time. Documented evidence supporting the petitioner's claim may be requested at that time. The final decision to pursue a petition for re-admission to Graduate Studies at RIT is solely at the discretion of the Bioinformatics Graduate Program Director. If a petition is to be forwarded to RIT Office of Graduate Studies for review, the dean of graduate studies will decide whether to re-admit the candidate. In no case, is the decision automatic, and

the petitioner may have their petition denied for any reason.

3.6 Academic Probation and Suspension Policy

Matriculated graduate, full-time or part-time, degree students will be placed on academic probation, or will be suspended from the Institute according to the criteria enumerated below. Students risk the loss of a teaching assistantship and tuition remission as a consequence of academic probation. Students need to check relevant policy updates at the RIT Academic Affairs website.

- a. Violation of RIT's Academic Honesty and Honor Code, which can be found at <https://www.rit.edu/studentaffairs/studentconduct/> or in the RIT Student Handbook that is provided on-line. Any matriculated graduate student whose Program Cumulative GPA falls below a 3.00 will be placed on academic probation and counseled by the Graduate Director concerning continuation in the graduate program. Students may lose their teaching or research assistantship and stipend while on academic probation. For purposes of the GPA calculation relevant to academic probation, a grade of incomplete (I) in a graduate course may, depending on the circumstances, temporarily be counted as an F.
- b. Those students placed on probation must raise their Program Cumulative GPA to 3.00 or better within one semester, or be suspended from the graduate program.
- c. Should it be necessary to suspend a graduate student for academic reasons, the student may petition for readmission with the Bioinformatics Graduate Program Director, who will consult with the Department Head and the Dean of Graduate Studies.
- d. A student who has completed all course credits but has not finished the thesis must register for Continuation of Research in all subsequent semesters until the degree is complete. Failure to do so may result in a requirement to reapply for entrance into the program.
- e. A student may apply for a Leave of Absence by writing a letter to the Bioinformatics Graduate Program Director, and the Dean of Graduate Studies. The time during a Leave of Absence counts toward the seven years policy.

4.0 Financial Assistance

Students who are matriculated in the Bioinformatics MS program are eligible for financial aids. Usually these aids are awarded on a competitive basis. These awards may consist of tuition remission and/or a stipend, depending on whether the award is: (1) Graduate merit-based scholarship; (2) Graduate teaching assistantship; or (3) Graduate research assistantship.

4.1 Graduate merit-based scholarship

Merit-based scholarships consist of tuition remission, which are awarded along with the Bioinformatics Graduate Committee's decision on an M.S. application. B.S./M.S. students are not qualified for the merit-based scholarship. The scholarships can be adjusted to encourage strong student performance in course work. The guideline of the adjustment is detailed below.

Specifically, full-time students with merit-based scholarships who perform well during their first year will see an increase in their merit-based scholarships for the subsequent years. Students with higher GPA's will receive larger increases.

Full-time students with merit-based scholarships who receive multiple probations or otherwise perform poorly will receive a decrease in their merit-based scholarships. This is not punitive, but instead to encourage improvement. At the Program Director's discretion, if a student performs sufficiently well in subsequent semesters, decreases may be removed, restoring the student to previous merit-based scholarship levels.

Note that the decreases are distinct from the merit-based scholarship increases, and additive. Additionally, decreases will happen in the semester immediately following the cause. For example, a student finishing their first year with a GPA of < 3.0 or a student receives two probations would see a total decrease of 10%.

For part-time students, evaluations will be made after completing the equivalent of a full-time year of courses (minimum of 18 credits).

Performance metric	merit-based scholarship change
First year GPA of > 3.7	+5%
First year GPA of 4.0	Additional +5% (total of +10%)
Two Probations or a First year GPA of < 3.0	-5% each

4.2 Graduate Teaching Assistantships (GTA)

There are a limited number of GTA positions each year subject to teaching needs and availability of departmental funds. These positions are highly competitive and usually announced during the summer time. Students who are interested in GTA positions are required to complete an application form (Appendix A) and provide a letter of recommendation before the deadline. GTA may include tuition remission and/or a monthly stipend. M.S. students and B.S./M.S. students who have completed 121 credit hours are eligible for GTA positions.

GTA will be expected with the following duties:

- a. teach undergraduate laboratories for a maximum of 10 contact hours per week;
- b. assist faculty members in the grading of undergraduate examinations, homework and laboratory reports;
- c. arrange and observe office hours for students who desire help in courses for which the GTA is responsible; and
- d. be knowledgeable about the course materials for which the GTA is responsible.

It is estimated that these duties would require approximately 20 hours per week. In addition to coursework, GTAs should treat this combination as a full time job requiring 100% of their effort. GTAs are hired by semester, which may be renewed, provided they are in good academic standing, and have adequately performed their GTA duties.

4.3 Graduate Research Assistantships (GRA)

GRA positions are funded through internal or external research grants. M.S. students and B.S./M.S. students who have completed 120 credit hours are eligible for GRA positions. Students who are interested in GRA positions are strongly encouraged to discuss with potential Research Advisors about the opportunities. These positions are similar to GTA except the students are performing research for up to 20 hours per week under the supervision of a Research Advisor. As a consequence of this GRA load and coursework, GRAs should treat this combination as a full time job requiring 100% of their effort. GRAs generally receive a stipend and/or tuition remission. The term of a GRA appointment is one semester and may be renewable, depending on the GRA's research performance and their Research Advisor's funding availability.

5.0 Bioinformatics B.S./M.S. and M.S. Programs Guidelines

The Bioinformatics B.S./M.S. program is 144-credit hour program, which normally requires 5 years to complete. The M.S. program is a 30-credit hour program, which normally requires 2 years to complete. In addition to required coursework with cumulative grade point average (GPA) > 3.0, students in both programs need to complete a thesis (6 credit hours). Students must complete the program in a seven-year time period.

5.1 Orientation

All newly matriculated M.S. students should arrive at least two weeks in advance of their first academic semester. This should be sufficient time to find a residence, get acclimated to the campus, and attend the graduate student orientation held by the Office of Graduate Education of RIT. Orientation is run in formal group activities prior to the fall semester. Students who enter the program during the other academic semester will receive a one-on-one orientation by the Program Director.

5.2 Graduate Advisor

During the first semester of attendance for a new graduate student, the Director of Graduate Program acts as the student's Academic Advisor. Graduate students are counseled by their Thesis Advisor after s/he selects the thesis topic.

5.3 Curriculum & Course Registration

For B.S./M.S. students, the curriculum and required courses can be found on the website of the Bioinformatics and Computational Biology Bachelor of Science Program (<https://www.rit.edu/study/bioinformatics-and-computational-biology-bs>). For B.S. Biotechnology and Molecular Bioscience/M.S. Bioinformatics students, the curriculum and required courses can be found on the website (<https://www.rit.edu/study/biotechnology-and-molecular-bioscience-bs#dualdegree>). For course registration, students must be counseled by their Undergraduate Academic Advisor (in the B.S. phase) or Graduate Program Staff (in the M.S. phase).

For M.S. students, the curriculum and required courses can be found on the website of the Bioinformatics Master of Science Program (<https://www.rit.edu/study/bioinformatics-ms>). For course registration, students must be counseled by Graduate Program Staff.

Both B.S./M.S. and M.S. students need to take 6 credit hours of graduate elective courses. A list of selected graduate electives is provided (Appendix B). In principle, any 600+ courses across RIT that can be justified as relevant to the Bioinformatics program can be taken as graduate electives upon the approval of the Graduate Director. Alternatively, students can also be registered for BIOL-798 (Graduate Independent Study), and an Independent Study/Research Contract needs to be completed by the students and

approved by the Program Director. The disadvantage is that it is listed as “Independent Study” on the transcript and has no information regarding the topic of the Independent Study.

5.4 Seven-Year Graduation Requirement

All graduate students must adhere to the seven-year graduation requirement specified at the RIT Academic Affairs website. The purpose of the requirement in graduate programs is to ensure content currency of a degree at the time of graduation. The seven-year requirement provides a mechanism for dealing with extenuating circumstances that may have prevented timely completion of a degree.

When a student's program is projected to exceed the seven-year limit, the Graduate Program Director may petition the dean of Graduate Education for an extension to the seven-year graduation requirement. The student should not be encouraged to take courses or work on a thesis, final project, or dissertation unless an extension has been granted by the dean of Graduate Education or, when necessary, the Graduate Council, with the understanding that a decision has not been made and an extension may not be granted.

6.0 Thesis Research

All B.S./M.S. and M.S. students must complete thesis research to get the degree. Students are strongly encouraged to disseminate their work through regional, national or international conferences, and/or in peer-reviewed journals. Financial support may be provided by the Thomas H. Gosnell School of Life Sciences, College of Science, or RIT Student Government.

6.1 Thesis advisor

The Program Director of Bioinformatics initially assumes primary advising responsibility for each graduate student. The Director together with other Program faculty should assist each student in matching the student's interest and career aspirations with a project that will appropriately prepare for their life after RIT. The student should select a research advisor on the basis of common interests shared between the advisor and the student. Full time faculty, adjunct faculty and professionals outside of RIT (e.g., University of Rochester, Rochester General Hospital, etc.) may serve as research advisors.

A list of graduate thesis advisors across RIT are provided (Appendix C). In every case, the Director must approve the selection of a research advisor. Students are strongly encouraged to interview at least three faculty members to select their Thesis Advisor during the first semester of their graduate study.

At the end of each academic year, the Program Director needs to collect information from Thesis Advisors about conference presentations and journal publications of the current and past thesis work.

6.2 Recommended Research Timeline

Below is a suggested research timeline for B.S./M.S. students

	Year 3			Year 4		Year 5	
	Spring	Summer	Fall	Spring	Summer	Fall	Spring
Application submission	■						
Select research topic and advisor		■	■				
Proposal writing and defense			■	■			
Research				■	■	■	
Thesis writing and defense						■	■

Below is a suggested research timeline for M.S. students

	Year 1			Year 2		
	Fall	Spring	Summer	Fall	Spring	Summer
Select research topic and advisor						
Proposal writing and defense						
Research						
Thesis writing and defense						

6.3 Research Progress Reporting

At the end of each semester, students must complete the Master's Research Performance Evaluation Form (Appendix D) with their thesis advisors. Completion of this form is required for the registration of the thesis credits (BIOL-790 or BIOL-791) or Full Time Equivalency for the next semester. Students should scan the complete form into PDF and send it to the Graduate Program Staff and Director for record.

6.4 Thesis Credit Registration

With the completed Master's Research Performance Evaluation Form, students should attach a literature review OR a report detailing their research progress in a PDF of 1-3 pages and submit it to the Program Director.

- (1) If the research project has not been decided, the report should include
 - a. Research meetings with faculty members to discuss projects
 - b. Research ideas/plan
 - c. Preliminary results
 - d. Plan for the next semester
- (2) If the research project has been decided, the report should include
 - a. Title of the project
 - b. Goals
 - c. Proposed methods (i.e., research design)
 - d. Expected outcomes
 - e. Recent progress (i.e., what you have done recently)
 - f. Plan for the next semester
 - g. A time table
 - h. important milestones such as
 - a. proposal defense (e.g., time, topic, names of committee members)
 - b. dissemination (e.g., conference presentations, journal publications)

(3) A literature review of the thesis project can be provided to replace the report.

The review should include

- a. Introduction
- b. Detailed review of the subject
- c. Discussions
- d. Conclusions
- e. References

The Program Director should review both the thesis report/literature review AND the Master's Research Performance Evaluation Form. Upon approval, the Program Staff should register thesis credit hours for the students.

There is no policy that students need to take thesis credits to defend their proposal. However, the general rule that we have been following is that students cannot defend their proposal and their thesis in the same semester. Therefore it is best to spread out their thesis credits between at least 2 semesters. So effectively, students are naturally registered in thesis credits in a semester to defend their proposal. They then use the remaining thesis credits in the subsequent semester to finish their thesis and defend it.

6.5 Proposal Requirements

Students need to prepare a research proposal, working in consultation with his or her research advisor. The proposal should be no longer than 15 pages and include the following sections.

A. Introduction: This section should describe, in detail, the background and rationale for the proposed project. This section must conclude with a succinct statement of the problem to be addressed by the proposed project.

B. Materials and Methods: This section should describe the project to be undertaken. Sufficient detail should be provided so that the student's thesis advisory committee can determine whether the proposed work represents a satisfactory thesis project in terms of scope and value.

C. Literature Cited: This should reflect a thorough search of relevant literature needed to support the proposed project. A comprehensive list of relevant literature will assist the student in assessing the relevance and potential impact of the proposed project.

The student will select a Thesis Advisory Committee composed of his or her advisor and 2-3 additional members. Members should be selected based on their potential to provide guidance for the proposed thesis project.

Two weeks prior to an initial Thesis Advisory Committee meeting, the student will distribute printed copies of his or her research proposal. At the initial committee meeting the student will present the proposal orally to their committee and be prepared to discuss and defend the proposal. By the end of that meeting, the committee will either approve the proposal as written or recommend changes. Any such changes will be incorporated by the student and the revised proposal distributed for committee approval. There is no need for a second committee meeting unless the committee deems it necessary.

Identification of a thesis advisor and approval of a thesis project should occur before the end of the first year of graduate study. Once the committee approves the project as suitable for a MS thesis in Bioinformatics the student may commence work on the proposed project. The thesis advisor needs to sign the Master's Research Performance Evaluation Form (Appendix D) to confirm when the proposal is defended. Students need to provide more information in the attached report about the proposal defense (e.g., defense time, project topic, names of committee members).

6.5 Thesis Requirements

Thesis writing

Formal requirements for the format of the written thesis are outlined by the RIT Library. As of May, 2019, this information is located at "<http://infoguides.rit.edu/thesis-services>". In the future, this information may move, but should be easily found from the Wallace Center's Home Page.

The below are recommendations, and can be superseded by the RIT thesis requirements as noted above.

The key to good thesis writing is organization and planning. Students are encouraged to read the following guidelines carefully.

Contents: In keeping with the convention in the scientific literature, as appropriate, the thesis should contain the following sections. Sections indicated as optional are not required.

1	Title Page	8	Introduction
2	Copyright Release Form	9	Experimental or Methods
3	Abstract	10	Results
4	List of Figures (optional)	11	Discussion
5	List of Tables (optional)	12	Conclusions
6	Acknowledgments (optional)	13	References
7	Table of Contents	14	Appendices (optional)

Title page should include the following statement. “Submitted in partial fulfillment of the requirements for the Master of Science degree in Bioinformatics at the Rochester Institute of Technology.”

Following the title page should be a list of the thesis committee members with their departmental and institutional affiliations.

Copyright Release Form: Occasionally RIT receives requests for copies of a thesis. You may or may not wish to grant Wallace Memorial Library the right to make a copy of your thesis when a request is received. Your choice is implemented by signing the appropriate permission or deny-permission Copyright Release Form.

Abstract: The abstract is a brief summary of your thesis. See any abstract in the scientific literature as an example. The length should be approximately 100 to 200 words.

References: References are a list of scientific literature cited in the thesis. These should follow one of two formats: listing by number or listing by author’s name and date. For example:

Both algorithms set equal to zero any data point with a value less than an arbitrary noise figure as defined previously.¹³

Both algorithms set equal to zero any data point with a value less than an arbitrary noise figure as defined previously (13).

Both algorithms set equal to zero any data point with a value less than an arbitrary noise figure as defined previously (Ludlow and Skuse 1995).

Collate all references at the end of the manuscript in numerical order of citation if listed by number and in alphabetical order if cited by author.

The exact format of the reference may vary slightly between the subdisciplines of biology. You should use the format acceptable in your subdiscipline. References to journal articles should contain authors, title of article, journal name in italics, volume (bold), pages, and year as presented in the following examples. Refer to *The ACS Style Guide* or CASSI for abbreviations of journals.

13. Ludlow, J.W. and Skuse, G.R. (1995) Viral oncoprotein binding to pRB, p130, and p300. *Virus Research*, 35:113-121.

An alternative format for some professional journals:

13. Ludlow, J.W. and Skuse, G.R. Viral oncoprotein binding to pRB, p130, and p300. *Virus Research*, 35: 113-121 (1995).

References to books should contain the author(s), title in italics, publisher, city, and year. You may also wish to include the *ISBN* number.

3. J.W. Ludlow and G.R. Skuse *Tumor Suppressors: Involvement in Human Diseases, Viral Protein Interactions, and Growth Regulation*; The R.G. Landes Company, Georgetown, TX 1994.

References to book chapters in an edited book should contain authors, title of chapter, title of book in italics, editor, publisher, city, year, page or chapter.

25. G.R. Skuse and P.T. Rowley "Tumor Suppressor Genes and Human Neoplasia" in *Biochemical and Molecular Aspects of Selected Tumors*; T.P.Pretlow and T.G. Pretlow eds.; Academic Press, Orlando, FL, 1991; chapter 1.

Additional formats may be used as long as the format of all references is consistent within the thesis.

Appendices: Appendices should, if necessary, have their own table of contents. The individual pages of an appendix should be numbered with the letter of the appendix and ascending page numbers (*i.e.*, A1, A2, A3....).

Thesis defense

Upon completion of the approved thesis project, a written report/thesis of the work performed will be submitted to the student's thesis advisory committee. The final report will contain all of the sections for the research proposal with the addition of a results and discussion section detailing the findings of the student's thesis research and include a scholarly review of the implications of the student's work (see above). At least two weeks prior to the defense, the student will distribute printed copies of his or her written thesis to the thesis advisory committee.

The student is required to summarize his or her work in a public seminar wherein he or she will present the thesis research and present it in its contemporary context. *The seminar defense must be advertised at least two weeks in advance, and must be in a different academic term than the proposal defense. Any defense that was not advertised at least two weeks in advance must be rescheduled to meet the requirement unless there were unavoidable reasons it could not happen and the Program Director approves.* A thesis defense is a public defense, and must be appropriately advertised. Therefore, students must make arrangements for the room reservation through the department more than two weeks in advance. The staff in the GSOLS office can assist with making room reservations. The seminar may be immediately followed by a private defense attended only by the student and his or her thesis advisory committee. In some instances, particularly when additional expertise is needed, a fourth committee member may be

invited to the student's thesis defense. If this is necessary, the student will be so informed at least one week prior to the thesis defense.

On the date of the defense, the Thesis Advisor should bring the Signature sheet to the defense. Signature sheet is available from the Graduate Program Staff of Thomas H. Gosnell School of Life Sciences.

At the defense, which will last no less than 50 minutes, the student will present the research work and be prepared to discuss and defend that work. By the end of that meeting, the thesis advisory committee will either approve the thesis as written or recommend changes. Any changes will be completed in a timely fashion, as specified by the thesis advisory committee, and approved before the student's research is considered complete. Should the student passes the defense, the committee members need to sign on the Signature sheet. The Thesis Advisor should return the signed Signature sheet to the Graduate Program Staff, who will scan the sheet into PDF for record use.

A corrected and committee approved copy of the final written thesis must be prepared. The electronic copy of the final written thesis should be sent to the Graduate Program Staff for reference in the future. It is highly recommended that the student make several extra copies for himself or herself.

When final approval has been received from the Thesis Advisory Committee, and all other requirements have been met, the student should submit the thesis to ProQuest.

Submission to ProQuest/Library

The student should submit the final thesis in PDF to ProQuest, together with a separate PDF of the Signature sheet following the instructions in <https://infoguides.rit.edu/thesis-services>. The student should receive an email from the ProQuest administrator stating that, after review, the PDF submission was accepted. The student should forward this email to Graduate Program Staff as proof of completion. This confirmation email is needed to degree certification.

7.0 After thesis defense

7.1 Certification

Students will be certified for their M.S. degree when the following requirements are met.

- a. Successfully complete all required courses of the university and the college. All grades must be recorded and any outstanding Incomplete ("I") grades must be resolved.
- b. A program cumulative grade point average of 3.00 (a "B" average).
- c. A minimum of 30 credit hours is required for the master's degree. At least 80% semester credit hours of graduate level course work and research (courses numbered 600-900) are required to be earned in residence at the university.

Exception: External master's degree programs allow for varying amounts of acceptable graduate transfer credits (usually up to 6 credits) and thus the residency requirement may be decreased, as approved by the Graduate Council and provost. Other exceptions pertaining to a group of students must be approved by the Graduate Council.

- d. Successfully defend the thesis and submit the final copy of the thesis following RIT Library guidelines. The thesis requirement may be waived and replaced by other appropriate research or comparable professional achievement as an integral part of the graduate program.
- e. Full payment or satisfactory adjustment of all financial obligations.
- f. Adherence to the seven-year graduation requirement.

7.2 Exit Questionnaire and Interview

After the thesis defense, students should complete the exit survey

https://rit.az1.qualtrics.com/jfe/form/SV_9AEYmkyWueorjG5.

A 30-minute exit interview should be scheduled with the Program Director. The purpose of this meeting is to collect feedback about the program (e.g., curriculum development and research issues).

8.0 RIT Non Discrimination Statement

RIT does not discriminate. RIT promotes and values diversity within its workforce and provides equal opportunity to all qualified individuals regardless of race, color, creed, age, marital status, sex, gender, religion, sexual orientation, gender identity, gender expression, national origin, veteran status, or disability.

The Title IX Coordinator has overall responsibility for the university's institutional compliance with Title IX. Any person with a concern about the university's handling of a particular matter related to sex or gender-based discrimination or harassment should contact:

Stacy DeRooy
Director of Title IX and Clery Compliance
Title IX Coordinator
171 Lomb Memorial Drive
Rochester, NY 14623
585-475-7158
Stacy.DeRooy@rit.edu
www.rit.edu/titleix

Any person may report sex discrimination, including sexual harassment, in person, by mail, by telephone, or by electronic mail, using the contact information listed for the Title IX Coordinator, or by any other means that results in the Title IX Coordinator receiving the person's verbal or written report. Reports may be made regardless whether the person reporting is the alleged victim of any conduct that could constitute sex or gender-based discrimination or harassment. Reports may be made at any time (including during non-business hours) by calling the telephone number noted above, by electronic mail, by mail to the office address listed for the Title IX Coordinator, or by filing a report on line with RIT's Title IX Office.

The U.S. Department of Education, Office for Civil Rights (OCR) is a federal agency responsible for ensuring compliance with Title IX. OCR may be contacted at 400 Maryland Avenue, SW, Washington, DC 20202-1100, (800) 421-3481.

THOMAS H. GOSNELL SCHOOL OF LIFE SCIENCES

Graduate Teaching Assistant (GTA) Application

Graduate Teaching Assistantships (GTA) responsibilities include, but are not limited to, conducting instruction within the classroom, setup/breakdown of any materials needed for instruction, posting materials and grades to MyCourses, responding to students' questions both verbally and electronically, grading student work, holding regular office hours, attending weekly instructor meetings and assisting with the administration of the course.

Please refer to the Graduate Assistantship link (<https://www.rit.edu/emcs/seo/graduate-assistantships>) on the RIT Student Employment Office webpage for more information.

Name _____ Academic Program _____

RIT UID _____

Mailing Address _____

Preferred Telephone _____

RIT Email Address _____

Personal Statement:

Please attached a 2 page (double-spaced) essay describing why you are interested in the GTA position and describe how becoming a GTA will impact your future career aspirations. Please send the essay to Amanda Dolan (arasbi@rit.edu).

Letter of Recommendation

Please have a faculty member send a letter of recommendation that addresses reliability/dependability and teaching competencies, as applicable to Amanda Dolan (arasbi@rit.edu).

The deadline for this application is **July 15th by 4pm**. Please note that this form, personal statement and faculty recommendation letter are required for consideration.

*Please note that all Graduate Teaching Assistantships are contingent on availability of funds

Appendix B. List of Selected Graduate Electives

Courses may have pre-requisites and may require instructor permission to enroll.

Subject	No.	Title	Term
CSCI	620	Introduction to Big Data	Fall, Spring
CSCI	622	Data Security and Privacy	Spring
BIOL	601	Genetic Diseases and Disorders	Spring
BIOL	650	High Throughput Sequencing Analysis	Spring
CHMB	702	Protein Conformation and Dynamics	Fall
CHMB	704	Biochemistry of Nucleic Acids	Spring
CHMB	610	Advanced Protein Biochemistry: Structure and Function	Spring
ISTE	600	Foundations of Data Mining	Fall, Spring
ISTE	610	Non-Relational Data Management	Fall, Spring
ISTE	612	Information Retrieval and Text Mining	Fall or Spring or Summer
ISTE	645	Foundations of Web Technologies I	Fall

Appendix C. List of some Thesis Advisors

For a list of possible GSOLS faculty mentors please visit our website at

<https://www.rit.edu/science/faculty> and choosing “Life Sciences” on the left. Please note

that faculty mentors do not have to be primarily associated with GSOLS or the

Bioinformatics Program. However, the majority of the committee members must be

GSOLS faculty.

Appendix D.

Thomas H. Gosnell School of Life Sciences
MASTER'S RESEARCH PERFORMANCE EVALUATION FORM
 Rochester Institute of Technology

Thesis Research Performance Evaluations are performed per thesis.

INSTRUCTIONS: Please complete this form, evaluating the student's performance over the previous period, as specified. The completed form should be shared with the student a copy placed in their student file.

Student Name: _____

Advisor Name: _____

Period of Evaluation: _____

Date of Performance Evaluation: _____

PERFORMANCE RATING SCALE

The three rating categories are Exceeds Expectations, Meets Expectations and Does Not Meet Expectations:

Expectations	Evaluation:			Clarifying Comments
	Exceeded	Meets	Not Met	
Quality of Work: The work is accurate and thorough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Initiative: Student demonstrates self-determination and self-direction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Time Management: Completes work on schedule	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Communication Skills: effectively communicates with internal and external audiences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Interpersonal Skills: interacts effectively and appropriately with others in the workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Overall Performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Has the student passed the proposal defense? YES Date: _____ No

If YES, who are on the thesis committee? _____

Specific Areas of Strength:

Opportunities for Growth:

Graduate Research Assistant Signature

Date Evaluation Received

Advisor/Supervisor Signature

Date of Evaluation

M.S. Program Director

Appendix E. Exit Questionnaire

Students should complete the following exit survey.

https://rit.az1.qualtrics.com/jfe/form/SV_9AEYmkyWueorjG5