

2016-2017

GEORGIA STATE UNIVERSITY
DEPARTMENT OF BIOLOGY

**MASTER OF SCIENCE DEGREE
POLICY DOCUMENT**

I. ADMISSION REQUIREMENTS and PROCEDURES

- A. Applicants must have a baccalaureate degree in biology or a related field.
- B. Applicants must submit transcripts of their past academic performance, scores on the Graduate Record Examination, and three letters of reference.
- C. Applicants must submit a statement of their academic interests and goals.
- D. In addition to meeting the regular admission requirements, international applicants must demonstrate proficiency in English, this can be satisfied by taking either the TOEFL or IELTS tests.

Applications for the M.S. program will be considered for fall and spring semesters. The upcoming deadlines for completion of all application materials and other correspondence concerning admission are as follows:

SEMESTER	DEADLINES
Fall	July 1 st
Spring	November 15 th

NOTE: International applications and all required documentation must be sent four weeks prior to the deadlines indicated above.

- E. All application materials should be submitted directly to: Graduate Admissions-College of Arts & Sciences <cas.gsu.edu/graduate-studies/admissions/>. There is a \$50.00 application fee.

Applications should be completed online and can be found at:

https://app.applyyourself.com/AYApplicantLogin/fl_ApplicantConnectLogin.asp?id=casgsu

II. STUDENT SUPPORT

Teaching assistantships are available, and individual faculty members may support students working on specific research programs with funds from research grants. Students requiring financial assistance are urged to apply as far in advance as possible. **Financial support is not guaranteed.**

III. DEGREE REQUIREMENTS

The Master of Science (M.S.) degree in the Department of Biology is offered with a *Non-Thesis* or *Thesis* option. Upon acceptance into the M.S. program, all students are enrolled in the Non-Thesis option. Students are admitted to the Thesis option upon approval and successful defense of a Thesis proposal. **In addition to the required courses listed below, Appendix II provides a listing of discipline-specific courses students may select for their area of study.**

A. The **Non-Thesis** option requires:

1. A minimum of 40 semester credit hours of coursework to be selected from 6000 and 8000 numbered courses. (Note: *Biology 6900 and courses numbered 7000-7999 are not applicable to the M.S. degree in Biology.*) Coursework must include:
 - a. One course in biochemistry of at least 3 hours [normally Chem 6600 (5 hours), 6610 (3 hours) or Chem 6670], although higher-level courses may be selected. A passing grade of C or better is required. This requirement may be waived if the student has successfully passed an equivalent undergraduate course with a B or better. By waiving this requirement, no student is exempt from completing 40 hours for graduation.
 - b. Two hours of Seminar (Biol 8700).
 - c. Two hours of Topics (Biol 8940, 8950, 8960, 8970, 8980) or Concepts (Biol 8110, 8310, 8510, 8710) are recommended but not required.
 - d. Up to 9 hours of Public Health and/or Law courses may be included in the 40 hour coursework requirement. A list of appropriate courses can be found in Appendix II.
 - e. Up to 4 hours of Biol 8800 (Research) may be included in the 40-hour coursework requirement.
2. The successful completion of a laboratory or literature-based research paper. (See VI A. Four hours of Biol 8888 (Non-Thesis MS Research))

B. The **Thesis** option requires:

1. A minimum of 40 credit hours including 26 semester credit hours of coursework to be selected from 6000 and 8000 numbered courses. (Note: *Biology 6900 and courses numbered 7000-7999 are not applicable to the M.S. degree in Biology.*) Coursework must include:
 - a. One course in biochemistry of at least 3 hours [normally Chem 6600 (5 hours), Chem 6610 (3 hours), Chem 6670], although higher-level courses may be selected. A passing grade of C or better is required. This requirement may be waived if the student has successfully passed an equivalent undergraduate course with a B or better. By

waiving this requirement, no student is exempt from completing 40 hours for graduation.

- b. Two hours of Seminar (Biol 8700)
 - c. Two hours of Topics (Biol 8940, 8950, 8960, 8970, 8980) or Concepts (Biol 8110, 8310, 8510, 8710) **are recommended but not required.**
 - d. Up to 9 hours of Public Health and/or Law courses may be included in the 40 hour coursework requirement. A list of appropriate courses can be found in Appendix II.
 - e. Up to 4 hours of Biol 8800 (Research) may be included in the 40-hour coursework requirement.
 - f. A minimum of 14 hours of Biol 8999 (Thesis Research)
2. A successfully defended Thesis proposal. (See VIIA)
 3. A Thesis
 4. A final oral presentation directed primarily to defense of the Thesis. (See VIIB)

IV. ACADEMIC PERFORMANCE

Students are required to maintain a minimum overall grade point average of 3.0 to remain in good standing. If a student's grade point average falls below 3.0, the student will be placed on academic probation. The student must regain a 3.0 average within the next 18 credit hours of coursework to remain in the program. Research performance also plays a significant role in the evaluation of a student's progress. Two negative evaluations in research courses (Biol 8800 or 8999) as indicated by a grade of U (Unsatisfactory) will be grounds for dismissal from the program.

V. ADVISEMENT

Students should obtain advisement from the MS Graduate Director or a member of the MS Area Advisory Committee (listed in Appendix I).

VI. NON-THESIS RESEARCH PAPER REQUIREMENTS (NON-THESIS OPTION ONLY)

All students electing to pursue the Non-Thesis option for the M.S. degree are required to successfully complete a Non-Thesis paper. Students are required to select a mentor under whose direction the Non-Thesis paper will be prepared. All Biology faculty are eligible to serve as M. S. Non-Thesis mentors upon approval by the MS Graduate Director. During preparation of the research paper, the student is required to enroll in Biol 8888 (Non-Thesis Masters Research) under the direction of a mentor.

A committee consisting of the student's mentor plus one other faculty member chosen in consultation with the mentor will evaluate the research paper. Students must file a M. S. Non-Thesis Committee Selection form with the Graduate Coordinator's office for approval by the Ms Graduate Director. The student's mentor is expected to review, make editorial and organizational suggestions of the first draft. The edited version will then be distributed to the mentor and the other reader of the committee for evaluation and grade assignment. Students must follow the Deadline Schedule posted for each semester. All papers must go through a plagiarism check. Contact the Graduate Coordinator for access. The paper along with the M. S. Non-Thesis Report form with signatures must be submitted to the Graduate Coordinator on or before the due date required by the department. The assigned grade will be the grade the student receives for Biol 8888 (a passing grade of C or better is required).

Non-Thesis Research Paper Options (Choose one of the following).

A. Laboratory-based Research Paper - The purpose is to provide students with the opportunity to do laboratory research and incorporate the results into a written document. A research project will be conducted under the mentor's supervision. Students may enroll in Biol 8800 (Research) to receive credit for their laboratory experience (up to four credit hours). Following the completion of Biol 8800 students will need to enroll in Biol 8888 (Non-Thesis Masters Research). The Non-Thesis research report will be evaluated on clarity of expression as well as scientific content. The report should be a minimum of 20 double-spaced pages (excluding appendix and references) and should include the following information:

1. Introduction - literature-based background to the research project
2. Specific Aims of the research project
3. Methodology used in the research project
4. Results of the research project
5. Discussion of the research project including the significance and limitations of the results discussed. If significant results are not obtained during the course of the research, suggestions should be made for alterations in the experimental design that would improve the chances of success
6. References, should follow conventions used by a scientific journal and must include titles for the articles.
7. Appendix: tables and figures with legends, these can also be incorporated into the text.

B. Literature-based Research Paper - The paper will consist of a critical analysis of a topic from the current scientific literature selected in conjunction with the mentor. Preparation of the paper is done under the supervision of the student's faculty mentor and should involve regular meetings with the mentor. Students are required to enroll in Biol 8888 (Non-Thesis Research). The analysis will be evaluated on clarity of expression as well as scientific content. The paper must be at least 20 double-spaced, typewritten pages (excluding references, tables and figures).

1. Introduction: a brief overview of background information designed to be understood by a first-year graduate student in the student's area of specialization.
2. Current Research Question: a clear presentation of the research topic or questions under consideration and a summary of results on the subject reported in the recent literature.

3. Significance and limitations of the research.
4. Discussion of future directions which the research may take.
5. References, should follow conventions used by a scientific journal and must include titles for the articles.
6. Appendix: tables and figures with legends, these can also be incorporated into the text.

VII. THESIS REQUIREMENTS (THESIS-OPTION ONLY)

A. Thesis Proposal

1. Thesis Committee Selection: A Thesis committee consisting of at least three members (one of whom is the student's faculty advisor) should be selected before or immediately after a Thesis topic has been selected by the student and advisor. At least half of the committee must be members or associate members of the Graduate Research Faculty in Biology. The student, in consultation with the advisor, will nominate other committee members. Students must file a **M.S. Thesis Committee Selection** form with the Graduate Coordinator's office for approval by the **MS Graduate Director**. The student's committee should play an important role in the synthesis and development of a research topic. The committee nominees should be selected carefully so that maximum assistance can be obtained with the research.
2. Proposal Format: The Thesis proposal will be 3-4 pages (double-spaced, type-written) in length and will consist of:
 - a. Cover Page (not included in page limit)
 - b. An Abstract
 - c. An Introductory section providing the rationale, justification for the proposed experiments and concluding with the hypothesis being tested.
 - d. The Specific Aims and Experimental Design
 - e. A brief description of the Materials and Methods
 - f. List of References (not included in page limit)

The purpose of the proposal is to provide a clear formulation of the specific aims in relation to a well-defined hypothesis. It may be necessary to go through multiple iterations of the proposal with both the advisor and Thesis committee before it is approved. All proposals should go through a plagiarism check. Contact the Graduate Coordinator for access. The advisor and Thesis committee members indicate their approval by signing the M.S. Thesis Proposal Cover Page form, which is then submitted to the Graduate Coordinator's Office by the student.

3. Oral Defense of Thesis Proposal. Following approval of the Thesis proposal by the committee, the student will orally defend the Thesis proposal at a meeting with the Thesis Committee. The oral defense will consist of a brief presentation of the Thesis proposal followed by questioning on the proposal as well as the background information relevant to the proposal. Following successful defense of the Thesis proposal, the committee will submit a "Thesis Proposal Defense Form" signed by a majority of the Thesis Committee to the

Graduate Coordinator's Office. If the defense is unsuccessful, the committee will determine a proper course of action.

4. Acceptance into Thesis-Option. Once an approved Thesis Proposal and Thesis Proposal Defense Form are on File in the Graduate Coordinator's Office, the student is considered to be accepted into the Thesis Option M.S. Program and is permitted to register for Biol 8999 (Thesis Research).

B. Thesis Preparation and Defense

1. Once the student's Thesis research is nearing completion (as judged by the major professor in consultation with the Thesis Committee), the student will commence preparation of the Thesis.
2. A copy of the Thesis as approved by the major professor must be submitted to Thesis Committee members at least **four** weeks prior to the proposed defense date.
3. After the Thesis Committee agrees that the Thesis is ready for defense (by signing the **Request for Scheduling of M.S. Thesis Presentation** form), a draft of the Thesis along with a one-page abstract and the **Request for Scheduling of M.S. Thesis Presentation** form will be submitted to the Graduate Coordinator's Office. This must be done at least **two** weeks before the requested date for the Thesis defense.
4. Upon submission of the **Request for Scheduling of M.S. Thesis Presentation Form**, the student will schedule a defense date in consultation with his/her committee members and will recommend a GSU faculty member to convene the Thesis presentation. The Graduate Coordinator will schedule a room for the presentation and send announcements at least **one** week in advance inviting all members of the department to attend. An abstract of the Thesis must accompany the announcement. A copy of the Thesis must be available in the Graduate Coordinator's office for examination at the time the announcement is made.
5. At the Thesis defense, the convener will moderate the proceedings. The defense will begin with an oral presentation of 30-45 minutes by the student in which the contents of Thesis will be summarized followed by a question-and-answer period from the general audience. Subsequently, the student will meet with members of the Thesis Committee to answer any remaining questions about the Thesis or the presentation. The Thesis Committee will then vote to determine whether or not the student has successfully defended the Thesis. The vote of the majority will prevail. The convener for the Thesis defense will send a signed **Defense of the M.S. Thesis Report** (Form 7) to the Graduate Coordinator. If the student does not defend the Thesis successfully, the Thesis Committee, in consultation with the MS Area Advisory Committee will schedule a new presentation or provide for other appropriate action.
6. Acceptance of the Thesis by the Thesis Committee is indicated by signatures on the Thesis Cover Page.

VIII. RESPONSIBILITY OF THE GRADUATE STUDENT

It is the responsibility of the student to meet the requirements and deadlines of the Graduate School of the College of Arts and Science concerning submission of the final Thesis copies to the Graduate Office.

The graduate student is also responsible for fulfilling the provisions of this policy document and for reading the Arts & Sciences current Graduate Bulletin and fulfilling all provisions detailed therein. Failure of the student to comply with the appropriate procedures outlined in this document and/or the Bulletin may lead to a delay in graduation.

All candidates for a degree must file a formal application for graduation with the Graduation Office. Graduate degree candidates must apply at least two semesters in advance of the expected semester of graduation.

IX. PETITIONS

If a Master's Degree student desires to deviate from the policies set forth in this document, the student must submit a written petition to the Graduate Coordinator for consideration by the MS Graduate Director. After the MS Graduate Director has acted on the request, a letter will be sent to the student and the major professor stating the action taken on the petition. Requests for deviation from any college or university requirements must be made in writing to the Petitions Committee of the College of Arts and Sciences. Request forms can be obtained from the Graduate Office (Haas/Howell Building, 8th floor).

X. CONTINUOUS ENROLLMENT POLICY

As part of the university's continuous enrollment policy, students in all graduate programs must maintain enrollment totaling 6 or more hours over all consecutive three semester periods (including summers). In other words, the total enrollment of the current term plus the two terms preceding it must add to 6 hours or more at all times. The status of all students will be checked by the midpoint of each term for compliance with the continuous enrollment requirement. Any student whose enrollment is out of compliance will be placed on inactive status effective at the end of the current term and all pre-registration for subsequent terms will be canceled. Those students will be notified by an e-mail message sent to their official Georgia State University e-mail account.

To resume their programs, inactive students must file for re-entry by the published deadline and must enroll at a level sufficient to satisfy the continuous enrollment criterion. That is, their enrollment in the re-entry term plus the two terms preceding it must total to 6 hours or more. The maximum required enrollment level for the re-entry term is 6 hours. For more information on the re-entry process, see section 1100 of the Graduate Catalog or visit <http://www.cas.gsu.edu/re-entry.html>.

Completion-Term Enrollment Requirement:

Additionally, all students must be enrolled in the term in which they complete the requirements for their degree. Normally, this is the term in which they will graduate. However, if the requirements are completed after the deadline for graduation in a term, but before the first day of classes in the subsequent term, then it is not necessary to enroll in the subsequent term. If the continuous enrollment criterion is not met in the term in which degree requirements are completed, then it must be met in the term of graduation. Students who have enrolled for a total 6 or more hours in the two terms preceding the term of completion may register for 1 hour in that term, unless their department requires a higher number of hours.

APPENDICES

APPENDIX I MS Program Advisors

**APPENDIX II Minimum Required Coursework for Each
Concentration**

APPENDIX III List of Request Forms

APPENDIX I

GRADUATE COORDINATOR/ M.S. PROGRAM ADVISORS

MS Graduate Coordinator:

Ms. Tracy Crayton
480 PSC (404)413-5306
tcrayton@gsu.edu

MS Graduate Co-Directors:

Dr. Kuk-Jeong
434 SA (office) (404)413-5311
kchin@gsu.edu

Dr. W. William Walthall
614 PSC (office) (404)413-5391
wwalthall@gsu.edu

MS Area Advisory Committee

Dr. W. William Walthall
408 PSC (office) (404) 413 5391
Dr. Kuk-Jeong Chin
434 SA (office) (404) 413-5311

APPENDIX II

Applied and Environmental Microbiology (Non-Thesis)

A. Discipline Specific Requirement

Biol 6484 Laboratory Techniques in AEM

B. Additional Course Requirements (8 hours)

Biol 6438 Applied Microbiology
Biol 6458 Microbial Ecology & Metabolism
Biol 6480 Principles of Toxicology
Biol 6595 Microbial Physiology and Genetics I
Biol 6744 Biostatistics or similar statistics course
Biol 6045 General Ecology
Biol 6053 Field Ecology
Biol 6428 Medical Microbiology
Biol 6430 Microbial Diversity and Systematics
Biol 6451 Aquatic Pollution and Toxicology
Biol 6580 Microbial Pathogenesis
Biol 6597 Microbial Physiology and Genetics II
Biol 6694 Biosafety: Principles & Practice
Biol 6696 Laboratory of Molecular Biological Techniques
Biol 6801 Survival Skills in Academia
Biol 8410 Advanced Microbiology
Biol 8415 Fermentation Microbiology
Biol 8416 Bacterial & Archaeal Systems
Biol 8510 Concepts in Microbiology

C. Specific Topics (2 hours)

Biol 8900 Topics in Microbiology or
Biol 8980 Topics in Applied and Environmental Microbiology

D. Research (8 hours)

Biol 8800 Non-Thesis Research*
Biol 8888 Preparation of Non-Thesis Research Report

*Students must spend two semesters in the laboratory working on a research project.

Applied and Environmental Microbiology (Thesis)

A. Course Requirements (8 hours)

Biol 6438	Applied Microbiology
Biol 6458	Microbial Ecology & Metabolism
Biol 6480	Principles of Toxicology
Biol 6595	Microbial Physiology and Genetics I
Biol 6045	General Ecology
Biol 6053	Field Ecology
Biol 6428	Medical Microbiology
Biol 6430	Microbial Diversity and Systematics
Biol 6451	Aquatic Pollution and Toxicology
Biol 6580	Microbial Pathogenesis
Biol 6597	Microbial Physiology and Genetics II
Biol 6696	Laboratory of Molecular Biological Techniques
Biol 6744	Biostatistics or similar statistics course
Biol 6801	Survival Skills in Academia
Biol 8410	Advance Microbiology
Biol 8510	Concepts in Microbiology

B. Specific Topics (2 hours)

Biol 8900	Topics in Microbiology <u>or</u>
Biol 8980	Topics in Applied and Environmental Microbiology

Requirements for Biology M.S. Program with Interdisciplinary Emphasis in Bioinformatics

Bioinformatics has grown from the creation of large biological databases that required computational approaches for efficient manipulation and analysis to a multi-faceted discipline that also includes microarray technology, statistical analysis, and molecular modeling. We offer Non-Thesis and Thesis options for this interdisciplinary degree. The Non-Thesis option requires a minimum of 40 semester hours of coursework and a Non-Thesis report. The Thesis option requires a minimum of 26 hours of coursework and 14 credit hours of research.

Coursework must include:

- a. One course in biochemistry of at least 3 hours [normally Chem 6600 (5 hours) or 6610 (3 hours)] although higher-level courses may be selected. This requirement may be waived if the student has successfully passed an equivalent undergraduate course with a B or better (in case that the biochemistry work is waived, the student must still complete requisite hours of coursework).
- b. Biol 6564 (Advanced Genetics), 4 hours.
- c. Biol 6640 (Fundamental of Bioinformatics), 4 hours.
- d. Biol 8700 (Graduate Research Seminar), 2 hours.
- e. Fifteen hours of interdisciplinary coursework to be selected from among the following:

CSC 7350	Programming for Bioinformatics, (3) → CSC 2301 - Computer Programming for Non-Majors
CSC 7351	System Programming for Bioinformatics (3) → CSC 3320 - System-Level Programming
CSC 7352	Data Structure for Bioinformatics (3) → CSC 2302 - Computer Programming II for Non-Majors
CSC 6310	Parallel and Distributed Computing (4) (Prerequisites: CSC 7350(Java) (3) and CSC 7351 (C++) (3))
CSC 6730	Scientific Visualization (4) (Prerequisites: CSC 7350 (Java) (3) and CSC 7351 (C++) (3))
CSC 6350	Software Engineering (4) (Prerequisites: CSC 7352 (Data Structure) (3), CSC 7350 and 7351 are prerequisites for CSC 7352)
CSC 6710	Database Systems (4) (Prerequisites: CSC 7352 (Data Structure) (3), CSC 7350 and 7351 are prerequisites for CSC 7352)
CSC 8630	Advanced Bioinformatics (prerequisites Bio 6640 or equivalent and CSC 7352)
CSC 8710	Deductive Databases and Logic Programming (4) (Prerequisites: CSC 6710)
Math 6544	Biostatistics (3)
Math 6548	Methods of Variance and Analysis of Regression (3) (Prerequisites: Math 6544 or Biol 6744 (Biostatistics))
Stat 8050	Statistics for Bioinformatics (Prerequisites: Math 6544 or Biol 6744)
Stat 8540	Multivariable Methods in Biostatistics (3) (Prerequisites: Math 6544 or Biol 6744)

Non-Thesis option

1. 13 hours of electives which may include:
 - a. Biology courses including four hours of research (Biol 8800)
 - b. Chem 6110 (Physical Chemistry, 2 hours) and Chem 6450 (Molecular Modeling, 2 hours); Prerequisite: Chem 6110
 - c. Additional computer science or math and statistics courses in excess of the 12 hour requirement.
 - d. Bio 8888 (Laboratory or Literature-Based Research Paper)
The guidelines for the research paper are similar to those for the Biology M.S. Non-Thesis research paper; *however, one of the committee members must be from the math or computer science department.*

Thesis option

1. An approved and successfully defended Thesis proposal. The guidelines for the written proposal and oral defense are similar to those for the written proposal and oral defense are similar to those for the Biology M.S. Thesis proposal; *however, the Thesis topic must be in the area of bioinformatics and one of the Thesis committee members must be from the math or computer science department.*
2. Fourteen hours Biol 8999 (Thesis Research).
3. A Thesis *on research that incorporates bioinformatics.*
4. A final oral presentation directed primarily to defense of the Thesis.

M.S. in Biology with a concentration in Biotechnology

Application /Acceptance: Students must submit a written letter of application to be considered for admission into the Biotech concentration. This application letter should include three areas of practical training that the student envisions and potential faculty sponsors. Students not currently enrolled in the M.S. program should include the application letter in the personal statement of their M. S. online application form; successful applicants will be admitted into both the M.S. program and the biotechnology concentration. Students who are currently enrolled in the M. S. program should submit the application letter to the graduate coordinator. In addition to the M.S. program admission requirements, applicants to the Biotechnology concentration must have completed Chem 6600 (Biochemistry) or its equivalent with a grade of "B" or better. Admission to the concentration will be made by the Biotechnology Area Committee on the basis of credentials and is dependent on space availability.

Discipline Specific Requirements:

Biol 6696	Laboratory Techniques in Molecular Genetics (4)
Biol 8970	Instrumentation (1)
Biol 6694	Biosafety: Principle & Practice
Biol 6438	Applied Microbiology
Biol 6484	Lab Tech: Applied and Environmental Microbiology
Biol 6595	Microbial Physiology and Genetics
Biol 6640	Fundamentals of Bioinformatics
Biol 6680	Biological Imaging
Biol 6690	Lab in Electron Microscopy
Biol 6744	Biostatistics
Biol 8540	Advanced Methodologies in Biostatistics
Biol 8510	Concepts in Biotechnology
	Fermentation
	Protein Purification
	(Potential topics include):
	Expression in yeast
	Eukaryotic Expression
	Biosafety
	Radiochemical Safety
	Quality Control
	Intellectual Property
	Robotics
Biol 8970	Topics in Molecular Biology
Chem 6000	Fundamentals of Chemical Analysis
Chem 6150	Introduction to Biophysical Chemistry
Chem 6190	Introductory Methods III: Spectroscopy
Chem 6820	Analytical Laboratory
Chem 6850	Bioanalytical Chemistry I
Chem 6860	Bioanalytical Chemistry II
Chem 6871	Electrochemical Methods

Non-Thesis Option

Core Courses (5CH):

Biol 6696	Laboratory Techniques in Molecular Genetics (4)
Biol 8970	Instrumentation (1)

Laboratory Practica (15CH):

Biol 6440	Practicum in Biotechnology (15) (Minimester; 5 hours each time taken)
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Non-Thesis Research Paper Preparation (4CH):

Biol 8888	Non-Thesis paper writing (4)
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Seminar	Biol 8700	Seminar (2)
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Electives (14CH) (Approved by Biotechnology Committee)

TOTAL **40 hours**

Laboratory Practica: A series of intensive courses designed to provide a student with working “hands-on” knowledge and experience in selected areas of current interest/importance in biotechnology. Hands-on experience will be integrated with theory and current best-practices. To maximize the learning experience and to maintain a reasonable instructor to student ratio, the enrollment in each practicum will be limited (5 students maximum).

Tentative Subject topics for the Practica include:

- Fermentation Processes
- Differential In-Gel Protein Analysis
- Biological Imaging
- Electron Microscopy
- Light and Fluorescence Microscopy
- Protein Purification
- Vaccine Design
- Immunohistochemistry
- Flow Cytometry and Cell Sorting
- Mass Spectrophotometry: MALDI-ToF
- Robotic Applications
- Microarray Application and Analysis
- RT and Quantitative PCR

Research Paper: Upon completion of each rotation, the student will submit a progress report covering activities engaged in during the rotation. An advisor will mentor the student in the writing process. The three progress reports will constitute part of the Non-Thesis research paper and will comprise the basis of a portfolio that the student can use as evidence of training and accomplishments.

Thesis Option

For admission into the Thesis option, the student must have a Thesis proposal accepted.

Prerequisite (5CH):

Chem 6600 Biochemistry (5)

Core Courses (5CH):

Biol 6696 Laboratory Techniques in Molecular Genetics (4)
Biol 8970 Instrumentation (1)

Laboratory Practica (15CH):

Biol 6440 Practicum in Biotechnology
(Minimester; 5 CH each time taken)

Thesis Research (14CH):

Biol 8999 Thesis Research (14 CH)
Up to 10CH of Biol 6440 (Practica) can be applied towards the Thesis Research requirement. 14 credits must come from 8999.

Seminar (2 CH):

Biol 8700 Seminar (2 semesters)

Electives (4 or 9 CH) (Approved by Biotechnology Committee)

TOTAL **40 hours**

Laboratory Practica: Both technique-based and project-based rotations will be offered. Students will meet with an advisory upon entrance into the concentration to determine rotations that best suit the student's goals and needs.

Research Paper: The student will submit a Thesis proposal to be accepted by a Thesis Committee. The student will complete a Thesis to be defended before the Thesis Committee. The Thesis may be based upon research done during the rotations.

Examination: The MS examination will consist of an oral defense of the Thesis Proposal.

Cellular & Molecular Biology (Non-Thesis)

A. Discipline Specific Required Course (a minimum of two required)

Biol 6246	Advanced Human Physiology
Biol 6248	Cell Physiology
Biol 6800	Principles of Cellular Biology

B. Additional Course Requirements (select three or more)

Biol 6074	Developmental Biology
Biol 6102	Fundamentals of Neurobiology
Biol 6240	Endocrinology
Biol 6246	Advanced Human Physiology
Biol 6248	Cell Physiology
Biol 6278	Immunology
Biol 6595	Microbial Physiology & Genetics I
Biol 6597	Microbial Physiology & Genetics II
Biol 6800	Principles of Cellular Biology
Biol 8010	Neurobiology I: Cellular
Biol 8020	Neurobiology II: Integrative
Biol 8040	Function Human Neuroanatomy
Biol 8220	Advance Molecular Cell Biology
Biol 8620	Eukaryotic Molecular Genetics
Biol 8800	Independent Research
Biol 6115	Medical Neuroanatomy
Biol 6284	Bioenergetics
Biol 6480	Principles of Toxicology
Biol 6630	Enzymology
Biol 6744	Biostatistics
Biol 6801	Survival Skills in Academia
Biol 8310	Concepts: Cell Biology and Physiology
Biol 8360	Protein Structure & Function

C. Specific Topics

Biol 8940	Topics in Physiology
Biol 8960	Topics: Cell Physiology & Biochemistry
Biol 8970	Topics in Molecular Biological Science

D. Non-Thesis Report

Bio 8888	(Laboratory or Literature-Based Research Paper)
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Molecular Genetics and Biochemistry

A. Prokaryotic Genetics Requirement

- Biol 6595 Microbial Physiology and Genetics I **or**
- Biol 8610 Physiology and Genetics of Prokaryotes

B. Eukaryotic Genetics Requirement

- Biol 6564 Advanced Genetics **or**
- Biol 8620 Eukaryotic Molecular Genetics

C. Electives (Additional electives select three or more)

- Biol 6074 Developmental Biology
- Biol 6278 Immunology
- Biol 6450 Molecular Modeling Methods
- Biol 6500 Human Genetics
- Biol 6564 Advanced Genetics
- Biol 6575 Virology
- Biol 6580 Microbial Pathogenesis
- Biol 6595 Microbial Physiology and Genetics I
- Biol 6630 Enzymology
- Biol 6640 Fundamentals of Bio-informatics
- Biol 6696 Laboratory of Molecular Biological Techniques
- Biol 6800 Advanced Cell Biology
- Biol 8278 Molecular Immunology
- Biol 8310 Concepts in Cell Biology and Physiology
- Biol 8360 Protein Structure and Function
- Biol 8610 Physiology and Genetics of Prokaryotes
- Biol 8620 Eukaryotic Molecular Genetics
- Biol 8630 Bio-informatics
- Biol 8637 Nucleic Acid Structure and Function
- Biol 8675 Molecular Virology
- Biol 8710 Concepts in Molecular Genetics
- Biol 8800 Independent Research (in the area of Molecular Genetics & Biochem)
- Chem 6610 Advanced Biochemistry
- Biol 6074 Developmental Biology
- Biol 6240 Endocrinology
- Biol 6246 Advanced Human Physiology
- Biol 6248 Cell Physiology
- Biol 6744 Biostatistics
- Biol 8010 Neurobiology I: Cellular Neurobiology
- Biol 8020 Neurobiology II: Integrative Neurobiology
- Biol 8410 Advanced Microbiology
- Biol 8510 Concepts in Microbiology
- Biol 8540 Advanced Methods of Biostatistics

D. Non-Thesis Report

- Bio 8888 (Laboratory or Literature-Based Research Paper)

Neurobiology & Behavior

A. Discipline Specific Requirement

Biol 6102	Fundamentals in Neurobiology
Biol 6241	Hormones and Behavior

B. Additional Course Requirements (Select three or more)

Biol 6074	Developmental Biology
Biol 6114	Neural Mechanisms of Regulatory Behavior
Biol 6115	Medical Neuroanatomy
Biol 6116	Primate Behavior
Biol 6065	Vertebrate Morphogenesis
Biol 6094	Developmental Neurobiology
Biol 6240	Endocrinology
Biol 6246	Advanced Human Physiology
Biol 6248	Cell Physiology
Biol 6500	Human Genetics
Biol 6564	Advanced Genetics
Biol 6696	Laboratory in Molecular Biological Techniques
Biol 6744	Biostatistics
Biol 6800	Principles of Cellular Biology
Biol 6801	Survival Skills in Academia
Biol 8010	Neurobiology I: Cellular Neurobiology
Biol 8020	Neurobiology II: Integrative Neurobiology
Biol 8040	Functional Human Neuroanatomy
Biol 8060	Behavioral Neuroscience
Biol 8220	Advance Molecular Cell Biology
Biol 8278	Molecular Immunology
Biol 8610	Physiology and Genetic of Prokaryotes
Biol 8620	Eukaryotic Molecular Genetics
Biol 8800	Independent Research (May not exceed four credits)
Biol 8910	Topics in Biology (requires prior approval)
Biol 8110	Concepts in Neurobiology (requires instructor approval and may be repeated for credit)
Biol 8950	Topics in Behavior and Neurobiology (requires instructor approval and may be repeated for credit)
Chem 6610	Advanced Biochemistry
Psych 6130	Sensation and Perception
Psych 8410	Psychological Research Statistics I

C. Non-Thesis Report

Bio 8888	(Laboratory or Literature-Based Research Paper)
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MS in Biology Medical Studies Concentration (MBMS)

The MBMS Program is designed to provide advanced medical instruction to students at GSU. The Master's Program consists of three required courses, a choice of electives, and one capstone course for a total of 40 credit hours.

Degree Requirements (40 hours)

1. Required Prerequisite Courses. The credit hours in this section will not count toward the Master's Degree. The student **MUST** take the following prerequisite courses, or have taken equivalent courses at the undergraduate level and received a grade no lower than a B in the following:

- Biol 7800 Cell Molecular Biology (3)
- Biol 7240 Applied Medical Physiology (3)
- Biol 7250 Human Physiology Lab (1)

2. Required courses (2 CH)

- Biol 8700 Graduate Seminar (2 credit hours)

3. Science Elective Courses (28 hours). The student must complete 28 credit hours of the following courses with a grade no lower than a B:

- Biol 6687 Surgical Anatomy (4)*
- Biol 6246 Advanced Human Physiology (4)
- Biol 6428 Medical Microbiology (4)
- Biol 6115 Medical Neurobiology (4)
- Biol 6102 Neurobiology (4)
- Biol 6278 Immunology (4)
- Biol 6074 Developmental Biology (4)
- Biol 6240 Endocrinology (4)
- Biol 6686 Pathophysiology (4)
- Biol 6685 Functional Histology (4)
- Biol 6282 Tumor Immunotherapy (4)
- Biol 6248 Cell Physiology (4)
- Chem 6610 Biochemistry II (4)
- Biol 6800 Advanced Cell Biology (4)
- Biol 6500 Human Genetics (4)
- Biol 6450 Bacterial Pathogenesis (4)
- Bio 6545 Bioethics (4)

***Physician's Assistant Admissions require 4 credit hours of a physiology and lab course and 4 credit hours of an anatomy course /lab. Biol 7240/7250 and Biol 6687 Surgical Anatomy would meet these requirements. Check with your institution to verify prerequisite requirements as these may differ.**

4. Additional Elective Courses (6 hours) choose from the following:

- GERO 8102 Life Course Sociology (3)
- GERO 7200 Health and the Older Adult (3)
- GERO 8320 Psychology of Aging (3)
- PH 7011 Intro to Epidemiology (3)
- Biol 7021 Infectious Disease and Society (3)
- HA 8160 Intro to Health Care System (3)
- HA 8190 Health Policy & Ethics (3)
- NUTR 6700 Med Biochem Principles (3)
- Biol 6744 Biostatistics or PH 7017 Fundamentals of Biostatistics (3)
- SNHP 6010 Medical Terminology (3) online course

5. Capstone Courses (choose 4 hours)

- Biol 8888 Non-thesis Masters Research project (4 credit hours)
- Biol 6916 Clinical Internship (4 credit hours) * this course has a prerequisite of Biol 6687 and Biol 6686

Approved Courses from the Schools of Law and Public Health (up to nine credit hours)
Please contact the College of Law or the School of Public Health to register for these courses.

Law 7098	Biotechnology Law, Policy & Ethics
Law 7200	Environmental Law
Law 7239	Health Law: Liability
Law 7243	HIV & the Law
Law 7244	Public Health Law
Law 7255	Comparative Health Law
Law 7351	Law & Psychiatry
PH 7011	Epidemiology for Public Health
PH 7012	Health Program Planning Implementation and Evaluation
PH 7014	Introduction to HIV /STD Public Health
PH 7015	Cancer and Society
PH 7017	Public Health Biostatistics
PH 7150	Environmental Health
PH 7275	Chronic Disease Epidemiology
PH 7280	Infectious Disease Epidemiology
PH 7293	Environmental Health Toxicology
PH 7295	Topics in Environmental Epidemiology
PH 7300	Urban Health
PH 7350	Biological Basis of Disease
PH 7540	Intro to Public Health Lab

APPENDIX III: FORMS

All of the forms listed below are available in the Biology Department, Main Office-Petit Science Center 4th floor, and via the website under Graduate Forms: <http://biology.gsu.edu/graduate-student-forms/>
You may also ask the MS Graduate Coordinator for assistance with locating and completing these forms.

M.S. Non-Thesis Committee Selection Form

M.S. Non-Thesis Report Form

M.S. Thesis Committee Selection Form

M.S. Thesis Proposal Cover Page

Request for Scheduling of M.S. Thesis *Proposal* Defense

Request for Scheduling of M.S. Thesis Presentation

Defense of M.S. Thesis Report (to be given to Thesis chair)

Updated 9/16/2016