

Master of Science in Biomedical Sciences
Student Handbook
2015



Biochemistry and Molecular Biology
Cell and Molecular Pharmacology and Experimental Therapeutics
Microbiology and Immunology
Neuroscience
Pathology and Laboratory Medicine
Regenerative Medicine and Cell Biology



Overview

The College of Graduate Studies at the Medical University of South Carolina offers degree programs which prepare students for careers as research scientists, investigators, or teachers, depending on the extent of training. Degrees are granted by the Board of Trustees on recommendation of the faculty, which in turn acts only on certification by the College of Graduate Studies.

The **Master of Science in Biomedical Sciences (MBS)** is a research intensive degree program requiring completion of an independent laboratory research project under the direction of a mentor in a student's chosen field, written thesis, and oral thesis defense. Students choose one of seven tracks as their field of concentration:

Tracks of concentration for the MBS program

- 1) Biochemistry and Molecular Biology
- 2) Cell and Molecular Pharmacology and Experimental Therapeutics
- 3) Microbiology and Immunology
- 4) Neurosciences
- 5) Pathology and Laboratory Medicine
- 6) Public Health Sciences*
- 7) Regenerative Medicine and Cell Biology

*Due to significant differences in structure between the Public Health Sciences degree requirements and the other MBS tracks, students in that track should not use this handbook, but instead should consult the Department of Public Health Sciences Student handbook posted at <http://academicdepartments.musc.edu/phs/academics/students/>

The Master of Science in Biomedical Sciences degree program is overseen by the Master in Biomedical Sciences Program Committee, consisting of a Chair appointed by the Dean of the College of Graduate Studies, the graduate program director for each track, and a student representative. The 2015 MBS Program Committee roster is in the table below:

2015 Master in Biomedical Sciences Program Committee

Program Committee Chair	Laura Kasman, Ph.D.
Biochemistry and Molecular Biology	David Long, Ph.D.
Cell and Molecular Pharmacology and Experimental Therapeutics	Jennifer Isaacs, Ph.D.
Microbiology and Immunology	Natalie Sutkowski, Ph.D.
Neurosciences	Antonieta Lavin, Ph.D.
Pathology and Laboratory Medicine	David Turner, Ph.D.
Public Health Sciences	Betsy Hill, Ph.D.
Regenerative Medicine and Cell Biology	Russell Norris, Ph.D.
Student representative	Michael Sarson

Degree Requirements

The College of Graduate Studies has specific course requirements and proficiency standards for the Master of Science in Biomedical Sciences degree. All tracks require completion of an original laboratory research project under the direction of a mentor in their chosen field, written thesis, and oral thesis defense. Coursework requirements vary by track, but consist of at least 45 total credit hours, including a minimum of 12 hours of didactic (non-research, non-thesis) instruction. Track specific course requirements are described in *Appendix 1*. Each student follows an individual *Program of Study* designed in consultation with the Thesis Advisor. MBS students are required to register for a minimum of nine hours each semester. Each student is expected to be familiar with the elements of statistics. If the sponsoring department considers that the student has insufficient preparation in this field, one or more courses may be included in the *Program of Study*.

Graduate students are expected to **maintain at least a 3.0 overall grade point average** in all merit graded courses and a passing grade in all research and Pass/Fail courses, in order to satisfy the required graduate credit hours. This represents the minimum requirement of the College. Individual programs may have more stringent requirements for continuation as a graduate student. A student whose total cumulative record is below these requirements at the end of any semester is placed on probationary status and is given one semester in which the cumulative average must be brought back to the required standard. By the end of the following semester, if the required level has not been attained, consideration for further enrollment by the program or college is obligatory.

Timeline

The MBS program is expected to last two fall semesters, two spring semesters and one summer, so that a degree can be obtained 21 months after the start of the program. The timeline below is recommended for students wishing to finish within this time frame.

Recommended Timeline (*Mandatory for all tracks.)

	Fall year 1	Spring year 1	Summer	Fall year 2	Spring year 2
Courses	CGS 710*, Track-specific courses, Research (970)	Track-specific courses, Research (970)	CGS 762* – Writing for the M.S.	Research (970)	Research (970)
Other milestones	Two 6-wk lab rotations (see note below). Choose mentor by end of semester.	Start thesis research project with chosen mentor.	Writing of thesis proposal in CGS 762 course.	Finish and defend thesis proposal. Admission to candidacy for M.S. degree.	Finish research. Write thesis. Defend thesis. Graduate!
CGS forms to submit	✓ Rotation agreement forms ✓ Appointment of Major Thesis Advisor	✓ Selection of Advisory Committee ✓ Program of study	✓ Individual Development Plan	✓ Plan of Research ✓ Admission to Candidacy ✓ Annual Evaluation of Student Progress	✓ Thesis Defense Notification (Ready to Defend form) ✓ Successful defense

Full time enrollment

Masters in Biomedical Sciences students are required to enroll for a minimum of 9 credit hours per term, including at least 1 credit hour of Research (course number 970-*Research*) or if all experiments are completed, Thesis (course number 980-*Thesis*), per term.

Lab rotations

Lab rotation requirements vary by track (see table). Some tracks admit students for thesis work with a specific investigator and do not require rotations. Others require all students to experience two lab environments, even if they have a chosen mentor. If required, MBS lab rotation hours should be accounted for under Research credit hours (970 course numbers for the student's chosen track). MBS students *do not* register for CGS 720/721, Ph.D. lab rotations, which is a year long course. Prior research experiences at MUSC or elsewhere may take the place of laboratory rotations at the discretion of the individual track. When a student starts a rotation, they are required to complete an MBS Rotation Agreement form with their mentor (*see Appendix 2*).

Table of Lab Rotation Requirements by track:

<i>Track</i>	<i>Lab rotation requirement</i>	<i>Course number to register for lab rotations</i>
Biochemistry and Molecular Biology	None required. Mentors chosen before admission.	BMB 970
Cell and Molecular Pharmacology and Experimental Therapeutics	Two 6-week rotations in the first semester	PCOL 970
Microbiology and Immunology	Two 6-week rotations in the first semester	MBIM 970
Neurosciences	None required. Mentors chosen before admission.	PHYSO 970
Pathology and Laboratory Medicine	None required. Mentors chosen before admission.	PATH 970
Public Health Sciences	None required. Mentors chosen before admission.	BMTRY 970
Regenerative Medicine and Cell Biology	Two 6-week rotations in the first semester.	CELL 970

Thesis Advisory Committee

This committee, which is recommended by the major department and approved by the Dean, shall consist of at least four members, three from the major department and one from outside the department. All members of the committee shall be members of the Graduate Faculty. The Advisory Committee chairperson must either be a full member of the Graduate Faculty, or an associate member with a full member as co-mentor. The Thesis Advisory Committee should be appointed after a student has chosen a specialized area in his/her field and no later than 6 months after the student enrolls (end of February of first year). In the interim, the student is advised by the departmental graduate committee or advisor.

Program of Study

The *Program of Study* is a list of courses and other requirements (including those of the major department) that the student must complete in order to meet the minimum requirements of their degree. It lists courses that are being transferred (rarely applicable), as well as courses that are to be taken on campus. It is planned in a meeting of the student and his/her Thesis Advisor. After approval by the Thesis Advisor, the approved *Program of Study* form is reviewed with the departmental graduate program director/coordinator who must also approve it, and then filed with the Office of the Dean of Graduate Studies. This should occur within three months of the Thesis Advisor being chosen. A decision to remove, substitute, or add courses to the program can be made in a joint meeting of the student and the Thesis Advisor. Any changes in the program must be completed no later than one week after the substituted or additional course has begun. A record of any change in the program will be submitted by the Thesis Advisor to ensure that any change in the *Program of Study* is consistent with the maintenance of at least the minimum course requirements of the major department. Ordinarily, only courses listed in the catalog of the College of Graduate Studies will be included in the program. The program must be completed before the final oral examination is scheduled.

Taking the Ph.D. first year curriculum as an M.S. student

MBS students are welcome to enroll in all portions of the Ph.D. First Year Curriculum except CGS 712 and CGS 720. MBS students wishing to take Foundations in Biomedical Sciences (CGS 701/ CGS 702) should enroll in the individual units (e.g. CGS 701-G, CGS 701-I, CGS-701-P) even if they intend to take all sections. Students should consult with their graduate program director or the Chair of the MBS Program Committee regarding which units are most appropriate for their needs. All units are 2 credits and run from 3-4 weeks in length. A description of the Ph.D. First Year Curriculum can be [found here](http://academicdepartments.musc.edu/grad/first_year_curriculum/).

< http://academicdepartments.musc.edu/grad/first_year_curriculum/>

Courses Audited

Any graduate student, with permission of the instructor and the chairperson of the Thesis Advisory Committee, and with written notice to the Graduate Office, may audit a course. Audited courses are not part of the *Program of Study* and will not be given credit.

Repeating Courses

The Thesis Advisory Committee may permit a student to repeat a course in order to raise the grade. Courses that have been repeated will be treated as follows: (1) Credit hours will be granted only once. (In computing the overall grade point average to determine eligibility for degrees or in rulings on probationary matters, the credit hours must be counted twice and both grades included). (2) The transcript must show both grades, with the second being designated as *Repeated*, and credit hours being given only once.

Transfer Credit

As stated in the MUSC Bulletin, at least 33 percent of semester credit hours applied toward a Medical University degree must be earned through instruction by the University. Only those courses (none from correspondence or research) in which grades of 3.0 or above were received

will be acceptable for transfer on the *Program of Study*. In some instances, the department may request that a student transfer hours received in certain courses that have been taken on a pass/fail basis, but these cannot be averaged in the GPA. It is the responsibility of the department to determine the student's comprehension of the material before such hours are shown on the *Program of Study* for credit toward the degree.

Individual Development Plan Requirement

In accordance with the CGS Individual Development Plan (IDP) policy, MBS students are required to complete an Individual Development Plan within 3 months of choosing a mentor and no later than the end of their first year. Its purpose is to ensure that MBS students begin post-graduation career planning early in their training and identify their training goals early. Review of the IDP with the mentor and/or thesis committee shall take place annually and be noted on the Annual Evaluation of Student Progress form. The CGS IDP assessment is titled [CGS Graduate Student IDP Worksheet](#), and is available on the College's website under links for current students.

Plan of Research (Research Proposal)

Prior to a student being certified as a candidate for the M.S. in Biomedical Sciences degree, he/she will submit a research proposal on the proposed thesis topic in NIH F31 grant format (Page limits for single-spaced text with 0.5 inch margins: Specific Aims – 1 page, Research Strategy – 6 pages, Literature Cited – no page limit). The required summer course for MBS students, CGS 762, provides instruction for this task. The proposal should show evidence of creative integration of course material, superimposed on a sound understanding of the pertinent literature and be fully referenced. The topic for the M.S. thesis shall be approved by the student's major advisor(s) and the department chairperson, the latter with regard to availability and utilization of departmental resources, by their signatures on the *Plan of Research* form.

Proposal Defense

The Thesis Advisory Committee will critically review the written proposal. Within two weeks of the submission of the written proposal to the committee, the student will present and defend the research proposal orally before the committee. The student will be questioned on those methodologies and background areas needed to successfully complete the proposed research.

Admission to Candidacy

Upon approval of the research proposal, the student will be certified as a candidate for the M.S. degree by the signing of the *Admission to Candidacy-Masters* form. Such admission to candidacy must occur at least three months prior to completing requirements for the degree.

The graduate school recognizes that the student's research may deviate substantially from that originally proposed. The student should be encouraged to pursue promising leads; however, long-term changes in the direction of the student's research should only occur in consultation with their Thesis Advisory Committee. An Annual Evaluation of Student Progress Form should be filled out and submitted to the College of Graduate Studies at the time of the proposal defense and at every meeting of the student and their Advisory Committee as a record of the meeting. The committee recommends the time until the next meeting on this form.

Residence

At least one year of residency at the Medical University of South Carolina is required before receiving the M.S. in Biomedical Sciences degree. A graduate student who has completed all the course requirements for the degree and experiments for their thesis and plans to write the thesis either in absentia or in residence must register and pay tuition for a minimum of one hour each semester (course number *980-Thesis*) until completion of a successful oral defense and submission of the final approved thesis. The student should also indicate their intention to graduate the semester before their last term by filling out the Degree Application Form.

Research Seminar

Students are required to make a research presentation, on campus or at a scientific conference, in a manner to be determined by the department or program and the Thesis Advisory Committee.

Thesis

A thesis, contributing new knowledge or the treatment of familiar materials from a new point of view, is required on a topic in the major field. Theses must comply with the regulations contained in *A Guide to the Preparation of Theses and Dissertations* which is available in the Graduate Office or through the CGS website.

Prior to confirming a Thesis Defense date, the thesis must be certified as ready to defend by the Thesis Advisory Committee. Certification must occur at least 21 days before the final defense and is communicated to the Dean by the signatures of all committee members, the graduate program director, and the department/program chair on the *Thesis/Dissertation Defense Notification form*. A draft thesis must therefore be distributed to the student's committee at least 4 weeks before the defense date so that the committee members have a week to review it before approving it as ready to defend.

It is common for corrections and revisions to the draft thesis to be required by Thesis Advisory Committee members. These must be communicated to the student in writing no later than 24h after the *Certification of Successful Defense* form has been sent to the Dean. The student will then have 30 days or until the last day of classes for the term (whichever comes first) to make all corrections, show them to each of the committee members, and collect the signatures of each on the title page of the thesis. **The final, approved and signed version of the thesis MUST be electronically submitted to MEDICA by the last day of classes of the semester. Students who do not submit their Dissertation within this time limit will be required to register for the next semester at their own expense for a minimum of one hour and will receive that semester as their completion date.**

Instructions for how to turn in the final, approved and signed version of the thesis are available on the College of Graduate Studies webpage. Submission is electronic and a paper copy of the title page only, with original signatures, must be turned in to the Registrar at the time of electronic submission, along with a form granting or withholding permission for online publication of the thesis. Students may order printed copies from the online depository. The M.S. degree is not awarded until the Dean's Office confirms the submission of the final Dissertation to MEDICA.

Final Examination (Thesis Defense)

Each candidate is required to pass a general oral examination covering the major field and the thesis. This shall begin with a formal presentation open to the public with appropriate slides and shall be at least 20 minutes in length for the M.S. candidate. The examination portion of the defense is conducted by the Thesis Advisory Committee, with its Chairperson presiding and is closed except to Graduate Faculty.

The Thesis Advisory Committee will have primary responsibility for evaluating the student's research, including the written thesis and formal oral presentation, and for administering the final oral examination.

Upon completion of the defense, each committee member will fill out an ***defense rubric form*** and give it to the Major Advisor. The Major Advisor will in turn collate the evaluations into one form, discuss it with the trainee and then submit it to the College's Registrar.

Approval by the Thesis Advisory Committee, with no more than one dissenting vote, is necessary for recommendation for awarding the degree. The decision of the Thesis Advisory Committee will be indicated by their signatures on the *Certification of Successful Defense* form and forwarded to the Dean of the College of Graduate Studies. The Graduate Faculty has the authority, which it has delegated to the Dean, for final approval of the candidate for the awarding of the degree.

In the event that a student fails to pass the thesis defense, only one opportunity for re-examination shall be given, at a time determined by the Thesis Advisory Committee but not more than one year from the time of the final examination at which this decision was made. Any candidate who is granted the privilege of re-examination shall retain the status and obligations of a graduate student until the time of such re-examination.

NOTE: Diplomas are awarded three times per year, in August, December and May, but the only Graduation Ceremony for MUSC is in the Spring. Degree candidates wishing to participate in the Hooding Ceremony and or the Graduation Ceremony must complete all requirements, including submission of the final approved thesis, prior to the last day of class for the appropriate Spring Semester. The Hooding Ceremony and a Day of Celebration for the graduates takes place on the Thursday before the University Commencement on Friday. Refer to the University Academic Calendar for the dates in a given year. The *Degree Application/ Graduation Order* form should be completed the semester before the student plans to complete all requirements for their degree. The deadline for ordering regalia is the preceding January 1st.

Time Limit

All requirements for the MS in Biomedical Sciences degree should be completed within a period of **three** years following initial registration, although course credit is not nullified until six years after completion of a course. Any student who has not achieved candidacy by the end of their second year (Spring 2) will be reviewed by the MBS Program Committee for placement on academic probation, and recommendations for progress will be established.

Publication requirement

It should be the goal of every student and mentor to eventually publish the student's work, and include the student on publications to which they have made a significant contribution. However, due to the short duration of the program, there is no publication requirement for completion of the degree.

Policies regarding transition from the M.S. to the Ph.D. program after one year

MBS students ultimately wishing to pursue a Ph.D. in Biomedical Sciences may apply to the MUSC Ph.D. program in the fall of their first MBS year, to transition to the Ph.D. program starting in the fall of their second year. Applications should be submitted by January 1st through the College of Graduate Studies online application portal. In most cases, test scores and transcripts submitted for the MBS application can be moved to the Ph.D. application without charge upon request to Enrollment Management. Admission to the Ph.D. program is in no way guaranteed. Applicants in the MBS program will be subject to the same expectations and procedures as applicants from outside of MUSC. Students wishing to apply to transition to the Ph.D. program are encouraged to take several units of the Ph.D. First Year Curriculum in the fall. In general, successful applicants have performed very well in their fall graduate coursework at MUSC, have an undergraduate GPA and GRE score competitive with the rest of the Ph.D. applicant pool, and have identified a thesis mentor willing to commit to supporting them financially for their Ph.D..

MBS students who apply to the MUSC Ph.D. in Biomedical Sciences program during their first year and are granted admission for the following fall, *must* remain enrolled for a minimum of 9 credits and pay tuition as full time MBS students throughout the summer term. They shall register for research credits and any available courses of their choosing. They are excused from further MBS course requirements and will not receive an M.S. degree.

Modifications to degree requirements:

If degree requirements are modified during the period in which a student is continuously enrolled in the Master of Science in Biomedical Sciences program, the requirements in place at the time of the student's matriculation shall be the ones which apply. However, the student may apply to the MBS Program Committee to be allowed to follow updated requirements.

Required CGS Forms for M.S. (Current versions for the M.S. are available at http://academicdepartments.musc.edu/grad/curr_students/forM.S._guidelines.htm/M.S._forM.S._info.htm)

Appendix I

Program	Minimum Required Didactic Coursework (not including Research Credit Hours –course number 970)*	Required Didactic Credit Hours
Biochemistry	<p>Required: CGS 710 - Responsible Conduct of Research (1cr) fall CGS 762 – Writing for the MBS (1 cr) summer Plus 10 additional credits decided by student and mentor. Suggested electives: CGS 701G - Receptors & Signaling (2cr) fall CGS 701K - Macromolecules: Nucleic Acids(2cr) fall CGS 701L - Macromolecules: Proteins (2cr) fall CGS 701O - Chemistry of Life Sciences (2cr) fall BMB 735 - Advanced Biochemistry (3cr) spring</p>	12
Microbiology & Immunology	<p>Required: CGS 710 - Responsible Conduct of Research (1cr) fall CGS 762 – Writing for the MBS (1 cr) summer MBIM 738 - Introduction to Micro & Immuno Methods (4cr) fall MBIM 770 – M & I Seminar (4 x 1 cr) CGS 701P – Immunology (2cr) fall Plus 3 additional credits decided by student and mentor. Suggested electives: MBIM 788 – Immunobiology (3cr) spring MBIM 623 – Microbiology for Dental Students (4cr) spring Individual units of CGS 701 (2cr) fall and spring MBIM 856 – Critical Literature Review in Inflammation & Immunity (1cr) Fall/Spring CRFB 624 – Oral Immunobiology (4cr) spring MBIM 779 – Immunogenetics (2cr) spring MBIM 772 – Environmental Microbiology (3cr) spring</p>	15
Neuroscience	<p>Required: CGS 710 - Responsible Conduct of Research (1cr) fall CGS 762 – Writing for the MBS (1 cr) summer NSCS 730 – Fundamentals of Neuroscience (8cr) spring NSCS 735 – Clinical/Systems Neuroscience (5cr) fall NSCS 780 – Seminars/Journal Club (4 x 1cr) fall/spring</p>	19
Pathology	<p>Required: CGS 710 - Responsible Conduct of Research (1cr) fall CGS 762 – Writing for the MBS (1 cr) summer CGS 701G - Receptors & Signaling (2cr) fall CGS 701K - Macromolecules: Nucleic Acids(2cr) fall CGS 701L - Macromolecules: Proteins (2cr) fall CGS 701N – Regulation of Gene Expression (2cr) fall CGS 702 – Foundations in Biomedical Sciences II (6cr) spring PATH 700 – Pathology Seminar Series (1cr) fall/spring</p>	17

Program	Minimum Required Didactic Coursework (not including Research Credit Hours –course number 970)*	Required Didactic Credit Hours
Pharmacology	<p>Required: CGS 710 - Responsible Conduct of Research (1cr) fall CGS 762 – Writing for the MBS (1 cr) summer CGS 701G - Receptors & Signaling (2cr) fall CGS 701K - Macromolecules: Nucleic Acids(2cr) fall CGS 701L - Macromolecules: Proteins (2cr) fall CGS 701N – Regulation of Gene Expression (2cr) fall Plus 3 additional credits decided by student and mentor. Suggested electives: PCOL 724 – Drug Discovery & Molecular Pharmacology (3cr) PCOL 721 – Principles of Pharmacology PCOL 747– Topics in Cancer Research (3 cr) PCOL 726 – Mass Spectrometry and Proteomics (3 cr)</p>	13
Regenerative Medicine	<p>Required: CGS 710 - Responsible Conduct of Research (1cr) fall CGS 762 – Writing for the MBS (1 cr) summer Plus 10 additional credits decided by student and mentor Suggested electives: CGS 701G - Receptors & Signaling (2cr) fall CGS 701K - Macromolecules: Nucleic Acids(2cr) fall CGS 701L - Macromolecules: Proteins (2cr) fall CGS 701O - Chemistry of Life Sciences (2cr) fall</p>	12

Master in Biomedical Sciences Rotation Agreement form

Rotation start date:	Rotation end date:
Student Name:	Student Email:
Mentor Name:	Mentor Email
Student class schedule:	
Mondays	
Tuesdays	
Wednesdays	
Thursdays	
Fridays	
Brief description of rotation project	
Mentor expectations (hours in lab, lab notes, lab meeting attendance)	
Student signature	
Mentor signature	
Grad Coord signature	

Turn in copy to Laura Kasman, BSB 208F, kasmanl@musc.edu. (Copies will be sent to your Graduate Program Coordinator , mentor, and you)

M.S. Rotation Evaluation Form:

This form will be filled out by lab rotation advisors after the rotation student has completed a rotation.

Student			
Name:		Email:	
Mentor		Program (circle one)	
Name:		Biochem	M&I
		Pathology	Pharm
		Neuroscience	Regen Med
Please rate the student on the following (circle one)			
Responsible. Shows up to lab when expected. Emails or calls when unable to arrive as expected.		Satisfactory	Unsatisfactory
Works hard when in lab. Keeps clear and complete lab notes.		Satisfactory	Unsatisfactory
Understands what he/she is doing, can summarize the purpose and results of experiments		Satisfactory	Unsatisfactory
Exhibits <i>potential</i> to perform experiments independently		Satisfactory	Unsatisfactory
Shows curiosity, communicates effectively with mentor and colleagues, attentive in lab meetings		Satisfactory	Unsatisfactory
Would you take this student into your lab?		Yes	No
		Undecided	
If not, please explain.			
Mentor signature			
Grad Coord signature			

Please turn in to Laura Kasman by email (kasmanL@musc.edu) or campus mail (MSC 504). Scanned copies will be sent to everyone who has signed the form.