

# M.S. IN BIOMEDICAL SCIENCES

## Overview

Our Master of Science in Biomedical Sciences (MiBS) program is a full-time program that packs a core curriculum in biochemistry, molecular biology, cell biology and physiology, along with several optional courses in three customized tracks – Medicine, Research or Drug Discovery. Our courses are taught by the same faculty that teach our medical and graduate students and will be tailored to meet your needs. In addition, students participate in physician and clinical shadowing or directed research to prepare you for a career in the biomedical sciences.

MiBS prepares recent undergraduates for medical or graduate school or a career in the biomedical industry. Our master's degree is an ideal way to use your gap year to build credentials and experience to propel yourself to any advanced degree. Students will have access to include hands-on faculty advising and mentoring to help you do your best and submit compelling applications. Students can begin our gap year program after their spring graduation and finish in time to start medical or graduate school the following August.

## Contact Information

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## Admission Requirements

Applicants to the MiBS program should have a bachelor's degree in a biological or related discipline (e.g., psychology, chemistry, engineering, physics). Although there are no prerequisites, courses in general biology, cell/molecular biology, calculus, general physics, organic chemistry, physical chemistry and biochemistry are encouraged. Applicants can submit applications here (<http://biomed.miami.edu/apply/apply-biomedical-sciences-masters/>).

Competitive candidates will have the following:

- Excellent academic record of 3.0 GPA or above
- Competitive GRE, MCAT or DAT exam scores (not required)
- Three strong letters of recommendation
- Motivation to learn biomedical sciences
- Personal statement focused on educational interests and career goals

## Curriculum Requirements

Code	Title	Credit Hours
<b>Journal Club</b>		
MBS 600	Journal Club <sup>1</sup>	2
<b>Required Courses</b>		
MBS 680	Professional Development Workshop	1
MBS 601	Biochemistry for the Biosciences	3
MBS 602	Molecular Biology for the Biosciences	3
MBS 603	Gross Anatomy and Histology	3
MBS 604	Advanced Molecular and Cell Biology	3
MBS 605	General Physiology	2
MBS 608	Basic Pathobiology	3
<b>Laboratory Research and Physician Shadowing</b>		
MBS 631	Laboratory Research	3
MBS 632	Physician Shadowing	3
<b>Electives <sup>3</sup></b>		
MBS 606	Human Neuroscience	
MBS 607	Human Cardiovascular Physiology	
MBS 615	Structural Biology and Drug Design	
MBS 616	Basis of Mitochondrial Medicine	
MBS 617	Human Embryology	
MBS 618	Anatomy Dissection Elective	

MBS 619	Concepts in Clinical Immunobiology	
PIB 705	Biostatistics for the Biosciences <sup>2</sup>	
PIB 706	Informatics for the Biosciences <sup>2</sup>	
<b>Total Credit Hours</b>		<b>31</b>

<sup>1</sup> Students in this degree program take MBS 600 two times, at 1 credit each for a total of 2 credits.

<sup>2</sup> Students interested in taking PIB 705 and PIB 706 need additional approval from the Graduate Program Director

<sup>3</sup> Students in this degree program must choose 2-3 electives in the Spring semester. Student must have a total of at least 30 credits to graduate.

## Sample Plan of Study

Year One		Credit Hours
<b>First Semester</b>		
MBS 601	Biochemistry for the Biosciences	3
MBS 680	Professional Development Workshop	1
MBS 631	Laboratory Research	3
<b>Credit Hours</b>		<b>7</b>
<b>Second Semester</b>		
MBS 600	Journal Club	1
MBS 602	Molecular Biology for the Biosciences	3
MBS 603	Gross Anatomy and Histology	3
MBS 604	Advanced Molecular and Cell Biology	3
MBS 631	Laboratory Research	3
<b>Credit Hours</b>		<b>13</b>
<b>Third Semester</b>		
MBS 600	Journal Club	1
MBS 605	General Physiology	2
MBS 608	Basic Pathobiology	3
MBS 632	Physician Shadowing	3
Electives		2-4
<b>Credit Hours</b>		<b>11</b>
<b>Total Credit Hours</b>		<b>31</b>

## Mission

The Miller School of Medicine offers an intensive 10-month Master of Science in Biomedical Sciences (MiBS) designed to fit perfectly in your gap year.

Our courses are taught by the same faculty that teach our medical and graduate students and are tailored to meet your needs. In addition, students participate in physician and clinical shadowing and laboratory research to prepare them for a career in the biomedical sciences.

## Goals

1. Students will learn about various science disciplines such as biochemistry, molecular biology, cell biology, and physiology.
2. Students will focus in any of the three customized tracks – Medicine, Research or Drug Discovery.
3. Students will participate in physician and clinical shadowing or directed research to prepare them for a career in the biomedical sciences.

## Student Learning Outcomes

1. Students will draw from advanced biomedical knowledge within specific science disciplines to investigate fundamental processes and mechanisms of health and disease.
2. Students will be able to critically evaluate the scientific literature pertinent to the field of study.
3. Students will demonstrate research skills, including the development of sound hypotheses, design of experiments, and interpretation of results.
4. Students will apply quantitative reasoning and statistical analysis techniques in the exploration and testing of theories and hypotheses.
5. Students will demonstrate knowledge of current and emerging technologies in their respective field of study.
6. Students will demonstrate problem-solving skills in addressing specific research problems.

7. Students will apply laboratory skills such as planning of experiments, data acquisitions, data management, analysis and interpretation to a specific research problem.

**MBS 504. GEN BIOLOGIC OCEAN. 3 Credit Hours.**

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MBS 505. GEN BIOLOGIC LAB. 1 Credit Hour.**

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MBS 600. Journal Club. 1 Credit Hour.**

To develop insights into the practice of biomedical research and medical practice, MBS students will be required to attend one research seminar, journal club or grand round of their choice per week. Students will prepare a written summary of the main points discussed in each event attended, and these will be monitored by their faculty advisor.

**Components:** SEM.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MBS 601. Biochemistry for the Biosciences. 3 Credit Hours.**

MBS 601 covers Biochemistry in three parts. In Part 1, you will examine the biochemical composition and structure of the four basic types of biological macromolecules: carbohydrates, nucleic acids, proteins, and lipids. This part also introduces enzymes, and the composition and function of dietary nutrients and vitamins. In Part 2, you will study how genetic information flows from its storage as DNA sequence to its expression as functional RNA and protein molecules. In Part 3, you will learn how metabolic pathways are used to convert food molecules into energy and chemical intermediates used for biosynthesis of our own cellular materials

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**MBS 602. Molecular Biology for the Biosciences. 3 Credit Hours.**

To introduce students to the molecular basis of life, this course is organized around the “mother of all biological questions” – How does life arise from stochastic associations between molecules acting in networks? While the course is organized around origins of life, it actually presents the basic properties of living things, the composition and properties of biomolecules, and how each individual property arises through diffusion, mass action and affinity.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBS 603. Gross Anatomy and Histology. 3 Credit Hours.**

Designed to cover topics such as gross anatomy, histology, embryology, and neuroanatomy.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBS 604. Advanced Molecular and Cell Biology. 3 Credit Hours.**

Structure, function, biogenesis of cellular organelles, and the cytoskeleton including its regulation and dynamic interactions are discussed.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBS 605. General Physiology. 2 Credit Hours.**

General principles of cell physiology, chemical and physical structure of membranes, membrane transport and electrical phenomena, action potentials, muscle contraction, energy transduction, nerve impulse conduction and synaptic transmission.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 606. Human Neuroscience. 2 Credit Hours.**

Physiology of the human nervous system. Physiology of vision, taste, and smell. Mechanoreceptors, nociception and pain. Spinal reflexes, hypothalamus, and autonomic nervous system.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 607. Human Cardiovascular Physiology. 2 Credit Hours.**

Physiology of the human cardiovascular systems. Heart as a mechanical pump, electrical activity of the heart, vascular system, regulation of blood pressure and response to stress.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 608. Basic Pathobiology. 3 Credit Hours.**

This course will cover essential nomenclature, causes of disease, cell injury and adaptation, tissue regeneration and repair, and neoplasia. The pathogenesis of diseases in major organs will be presented.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 615. Structural Biology and Drug Design. 2 Credit Hours.**

This course provides an introduction to structural biology, and illustrates how understanding the relationship between structure and function of biological macromolecules drives drug discovery.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 616. Basis of Mitochondrial Medicine. 2 Credit Hours.**

Overall, the course aims to integrate basic knowledge in mitochondrial structure and function with our current understanding of the role mitochondria play in human health and disease. The first part of the course provides a core introduction to the major aspects of mitochondrial biology, including mitochondrial metabolism, genetics and biogenesis. The second part of the course focus on the role of mitochondrial and metabolic dysfunction in specific human disorders.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 617. Human Embryology. 1 Credit Hour.**

This course provides an overview of human embryology, focusing on the first 8 weeks of development beginning with fertilization. Development of the embryo is then followed from blastocyst formation through implantation in the uterus, formation of the embryonic disc, gastrulation, neurulation, and establishment of the basic body form. The focus then shifts to initial development of the major organ systems (heart, lungs, pharynx, gut and gut derivatives, kidneys and gonads, musculoskeletal system), and the course finishes with a session on teratology and parturition at the end of the fetal period.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 618. Anatomy Dissection Elective. 2 Credit Hours.**

This course is designed to provide graduate students with a dissection-based anatomy elective that covers the abdomen, pelvis and perineum. The students will be divided into two groups and will dissect every other dissection. After they finish their dissection, they will present that material to the other color group the following week who will then perform the next dissection. This will strengthen their knowledge of the area by using peer teaching. At the conclusion of the course, the students should be able to identify and discuss the anatomy of the abdomen, pelvis and perineum including the bones, muscles, organs, innervation, blood supply and functional aspects. Clinical conditions associated with the anatomy of the regions will also be assessed.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 619. Concepts in Clinical Immunobiology. 1 Credit Hour.**

Welcome to Concepts in Clinical Immunobiology, a 4½-week course designed to provide premed students with a foundational understanding of the immune system in normal immune defense and immune-mediated diseases. The course comprises weekly lectures complemented by small group collaborative learning sessions, each accommodating approximately four students, facilitated by faculty. These small group sessions will provide you the opportunity to delve into lecture concepts through real-world applications of immunobiology through mini-case studies of patients. These cases may cover a wide range of immune system-related topics, from the dynamics of overactive immunity observed in diseases like sepsis and allergies, to the role of normal immunity in diseases related to transfusion medicine and organ transplantation, as well as the complexities of compromised immunity, as seen in acquired (HIV/AIDS) and inborn immunodeficiencies. The grade is based on lecture attendance (5%), active engagement and contribution in small group sessions (20%), and a final exam that evaluates your grasp of the course material (75%).

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBS 623. INVERTEBRATE EMBRYO. 4 Credit Hours.**

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MBS 631. Laboratory Research. 1-3 Credit Hours.**

This course will consist of rotations (minimum 2-3 hours per week for each credit hour) in selected laboratories. Students will be rigorously monitored for progress by faculty advisors, and present their work at a rotation symposium at the end of the semester.

**Components:** EXP.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MBS 632. Physician Shadowing. 1-3 Credit Hours.**

This course will consist of rotations (minimum 2-3 hours per week for each credit hour) in selected shadowing clinics with UMMSM physicians. Students will be rigorously monitored for progress by faculty advisors, and present their work at a rotation symposium at the end of the semester.

**Components:** EXP.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MBS 635. Special Topics in Biomedical Sciences. 1-3 Credit Hours.**

Special work, lecture, laboratory, reading, seminar, or a combination of these as determined by advisor.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MBS 680. Professional Development Workshop. 1 Credit Hour.**

Survival Skills, Responsible Conduct of Research (RCR), Learning Skills, Lab & Animal Safety, Collaborative Institutional Training Initiative (CITI), Ethics

**Components:** WKS.

**Grading:** GRD.

**Typically Offered:** Summer.

**MBS 700. Biomedical Internship. 1-3 Credit Hours.**

Students may earn academic credit through a pre-approved internship related to biomedical sciences. Requires the creation of a learning contract between the MSOM, the students, and the internship host.

**Components:** PRA.

**Grading:** SUS.

**Typically Offered:** Fall, Spring, & Summer.