

# PROGRAM IN BIOMEDICAL SCIENCES

## Overview

Programs in Biomedical Sciences (PIBS) at the University of Miami Miller's School of Medicine (UMMSM) provides students a wide variety of research opportunities in the biological sciences across many disciplines and departments.

First-year students take a core curriculum that builds a solid foundation in the biomedical sciences. The common coursework in the first semester ranges from molecules to cells to systems of human physiology. Lectures are balanced by breakout sessions, in which faculty members discuss the primary literature with students in small groups. Students have the flexibility to select breakout sessions that match their interests. The core curriculum also offers critical learning opportunities in biostatistics, genomic and analytical tools. In the second semester, students select individual modular courses offered in our eight disciplines. These courses cover topics of specific relevance to graduate programs or research topics. Students also complete a course in Biostatistics and a workshop in Bioinformatics.

## PhD Program Selection

During their first year in the umbrella program, students complete three to four laboratory rotations in various disciplines. This opportunity allows students to explore their interests before selecting a program and dissertation mentor. Students match with mentors in specific programs and achieve program affiliation at the end of their first year in one of the following programs (for years two through five):

- Biochemistry & Molecular Biology (<http://biomed.med.miami.edu/graduate-programs/biochemistry-and-molecular-biology/>)
- Cancer Biology (<http://biomed.med.miami.edu/graduate-programs/cancer-biology/>)
- Cellular Physiology and Molecular Biophysics
- Human Genetics & Genomics (<http://biomed.med.miami.edu/graduate-programs/human-genetics-and-genomics/>)
- Microbiology & Immunology (<http://biomed.med.miami.edu/graduate-programs/microbiology-and-immunology/>)
- Molecular & Cellular Pharmacology (<http://biomed.med.miami.edu/graduate-programs/molecular-and-cellular-pharmacology/>)
- Molecular Cell & Developmental Biology (<http://biomed.med.miami.edu/graduate-programs/molecular-cell-and-developmental-biology/>)
- Neuroscience (<http://biomed.med.miami.edu/graduate-programs/neuroscience/>)

## Contact Information

Office of Graduate Studies  
Rosenstiel Medical Sciences Building, Suite 1128  
1600 NW 10th Avenue, M857  
Miami, FL 33136

[pibs@miami.edu](mailto:pibs@miami.edu)

## Admission Requirements

Please see the Office of Graduate Studies (<https://med.miami.edu/graduate-studies/doctoral-programs/first-year-program/application-process/>) website for application requirements for the Program in Biomedical Sciences (PIBS).

## Curriculum Requirements

Code	Title	Credit Hours
<b>BIOMEDICAL SCIENCES FOUNDATION</b>		<b>15-24</b>
<b>Journal Club (2 credits)</b>		
PIB 700	Journal Club <sup>1</sup>	
<b>Required Courses</b>		
PIB 701	Introduction to Biomedical Sciences (Students should take 5 credits, unless authorized by the GPD to take less.)	
PIB 702	Scientific Reasoning	
PIB 705	Biostatistics for the Biosciences	
PIB 731	Laboratory Research	
PIB 780	Research Ethics	
PIB 782	Professional Development: Skills for Success I	
PIB 783	Professional Development: Skills for Success II	

PIB 790	Grant Writing Basics for Biomedical Graduate Students (Course for students who have completed the PiBS year. Students may register in the summer following PiBS or any subsequent semester.)	
PIB 830	Doctoral Dissertation	
<b>BIOMEDICAL SCIENCES PHD PROGRAM SELECTION</b>		<b>36-45</b>
At the end of the first year, choose one of the Biomedical Sciences PhD programs below:		
<b>Biochemistry &amp; Molecular Biology</b>		
<a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/biochemistry-molecular-biology/biochemistry-and-molecular-biology-phd">https://bulletin.miami.edu/graduate-academic-programs/medicine/biochemistry-molecular-biology/biochemistry-and-molecular-biology-phd</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/biochemistry-molecular-biology/biochemistry-and-molecular-biology-phd/">https://bulletin.miami.edu/graduate-academic-programs/medicine/biochemistry-molecular-biology/biochemistry-and-molecular-biology-phd/</a> )		
<b>Cancer Biology</b>		
<a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/cancer-biology/cancer-biology-phd">https://bulletin.miami.edu/graduate-academic-programs/medicine/cancer-biology/cancer-biology-phd</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/cancer-biology/cancer-biology-phd/">https://bulletin.miami.edu/graduate-academic-programs/medicine/cancer-biology/cancer-biology-phd/</a> )		
<b>Cellular Physiology and Molecular Biophysics</b>		
<a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/physiology-biophysics/phd">https://bulletin.miami.edu/graduate-academic-programs/medicine/physiology-biophysics/phd</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/physiology-biophysics/phd/">https://bulletin.miami.edu/graduate-academic-programs/medicine/physiology-biophysics/phd/</a> )		
<b>Human Genetics &amp; Genomics</b>		
<a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/human-genetics-genomics/human-genetics-and-genomics-phd">https://bulletin.miami.edu/graduate-academic-programs/medicine/human-genetics-genomics/human-genetics-and-genomics-phd</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/human-genetics-genomics/human-genetics-and-genomics-phd/">https://bulletin.miami.edu/graduate-academic-programs/medicine/human-genetics-genomics/human-genetics-and-genomics-phd/</a> )		
<b>Microbiology &amp; Immunology</b>		
<a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/microbiology-immunology/microbiology-and-immunology-phd">https://bulletin.miami.edu/graduate-academic-programs/medicine/microbiology-immunology/microbiology-and-immunology-phd</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/microbiology-immunology/microbiology-and-immunology-phd/">https://bulletin.miami.edu/graduate-academic-programs/medicine/microbiology-immunology/microbiology-and-immunology-phd/</a> )		
<b>Molecular &amp; Cellular Pharmacology</b>		
<a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/molecular-cellular-pharmacology">https://bulletin.miami.edu/graduate-academic-programs/medicine/molecular-cellular-pharmacology</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/molecular-cellular-pharmacology/">https://bulletin.miami.edu/graduate-academic-programs/medicine/molecular-cellular-pharmacology/</a> )		
<b>Molecular Cell &amp; Developmental Biology</b>		
<a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/molecular-cell-developmental-biology">https://bulletin.miami.edu/graduate-academic-programs/medicine/molecular-cell-developmental-biology</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/molecular-cell-developmental-biology/">https://bulletin.miami.edu/graduate-academic-programs/medicine/molecular-cell-developmental-biology/</a> )		
<b>Neuroscience</b>		
<a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/neuroscience">https://bulletin.miami.edu/graduate-academic-programs/medicine/neuroscience</a> ( <a href="https://bulletin.miami.edu/graduate-academic-programs/medicine/neuroscience/">https://bulletin.miami.edu/graduate-academic-programs/medicine/neuroscience/</a> )		
<b>Total Credit Hours</b>		<b>60</b>

<sup>1</sup> Students in this degree program take PIB 700 two times, at 1 credit each for a total of 2 credits.

## Program Elective Courses

The following program courses are available to first year students in their spring semester. It is generally recommended that students only take courses in the program they wish to enter. This will put students on a timely path to graduation. Your options will be discussed in your spring course advising session.

Code	Title	Credit Hours
BMB 705	Principles of Biochemistry and Molecular Biology	4
BMB 709	Advanced Biochemistry and Molecular Biology	3
BMB 715	Structural Biology and Applications to Drug Discovery	2
BMB 719	Fundamentals of Epigenetics	3
CAB 710	Cancer Biochemistry and Molecular Biology	3
HGG 630	Variation and Disease	2
HGG 640	Family Studies and Genetic Analysis	2
MCP 704	Mechanisms of Drug Action	3
MCP 743	Introductory Python Programming for Bioscientists	3
MCP 752	Systems Biology and Approaches in Pharmacology	3
MCP 753	Computational Pharmacology and Fundamentals of Drug Design	2
MDB 751	Advanced Cell Biology Approaches to Molecular Medicine	3

MDB 752	Current Topics in Mammalian Development	3
MDB 753	Histology	1
MIC 623	Mechanisms of Microbial Virulence	2
MIC 728	Principles of Immunology	3
NEU 721	Principles of Membrane Physiology and Biophysics I	2
NEU 722	Principles of Membrane Physiology and Biophysics II	2
NEU 760	Neuroscience 1A (Molecular and Cellular Neuroscience)	2
NEU 761	Neuroscience 1B (Developmental Neuroscience)	2
PHS 741	Principles of Membrane Physiology and Biophysics I	2
PHS 742	Principles of Membrane Physiology and Biophysics II	2
PHS 610	Cell Physiology Biophysics	2
PHS 611	Neurophysiology	2
PHS 612	Systemic Physiology	4

## Plan of Study

Students enrolled in the first year program complete the biomedical sciences foundation coursework in the first year and then complete the curricula for years two through five based on the selected PhD program (see the program links above for specific coursework for each PhD program).

Year One		Credit Hours
<b>Fall</b>		
PIB 701	Introduction to Biomedical Sciences	5
PIB 702	Scientific Reasoning	1-3
PIB 731	Laboratory Research (1 credit per lab rotation)	2
PIB 700	Journal Club	1
PIB 780	Research Ethics	1
PIB 782	Professional Development: Skills for Success I	1
<b>Credit Hours</b>		<b>13</b>
<b>Spring</b>		
PIB 700	Journal Club	1
PIB 705	Biostatistics for the Biosciences	3
PIB 731	Laboratory Research (1 credit per lab rotation)	2
PIB 783	Professional Development: Skills for Success II	1
Program Electives		
<b>Credit Hours</b>		<b>7</b>
<b>Summer</b>		
PIB 830	Doctoral Dissertation	1
<b>Credit Hours</b>		<b>1</b>
<b>Summer II</b>		
PIB 830	Doctoral Dissertation <small>Early Start</small>	1
<b>Credit Hours</b>		<b>1</b>
<b>Year Two</b>		
<b>Fall</b>		
Complete Selected Biomedical Sciences PhD Program Coursework/Dissertation Research		8
<b>Credit Hours</b>		<b>8</b>
<b>Spring</b>		
Complete Selected Biomedical Sciences PhD Program Coursework/Dissertation Research		8
<b>Credit Hours</b>		<b>8</b>
<b>Summer</b>		
Complete Selected Biomedical Sciences PhD Program Dissertation Research		1
<b>Credit Hours</b>		<b>1</b>

<b>Year Three</b>	
<b>Fall</b>	
Complete Selected Biomedical Sciences PhD Program Coursework/Dissertation Research	4
<b>Credit Hours</b>	<b>4</b>
<b>Spring</b>	
Complete Selected Biomedical Sciences PhD Program Coursework/Dissertation Research	4
<b>Credit Hours</b>	<b>4</b>
<b>Summer</b>	
Complete Selected Biomedical Sciences PhD Program Dissertation Research	1
<b>Credit Hours</b>	<b>1</b>
<b>Year Four</b>	
<b>Fall</b>	
Complete Selected Biomedical Sciences PhD Program Dissertation Research	3
<b>Credit Hours</b>	<b>3</b>
<b>Spring</b>	
Complete Selected Biomedical Sciences PhD Program Dissertation Research	3
<b>Credit Hours</b>	<b>3</b>
<b>Summer</b>	
Complete Selected Biomedical Sciences PhD Program Dissertation Research	1
<b>Credit Hours</b>	<b>1</b>
<b>Year Five</b>	
<b>Fall</b>	
Complete Selected Biomedical Sciences PhD Program Dissertation Research	2
<b>Credit Hours</b>	<b>2</b>
<b>Spring</b>	
Complete Selected Biomedical Sciences PhD Program Dissertation Research	2
<b>Credit Hours</b>	<b>2</b>
<b>Summer</b>	
Complete Selected Biomedical Sciences PhD Program Dissertation Research	1
<b>Credit Hours</b>	<b>1</b>
<b>Total Credit Hours</b>	<b>60</b>

**PIB 700. Journal Club. 1 Credit Hour.**

All PIBS students are required to attend one journal club or seminar each week.

**Components:** SEM.

**Grading:** SUS.

**Typically Offered:** Fall & Spring.

**PIB 701. Introduction to Biomedical Sciences. 1-5 Credit Hours.**

This course surveys fundamentals of molecular and cellular biology that underly all modern biomedical research. Lectures are organized into modules that cover Proteins and DNA, Gene Expression, Signaling and Membranes, Cells, and Development. A final module covers immunology, organ systems, and genetics. Experimental techniques are emphasized throughout, with the first week of the course devoted to a bootcamp on common biomedical methods.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**PIB 702. Scientific Reasoning. 1-3 Credit Hours.**

This course teaches scientific reasoning by critical reading of primary research papers in a small-group setting. Multiple small groups are offered every week and students can choose from different topics related to lectures in the companion PIB 701 course. Research papers are discussed in two 1-hour sessions each week.

**Components:** DIS.

**Grading:** GRD.

**Typically Offered:** Fall.

**PIB 703. Methods in Biomedical Sciences: Experimental Techniques Bootcamp. 1 Credit Hour.**

This course is a companion to PIB 701, which surveys fundamentals of molecular and cellular biology that underlie all modern biomedical research. PIB 703 is a week-long intensive course devoted to common biomedical methods; it immediately precedes PIB 701.

**Components:** WKS.

**Grading:** SUS.

**Typically Offered:** Fall.

**PIB 705. Biostatistics for the Biosciences. 3 Credit Hours.**

This is an introductory course that will cover the basics of applied statistics. The course will emphasize a practical understanding of statistical concepts: the goal is to prepare you to be able to properly analyze and interpret data from your research, not to turn you into a statistician. As such, the structure of the course is designed to give you lots of hands-on experience with data and statistical software, and to teach you how to proceed when you encounter novel problems in the future (e.g., data that you're not quite sure how to analyze). An overall goal of the course is to prepare you to be able to intelligently assess the statistics commonly encountered in journal articles within your field and provide you with the fundamental skills required for more advanced statistical methods when you later encounter the need.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**PIB 706. Informatics for the Biosciences. 3 Credit Hours.**

PIB 706 is designed to teach problem solving using the Python programming language. No prior programming knowledge is needed. Students will learn to write their own original Python programs to parse, manipulate, and analyze big data sets containing genomic, proteomic, and structural information. As the course progresses, students will be encouraged to apply their emerging programming knowledge to tackle scientific problems of their interest. The course culminates with each student designing a final project related to their research. This is a hands-on course with in-class interactive programming. Therefore, students are required to have their own Mac or PC laptop in good working condition for every class—no exceptions.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**PIB 707. Survey of Data Science for Bioinformatics. 3 Credit Hours.**

This survey course on data science for bioinformatics aims to introduce students to a variety of data science tools, libraries, and packages available for bioinformatics applications. Bioinformatics is the science of collecting, analyzing, and interpretation of complex biological data such as sequencing and imaging. Data science is the study of data to extract meaningful insights by means of statistics and machine learning to extract data dependencies and develop predictive models. This survey course engages students through problem-based learning strategies in application of data science tools for bioinformatics. Through this course, students will be exposed to computing architectures covering both personal and supercomputing environments and Python-based hands-on learning through programming and data analytics.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Summer.

**PIB 710. Internship in Biomedical Sciences. 1-9 Credit Hours.**

The purpose of this internship program is to provide an opportunity for graduate students to obtain experience in a broader set of careers for PhD graduates and gain professional competence in the field of biomedical sciences.

**Components:** EXP.

**Grading:** SUS.

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

**PIB 731. Laboratory Research. 1-6 Credit Hours.**

Laboratory rotations familiarize students with a variety of modern techniques in biomedicine and potential mentors for their dissertation projects. One credit is awarded per rotation.

**Components:** LAB.

**Grading:** GRD.

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

**PIB 780. Research Ethics. 1 Credit Hour.**

The NIH Guide for Grants and Contracts stipulates that Institutions receiving support for National Research Service Award Training Grants are required to develop a program in the principles of scientific integrity. This program should be an integral part of the proposed training effort.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**PIB 782. Professional Development: Skills for Success I. 1 Credit Hour.**

This workshop will teach students the basics on how to: manage your career, choose a rotation lab / mentor, read a scientific paper, write a lab report and present in the journal club and lab meetings.

**Components:** LEC.

**Grading:** SUS.

**Typically Offered:** Fall.

**PIB 783. Professional Development: Skills for Success II. 1 Credit Hour.**

This workshop will teach students the basics on how to: write a fellowship and scientific paper as well as the proper and ethical handling of research data.

**Components:** LEC.

**Grading:** SUS.

**Typically Offered:** Spring.

**PIB 784. Practical Graduate Teaching. 1 Credit Hour.**

Senior graduate students have the opportunity to participate in Graduate School teaching by evaluating presentations, teaching in small groups, and mentoring first-year graduate students in the Program in Biomedical Sciences. The overarching goal is to prepare future academicians in the complex process of training accomplished, well-rounded scientists. The activities required from the students would be: Participate in the mentoring program; read and evaluate abstracts of PIBS student rotations; participate of PIBS rotation presentations, ask questions; provide feedback of rotation presentations (abstracts and oral) to PIBS students within small groups; and provide mentoring to PIBS students in PIB701 topics.

Prerequisite: PIB 701.

**Components:** FLD.

**Grading:** SUS.

**Typically Offered:** Fall & Spring.

**PIB 785. PIBS Bioinformatics Workshop. 1 Credit Hour.**

The aim of this workshop is to introduce graduate students to basic bioinformatics data retrieval and analysis as relevant to bio-medical research.

The sessions will include discussion on focused topics and hands-on, project-based exercises. Only publicly available databases and web-tools will be used, no programming will be taught.

**Components:** WKS.

**Grading:** SUS.

**Typically Offered:** Summer.

**PIB 790. Grant Writing Basics for Biomedical Graduate Students. 1 Credit Hour.**

This course will provide biomedical graduate students with knowledge on how to find grant opportunities, plan for a grant submission, and write specific components of the grant application. Emphasis will be placed on F30/F31 grant submissions and how to write a training plan, selection of the sponsor and institution, training in RCR and facilities and other resources. This course is meant to complement the Introductory Writing Course offered by the Miami CTSI program and is not designed to provide in depth scientific assistance on the Specific Aims and Research Strategy sections of the proposal.

**Components:** WKS.

**Grading:** SUS.

**Typically Offered:** Fall & Summer.

**PIB 791. Introduction to Computing and Data Science Environments for Bioinformatics. 1 Credit Hour.**

This course is aimed to introduce you to computing capabilities and data science tools applicable to applications in bioinformatics. This one-credit hour course should assist you in knowing the tools and computing strategies across both worlds and help you make informed decisions on your career goals. This course is divided into four modules and will be engaged for a minimum of 15 contact hours. In first module, students are introduced to an overview of computing, data analytics, and other tools such as Jupyter Notebooks, and programming in python for data processing and analytics with specific examples drawn from sequencing and bioinformatics. The second module devotes a discussion on different types of computing environments accessible to you on campus, in the cloud, and learning on ways to access them for your application specific needs. In this module we will know how to use Triton/Pegasus on campus and google/IBM cloud project. In the third module, students will work with pipelines and machine learning tools for data analytics. At the end of this module, students will know how to load, process, and analyze data for outliers using python tools and explore machine learning algorithms. In the last module, students will be required to pick problems from a stack and grouped to discuss and propose what strategies they would apply to advance knowledge in the challenge problems. Each student will submit a report on their experiences and lessons learned.

**Components:** LEC.

**Grading:** SUS.

**Typically Offered:** Spring.

**PIB 792. Data Science for Bioinformatics. 1 Credit Hour.**

This course provides an extended opportunity to upskill students interested in interdisciplinary areas of data science and bioinformatics. This week-long course is divided into three modules. During the first module, students are introduced to python programming, pipelines, and their applications in bioinformatics. The second module devotes efforts in understanding ways to design and prototype pipelines based on the sequencing datasets and questions to be analyzed. This includes a discussion on relevant machine learning algorithms. Finally, during the third modules students will be introduced to various computing architectures for scalable sequencing applications. Successful completion of this course will help students in better understanding the advanced computing and analytics tools and their gainful application in bioinformatics sequencing applications.

**Components:** LEC.

**Grading:** SUS.

**Typically Offered:** Summer.

**PIB 830. Doctoral Dissertation. 1-12 Credit Hours.**

Required for all PhD candidates. First-year students generally take one credit of doctoral dissertation in their first summer semester then continue in program specific dissertation credit through graduation.

**Components:** THI.

**Grading:** SUS.

**Typically Offered:** Summer.