PH.D. IN CELLULAR PHYSIOLOGY AND MOLECULAR BIOPHYSICS

Program Overview

Cellular Physiology and Molecular Biophysics is focused on how human organism function by applying principles of physics to the underlying molecules and cells. The training and research emphasis in the Graduate Program in Cellular Physiology and Molecular Biophysics at the University of Miami School of Medicine is directed at determining the molecular mechanisms underlying physiological functions, such as how does the heartbeat, how does the brain work, and how do we see, smell, and taste using biophysical techniques and analyses. More specifically, research facilities and guidance for graduate work are available in developmental neurobiology, sensory receptor mechanisms, axonal electrophysiology, ionic mechanism of the nerve impulse ,electrophysiological and molecular aspects of synaptic and neuromuscular transmission, mechanisms of ion channel gating, selectivity, and conductance, metabolic aspects of nervous function, molecular neuroscience, neuroimmunology, protein structure-function studies, molecular recognition, ligand-receptor interactions, axonal growth, neurotrophic factors, cytokines, gene targeting, neuronal apoptosis, nerve regeneration, molecular adhesion, and regulation of muscle contraction.

The Graduate Program in Cellular Physiology and Molecular Biophysics trains its students to use and develop state-of-the-art biophysical techniques that address fundamental questions related to molecular and cellular physiology and biophysics and developmental and molecular neuroscience. In addition, the students receive training in related biological disciplines and in systemic physiology to obtain a broad viewpoint. This training prepares the students for future careers in research and teaching in academic institutions and for careers in industry.

Contact Information

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Admission Requirements

Applicants to biomedical programs should have a bachelor degree in a biological or related discipline (e.g., psychology, chemistry, engineering, physics). Although there are no prerequisite requirements, courses in general biology, cell/molecular biology, calculus, general physics, organic chemistry, physical chemistry, and biochemistry are encouraged. Applications are generally accepted from September to December for fall entry only. Select applicants will be offered an interview.

COMPETITIVE CANDIDATES WILL HAVE THE FOLLOWING:

- Excellent academic record
- Research experience in a laboratory setting
- Publications of abstract and / or papers
- Co-authorship in a peer-reviewed journal is recommended
- Strong letters of recommendation from research scientists who know the candidate well
- Motivation to pursue state-of-the-art biomedical research

APPLICANTS MUST SUBMIT THE FOLLOWING:

- Online Application
- Application Fee
- Official Academic Transcripts
- English Proficiency Exam (non-native speakers)
- Statement of Purpose
- Resume / CV

Full application instructions can be found here (http://biomed.med.miami.edu/apply/).

During the first year, the students choose several laboratories in which to do brief, introductory research projects (rotations). After the student's selection of a faculty mentor the main emphasis of training shifts to the design and proposal of a dissertation research project, and, with its approval, laboratory research. Students report periodically on their research in discussions with other students and the faculty.

Since the Department aims to prepare its graduates for careers in research and teaching, all students in the Department are expected to participate in teaching; these teaching activities typically require no more than 1-2 weeks per year.

Curriculum Requirements

Code	Title	Credit Hours
Biomedical Science Core		
PIB 700 [1]		2
PIB 700	Journal Club	
PIB 701	Introduction to Biomedical Sciences	5
PIB 702	Scientific Reasoning	3
PIB 705	Biostatistics for the Biosciences	3
PIB 731	Laboratory Research	2
PIB 780	Research Ethics	1
PIB 782	Professional Development: Skills for Success I	1
PIB 783	Professional Development: Skills for Success II	1
PIB 785	PIBS Bioinformatics Workshop	1
PIB 830	Doctoral Dissertation	1
Physiology Required Courses		
PHS 610	Cell Physiology Biophysics	2
PHS 611	Neurophysiology	2
PHS 612	Systemic Physiology	4
PHS 700 [2]		4
PHS 700	Research Seminar in Membrane Biophysics and Neurobiology	
PHS 741	Principles of Membrane Physiology and Biophysics I	2
PHS 742	Principles of Membrane Physiology and Biophysics II	2
Research Credits		**26**
PHS 830	Doctoral Dissertation	-
PHS 840	Doctoral Dissertation- Post Candidacy	-
Total Credit Hours		**62**

1 Students in this program take PIB 700 twice for a total of 2 credits. Please see the Plan of Study for more information.
2 Students in this program take PHS 700 four times for a total of 4 credits. Please see the Plan of Study for more information.

Program Plan

The Department of Cellular Physiology and Molecular Biophysics' PhD program trains highly qualified students for successful careers in research, teaching and industry. A high faculty to student ratio assures that each student receives individualized help from the faculty together with access to the latest scientific instrumentation.

Student training is enhanced by research seminars and student-oriented discussions presented by world-renowned visiting scientists, as well as by participation in research seminars and research discussion groups. We seek to provide a congenial and supportive environment in which each student develops to the fullest thier abilities to reason critically, design and conduct incisive experiments, and communicate research results effectively in both written and oral formats. Our faculty's wide collective experience as successful researchers, teachers, journal editors, and peer reviewers is available to help graduates prepare for and attain research and teaching positions in academia and industry.

Please note that the following is only a sample curriculum plan. Current students must discuss their plan with their program director to make adjustments as needed. It is the student's responsibility to contact the program to verify the information.

Year One		
Fall		**Credit Hours**
PIB 700	Journal Club	1
PIB 701	Introduction to Biomedical Sciences	5
PIB 702	Scientific Reasoning	3
PIB 731	Laboratory Research	1-2
PIB 780	Research Ethics	1
PIB 782	Professional Development: Skills for Success I	1
	Credit Hours	**12**
Spring		
PIB 700	Journal Club	1
PIB 731	Laboratory Research	1-2
PIB 783	Professional Development: Skills for Success II	1
PHS 610	Cell Physiology Biophysics	2
PHS 611	Neurophysiology	2
PHS 612	Systemic Physiology	4
PHS 741	Principles of Membrane Physiology and Biophysics I	3
PHS 742	Principles of Membrane Physiology and Biophysics II	3
PIB 705	Biostatistics for the Biosciences	3
	Credit Hours	**20**
Summer		
PIB 830	Doctoral Dissertation	1-12
	Credit Hours	**1**
Year Two		
Fall		
PHS 700	Research Seminar in Membrane Biophysics and Neurobiology	1
PHS 830	Doctoral Dissertation	3
	Credit Hours	**4**
Spring		
PHS 700	Research Seminar in Membrane Biophysics and Neurobiology	1
PHS 830	Doctoral Dissertation	3
	Credit Hours	**4**
Summer		
PIB 830	Doctoral Dissertation	1
	Credit Hours	**1**
Year Three		
Fall		
PHS 700	Research Seminar in Membrane Biophysics and Neurobiology	1
PHS 840	Doctoral Dissertation- Post Candidacy	3
	Credit Hours	**4**
Spring		
PHS 700	Research Seminar in Membrane Biophysics and Neurobiology	1
PHS 840	Doctoral Dissertation- Post Candidacy	3
	Credit Hours	**4**
Summer		
PHS 840	Doctoral Dissertation- Post Candidacy	1
	Credit Hours	**1**
Year Four		
Fall		
PHS 840	Doctoral Dissertation- Post Candidacy	3
	Credit Hours	**3**

Spring		
PHS 840	Doctoral Dissertation- Post Candidacy	3
	Credit Hours	**3**
Summer		
PHS 840	Doctoral Dissertation- Post Candidacy	1
	Credit Hours	**1**
Year Five		
Fall		
PHS 840	Doctoral Dissertation- Post Candidacy	3
	Credit Hours	**3**
Spring		
PHS 840	Doctoral Dissertation- Post Candidacy	3
	Credit Hours	**3**
Summer		
PHS 840	Doctoral Dissertation- Post Candidacy	1
	Credit Hours	**1**
	Total Credit Hours	**65**

Mission

The Physiology & Biophysics Ph.D. program offers training in physiological and biophysical research and education to students seeking a Ph.D. degree. The mission of the program is to provide to our students 1) the knowledge of the relevant literature in molecular and cellular physiology, the ability to formulate hypotheses about physiological functions in humans and animal models under healthy and disease states, to critically evaluate data and draw the appropriate conclusions from the data, and the ability to present hypotheses and data in written and oral presentations, 2) training in different biophysical techniques to have the technical ability to conduct experiments to study diseases at the molecular and cellular level, to have the quantitative and computational knowledge to analyze the data, and to use the appropriate statistical methods to evaluate the data.

Student Learning Outcomes

- Students will demonstrate an overall knowledge and understanding of the core concepts in Physiology and Biophysics, including the essential skills to conduct research in Physiology and Biophysics.
- Students will demonstrate critical thinking skills, the capability to develop hypotheses, and the ability to evaluate hypotheses, paying attention to responsible conduct of research as appropriate.
- Students will demonstrate the ability to write effective scientific reports and to present scientific results orally.

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 late 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.

PHS 610. Cell Physiology Biophysics. 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: Fall.

PHS 611. Neurophysiology. 2 Credit Hours.
Physiology of the mammalian nervous system. Course is intensive, adapted to the schedule of the medical curriculum and comprising roughly five hours of lecture and four hours of conference weekly for five to six weeks. A lecture course coordinated with neuroanatomy.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

PHS 612. Systemic Physiology. 4 Credit Hours.
Physiology of the mammalian cardiovascular, respiratory, renal, digestive, endocrine, and reproductive systems. Course is intensive and adapted to the schedule of the medical curriculum, occupying the equivalent of about two days a week for most of semester. Lecture and laboratory are included.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

PHS 669. Nerve and Synapse. 2 Credit Hours.
An advanced seminar course in the basic mechanisms underlying the propagated nerve impulse and synaptic transmission.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

PHS 700. Research Seminar in Membrane Biophysics and Neurobiology. 1 Credit Hour.
The student may be required to present a short talk on a research area of interest. All students in the Department of Physiology and Biophysics are required to register for this seminar. For other students, permission of the Departmental Graduate Studies Committee is required.
Components: SEM.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

PHS 731. Special Work. 1-5 Credit Hours.
Special work, lecture, laboratory, reading, seminar, or a combination of these as determined by advisor in accordance with student's interest.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

PHS 741. Principles of Membrane Physiology and Biophysics I. 3 Credit Hours.
Course discusses chemical and physical structure of membranes, model systems, permeability and transport, membrane potential, ionic channels, excitability in nerve and muscle, ionophores, active transport, and membrane receptors. Identical with MCP 641.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

PHS 742. Principles of Membrane Physiology and Biophysics II. 3 Credit Hours.
Course topics include osmosis and cell volume, tracer analysis of permeability and compartmentation, theory of channels and carriers, cable properties, Hodgkin-Huxley formalism, Na, K, and Ca ion channels, regulation of cellular Na, Ca activities, single-channel analysis, chemical synapses, membrane receptors, cell junctions, excitation and E-C coupling in muscle. Identical with MCP 642.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

PHS 830. Doctoral Dissertation. 1-12 Credit Hours.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 24. Not more than 12 hours of PHS 730 may be taken in a regular semester, nor more than six in a summer session. Where a student has passed his/her (a) qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

PHS 840. Doctoral Dissertation- Post Candidacy. 1-12 Credit Hours.
Required for all PhD candidates. The student will enroll for credits as determined by the Office of Graduate and Postdoctoral Studies.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

PHS 850. Research in Residence. 1 Credit Hour.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.
Components: THI.
Grading: SUS.
Typically Offered: Offered by Announcement Only.