

# PHYSIOLOGY AND BIOPHYSICS, MASTER OF SCIENCE (M.S.)

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## Program goal

The master's program in physiology and biophysics is designed to provide students with the skills required to advance to positions as physiology and bioscience researchers and trainers in a broad spectrum of positions. The structure of the program provides a framework for the progressive development of a mastery of the current state of the subject matter of physiology and bioscience, as well as an ability to synthesize this information and apply this foundation to the identification of key areas of investigation and experimentation in bioscience. The program relates the above framework to the development of the ability to design, implement and interpret experimental approaches which address the questions identified. In addition, students will develop skills in the various means of communicating both the core of bioscience knowledge and the expression of experimental design, results and interpretation to a variety of potential audiences.

## Student learning outcomes

1. Problem-solving and analytical skills: Degree candidates will demonstrate an appropriate level of skill to identify and address scientific questions and utilize appropriate analytical methods and tools.
  - a. Problem-solving skills include the ability to: (1) define and state the hypotheses to be tested and their significance; (2) execute experimental and analytical methods to address the research questions; and (3) appropriately maintain complete records of experimental protocols, experimental data and working results of data analysis in order to document the accuracy and reproducibility of the studies and scientific publications.
  - b. Analytical skills include the ability to: (1) interpret information and quantitative data relevant to studies and apply appropriate statistical tests to ensure data are robust; (2) connect rationales to experimental approaches; (3) draw reasonable conclusions from the evidence obtained; and (4) identify limitations in the experimental design and interpretation.
2. General knowledge of sciences and integration skills: Students will demonstrate an appropriate level of knowledge in their individual area of scholarship and related disciplines, including an appropriate familiarity with and understanding of the relevant research literature.
3. Communication skills: Degree candidates will demonstrate that an appropriate level of oral, written and visual communication skills have been acquired.
  - a. Oral communication skills include selection of content, organization and logical flow of ideas, and development of clear and professional presentations using appropriate language and incorporating appropriate visual aids.
  - b. Written communication skills include an appropriate use of grammar, syntax, spelling and vocabulary to effectively present written information in scientific style, including the use of figures, tables and citations.

## VCU Graduate Bulletin, VCU Graduate School and general academic policies and regulations for all graduate students in all graduate programs

The VCU Graduate Bulletin website documents the official admission and academic rules and regulations that govern graduate education for all graduate programs at the university. These policies are established by the graduate faculty of the university through their elected representatives to the University Graduate Council.

It is the responsibility of all graduate students, both on- and off-campus, to be familiar with the VCU Graduate Bulletin as well as the Graduate School website (<http://www.graduate.vcu.edu/>) and academic regulations in individual school and department publications and on program websites. However, in all cases, the official policies and procedures of the University Graduate Council, as published on the VCU Graduate Bulletin and Graduate School websites, take precedence over individual program policies and guidelines.

**Visit the academic regulations section** for additional information on academic regulations for graduate students. (<http://bulletin.vcu.edu/academic-regs/>)

## Degree candidacy requirements

A graduate student admitted to a program or concentration requiring a final research project, work of art, thesis or dissertation, must qualify for continuing master's or doctoral status according to the degree candidacy requirements of the student's graduate program. Admission to degree candidacy, if applicable, is a formal statement by the graduate student's faculty regarding the student's academic achievements and the student's readiness to proceed to the final research phase of the degree program.

Graduate students and program directors should refer to the following degree candidacy policy as published in the VCU Graduate Bulletin for complete information and instructions.

**Visit the academic regulations section** for additional information on degree candidacy requirements. (<http://bulletin.vcu.edu/academic-regs/grad/candidacy/>)

## Graduation requirements

As graduate students approach the end of their academic programs and the final semester of matriculation, they must make formal application to graduate. No degrees will be conferred until the application to graduate has been finalized.

Graduate students and program directors should refer to the following graduation requirements as published in the Graduate Bulletin for a complete list of instructions and a graduation checklist.

**Visit the academic regulations section** for additional information on graduation requirements. (<http://bulletin.vcu.edu/academic-regs/grad/graduation-info/>)

## Other information

### School of Medicine graduate program policies

The School of Medicine provides policies applicable to all programs administratively housed in the school. Information on **master's programs** is available elsewhere in this chapter of the Graduate Bulletin.

Apply online today. (<https://www.vcu.edu/admissions/apply/graduate/>)

## Admission requirements

Degree:	Semester(s) of entry:	Deadline dates:	Test requirements:
M.S.	Fall (preferred)	Jun 1	GRE, MCAT or DAT
	Summer	Apr 1	

In addition to the general admission requirements of the VCU Graduate School (<http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements/>), successful applicants will typically have the following credentials:

1. Baccalaureate degree or its equivalent at the time of enrollment with a minimum overall GPA of 3.0
2. GRE scores of at least 153 on verbal, 155 on quantitative, 4.0 on analytical writing components. GRE requirements for international students may vary. For students not taking the GRE, MCAT scores of at least 501 or DAT scores of at least 19.
3. Test of English as a Foreign Language examination with a minimum score of 100 (IBT), 250 (CBT) or 600 (PBT) or 6.5 on the IELTS for foreign applicants who do not use English as their native language

Although there are no absolute course requirements for admission, fundamental knowledge of general and organic chemistry and biology are considered necessary to pursue advanced studies, and course work in physics, molecular and cellular biology and calculus are desirable. Previous research experience is also desirable.

A personal statement describing the applicant's research experience and interests, as well as letters of reference from previous supervisors, are helpful in determining an applicant's suitability for this curriculum. Official transcripts of all graduate and undergraduate records must be mailed from the college or university registrar.

## Basic science, research-intensive, non-thesis curriculum for medical students

Individuals who are participants in medical training (the Doctor of Medicine program) at VCU may be eligible for enrollment in a research-intensive, non-thesis graduate curriculum. This basic science option builds on the core of disciplinary material embedded in the first two years of training in the medical school curriculum. Additional exposure is provided to specialized areas in basic science disciplines in concert with an intensive research experience leading to the preparation of a report in the form of a manuscript suitable for publication. The program is designed to be completed within 12 to 15 months. Subject matter related to the core material and/or suitable elective courses taken in the didactic phase of medical training correspond to a minimum of the equivalent of 24 graduate credit hours. The equivalent of 12 credit hours may be applied to the M.S. degree program in which the student is enrolled in accordance with Graduate School policy. Medical students interested in the basic science option should contact the M.S. graduate program director for additional information.

## Degree requirements

The Department of Physiology and Biophysics offers courses of study leading to the Master of Science and the Doctor of Philosophy. A combined M.D.-Ph.D. degree program is also available through this department and the School of Medicine. It is generally recommended that students intending to pursue careers as professional physiologists

should attempt to earn the Ph.D. Work done in partial or complete fulfillment of the requirements for the master's degree may be applied toward the Ph.D. provided that it is of adequate quality.

Graduate study in the Department of Physiology and Biophysics in the School of Medicine is a highly individualized undertaking and required course work represents only one component. Each student's program is tailored to meet their particular interests, with the primary emphasis on developing research and scholarship skills.

The M.S. degree program includes a first year comprising mainly didactic course work and a second year largely devoted to the completion of an independent research project under the guidance and in the laboratory of a chosen adviser. Many applicants who are admitted have successfully completed VCU's Certificate in Pre-medical Graduate Health Sciences program. A number of the certificate program's courses overlap with the first-year didactic requirements or electives and can satisfy those requirements; this allows students to start their M.S. training and research in the summer following completion of the certificate program. Additional information may be found on the department's website (<https://physiology.vcu.edu/education/>) or applicants may contact the graduate program director.

In addition to successfully competing required course work and electives, students are required to prepare a thesis based on their laboratory research and successfully present and defend their thesis in an oral defense.

In addition to the general VCU Graduate School graduation requirements (<http://bulletin.vcu.edu/academic-regs/grad/graduation-info/>), students must complete a minimum of 30 graduate credit hours, including directed research, to earn an M.S. in Physiology and Biophysics.

## Teaching experience

M.S. students may have the opportunity to acquire teaching experience and financial support by serving as teaching assistants for PHIZ 206 for undergraduates. Contact the program coordinator or graduate program director in advance of the beginning of classes for additional information.

## Course requirements

Course	Title	Hours
<b>Required core courses</b>		
BIOC 503	Biochemistry, Cell and Molecular Biology	5
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IBMS 600	Laboratory Safety	1
PHIS 501	Mammalian Physiology	5
PHIS 650	Critical Thinking in Physiology	1
PHIS 690	Physiology Research Seminar (one-credit course taken twice)	2
<b>Required additional courses</b>		
OVPR 601	Scientific Integrity	1
or OVPR 602	Responsible Scientific Conduct	
or OVPR 603	Responsible Conduct of Research	

**Elective courses**  
Select six credits from the following or as recommended by the graduate advisory committee and approved by the graduate program director.

IBMS 635	Cellular Signalling	
PHIS 512	Cardiac Function in Health and Disease	
PHIS 604	Cell Physiology: Cardiovascular and Respiratory	
PHIS 606	Molecular Basis for Disease	
PHIS 607	Cell Physiology: GI and Endocrine	
PHIS 612	Cardiovascular Physiology	
PHIS 615	Signal Detection in Sensory Systems	
PHIS/PHTX 620	Ion Channels in Membranes	
<b>Thesis research</b>		
PHIS 697	Directed Research in Physiology (variable credit course; required each semester)	4
Total Hours		30

The minimum total of graduate credit hours required for this degree is 30.

## Typical plan of study

Many students often end up taking more than the minimum number of hours required for a degree program. The total number of hours may vary depending upon the program, nature of research being conducted by a study or in the enrollment or funding status of the student. Students should refer to their program websites and talk with their graduate program directors or advisers for information about typical plans of study and registration requirements.

### Contact

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### Additional contacts

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**Program website:** [physiology.vcu.edu](http://physiology.vcu.edu) (<http://physiology.vcu.edu>)