BIOCHEMISTRY, DOCTOR OF PHILOSOPHY (PH.D.)

Program goal

The Ph.D. program in biochemistry prepares students for research-oriented careers as independent scientists in academia, government and biotechnology. The core of this degree program is an original independent research project under the supervision of a faculty adviser. The Department of Biochemistry and Molecular Biology has research efforts of international stature in several areas, including cellular and molecular signaling, tumor biology, structural biology, eukaryotic molecular biology, lipid and membrane biochemistry and molecular genetics, using state-of-the-art approaches in enzymology, genomics, proteomics and lipidomics.

While emphasizing independent research in biochemistry and molecular biology and training in the responsible conduct of research, the program also provides a background of courses designed to match the needs and interests of each student. The program is designed to provide students with the skills required to advance to positions as bioscience researchers/trainers in a broad spectrum of positions. The program provides a framework for the progressive development of a mastery of the current state of the subject matter of biochemistry, cell and molecular biology, 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, the program 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. Oral communication skills: The candidate will demonstrate the achievement of an appropriate level of oral communication skills with respect to the content, organization, logical flow, presentation and appropriate use of language incorporating the use of visual aids.
2. Written communication skills: The candidate will demonstrate the achievement of an appropriate level of written communication skill with respect to grammar, syntax, spelling and use of vocabulary to effectively present information including the use of figures, tables and citations.
3. Experimental design: The candidate will demonstrate the achievement of an appropriate level of competence in the ability to appraise, modify and/or create, and implement experimental protocols and to design and develop experiments.
4. Problem-solving skills: The candidate will demonstrate an appropriate level of skill in the identification and selection of meaningful problems to be addressed in bioscience research, including the ability to defend said identifications and to design and develop appropriate methods to solve said problems.
5. General knowledge of science: The candidate will demonstrate an appropriate level of knowledge of the current elements of the biosciences as related to disciplinary specialization and a more detailed understanding of the individual area of scholarship, including an appropriate familiarity with the research literature and the ability to evaluate and critique publications.

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. (https://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. (https://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. (https://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 **doctoral 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:
Ph.D.	Fall	Dec 1 of year before matriculation	TOEFL if international

Special requirements

- Applications for the program must be submitted to the Biomedical Sciences Doctoral Portal – School of Medicine – Ph.D. selected from the drop-down menu of programs on the VCU online application form.
- Applications to the BSDP should be completed (i.e. receipt of all forms, letters, transcripts, etc.) by Dec. 1 of the year before matriculation. Applications completed after this date will be reviewed only as remaining space permits.

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

1. A baccalaureate degree or its equivalent at the time of enrollment, with an undergraduate GPA of 3.5
2. TOEFL scores of 600 (pBT), 250 (cBT) or 100 (iBT) for individuals for whom English is a second language; or 6.5 on the IELTS (To report GRE or TOEFL score, use VCU Code 5570.)
3. Personal statements, which should include: long-term career goals to assess reasons behind the candidate's application; how a Ph.D. in biomedical science helps achieve those goals; the factors motivating a career in research; and research experience, including dates, places and duration
4. Three letters of recommendation that speak to the scientific competency and experience of the applicant
5. The equivalent of two semesters of general chemistry, two semesters of organic chemistry and two semesters of upper-level biology courses (e.g. cell biology, molecular biology, biochemistry, genetics, neuroscience, physiology, biophysics, etc.)

Degree requirements

In addition to the general VCU Graduate School graduation requirements (https://bulletin.vcu.edu/academic-regs/grad/graduation-info/), students must complete a minimum of 60 graduate credit hours.

Ph.D. students are expected to enroll as full-time graduate students. During the first year, students pursue research rotations, take formal course work and become familiar with current research topics through seminars, discussion groups and lectures by distinguished scientists. By the end of the first year, students choose a faculty adviser and begin dissertation research. Following completion of the research project and defense of the doctoral dissertation, graduates are equipped to participate in virtually any area of current biomedical research in the most prestigious laboratories.

Training in the responsible conduct of research

All Ph.D. students are required to complete the following training in the responsible conduct of research:

1. OVPR 601, OVPR 602 or OVPR 603
2. Collaborative Investigator Training Initiative: an online course that provides training in human subjects research. The course must be completed during the fall semester of year two. Students must submit the certificate of completion before starting the spring semester of year two. Consult the following link to access the course: research.vcu.edu/human_research/citi_requirements.htm (http://www.research.vcu.edu/human_research/citi_requirements.htm)
3. Animal research training: Students are required to complete an online training course for the conduct of animal subjects research. The training must be completed during the fall semester of year two. Students must submit the certificate of completion before starting the spring semester of year two. Access and guidance for the course is available through the "Animal Research" link on the Office of Research and Innovation website (https://research.vcu.edu/).

Course requirements

Course	Title	Hours
Required core courses		
ANAT 620	Scientific Writing and Grantsmanship	2
BIOC 503	Biochemistry, Cell and Molecular Biology	5
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BIOC 651	Biochemistry Journal Club (one-credit course taken at least four times)	4
BIOC 661	Critical Thinking (one-credit course repeated for two credits)	2
BIOC 690	Biochemistry Seminar (one-credit course taken at least four times)	4
BIOC 695	Biochemistry Student Seminar	1
IBMS 600	Laboratory Safety	1
IBMS 621	Laboratory Rotation I	2
IBMS 622	Laboratory Rotation II	2
IBMS 623	Laboratory Rotation III	2
IBMS 635	Cellular Signalling	3
Required additional courses		
OVPR 601	Scientific Integrity	1
or OVPR 602	Responsible Scientific Conduct	
or OVPR 603	Responsible Conduct of Research	
Elective courses		
Take at least two courses for four credits total from the following:		4
ANAT 615	Techniques in Neuroscience and Cell Biology	
BIOC 601	Membranes and Lipids	
BIOC 605	Molecular Biology	
BNFO 653	Advanced Molecular Genetics: Bioinformatics	
HGEN 501	Introduction to Human Genetics	
MICR 505	Immunobiology	

MICR 605	Microbial Physiology and Genetics	
MICR 607	Techniques in Molecular Biology and Genetics	
PHTX 691	Special Topics in Pharmacology	
Dissertation research		
BIOC 697	Directed Research in Biochemistry (taken each semester)	22
Total Hours		**60**

The minimum number of graduate credit hours required for this degree is 60.

Students who complete the requirements for this degree will receive a Doctor of Philosophy in Biochemistry.

Typical plan of study

Many students often take 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 student or in the enrollment or funding status of the student. Students should refer to their program websites and talk with their graduate program directors and advisers for information about typical plans of study and registration requirements.

M.D.-Ph.D. opportunity

The M.D.-Ph.D. program allows students to pursue both the M.D. and Ph.D. degrees using a coordinated program of study and apply a limited number of M.D. requirements toward fulfillment of requirements for the Ph.D. See the dual degree program page (https://bulletin.vcu.edu/graduate/dual-degree-opps/md-biochem-phd/) for additional details.

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Program website: biochemistry.vcu.edu (http://www.biochemistry.vcu.edu)