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 lipodomics.

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 graduatervcu 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-reg/s/)

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-reg/s/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-reg/s/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 Applications received prior to Jan 15 given priority consideration

### 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.

### Degree requirements

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 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://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. Consult the following link to access the course: research.vcu.edu/human_research/citi_requirements.htm

### Course requirements

**Course** | **Title** | **Hours**
--- | --- | ---
ANAT 620 | Scientific Grantsmanship | 2
BIOC 503 | Biochemistry, Cell and Molecular Biology | 5
BIOC 504 | Biochemistry, Cell and Molecular Biology | 5
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 620 | Laboratory/Clinical Rotations (repeat for six credits) | 6
IBMS 635 | Cellular Signalling | 3

**Required additional courses**

- OVPR 601 | Scientific Integrity | 1
- or OVPR 602 | Responsible Scientific Conduct

Students who plan to eventually work toward the Ph.D. degree in biochemistry at VCU should apply directly to the Ph.D. program and forego the Master's (M.S.) degree. However, applicants who are unsure if they want to earn a Ph.D. and desire experience in biomedical research before making this decision will be well-served by the M.S. program. Outstanding performance in the M.S. program can help students gain admittance to a doctoral program at VCU or elsewhere.

Master's students who wish to gain admission to the Ph.D. program should apply directly to the Biomedical Sciences Doctoral Portal and/or the Biochemistry Ph.D. program. Current M.S. students that are successful applicants to the Ph.D. program typically have final grades in the top 50% in BIOC 503 and BIOC and have earned grades of A in BIOC 505 and BIOC 661.
or OVPR 603  Responsible Conduct of Research

**Elective courses**

Take at least two courses for four credits total from the following:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ANAT 615</td>
<td>Techniques in Neuroscience and Cell Biology</td>
</tr>
<tr>
<td>BIOC 601</td>
<td>Membranes and Lipids</td>
</tr>
<tr>
<td>BIOC 605</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>HGEN 501</td>
<td>Introduction to Human Genetics</td>
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<tr>
<td>MICR 505</td>
<td>Immunobiology</td>
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<tr>
<td>MICR 605</td>
<td>Prokaryotic Molecular Genetics</td>
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<tr>
<td>MICR 607</td>
<td>Techniques in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>MICR 653</td>
<td>Advanced Molecular Genetics: Bioinformatics</td>
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<tr>
<td>PHTX 691</td>
<td>Special Topics in Pharmacology</td>
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</tbody>
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**Dissertation research**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BIOC 697</td>
<td>Directed Research in Biochemistry (taken each semester)</td>
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**Total Hours**  60

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

**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 (http://bulletin.vcu.edu/graduate/dual-degree-opps/md-biochem-phd/) for additional details.

**Contact**

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