

BIOCHEMISTRY, MASTER OF SCIENCE (M.S.)

Program goal

The M.S. program in biochemistry prepares students for research-oriented careers 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, 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, 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. Experimental design: Degree candidates 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.
2. Oral communication skills: Degree candidates 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.
3. Written communication skills: Degree candidates 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.
4. General knowledge of science: Degree candidates 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.
5. Problem-solving skills: Degree candidates 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.

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.	Summer or fall preferred	Applications accepted through DAT June; priority given to early applications	GRE, MCAT or

Special requirements

- MCAT or DAT acceptable in lieu of GRE for combined professional/academic degree programs.

Applicants to the Master of Science in Biochemistry program must meet all general admission requirements of the VCU Graduate School (<http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements/>). In addition, applicants must meet the following requirements.

1. Organic chemistry (with a minimum grade of B)
2. Undergraduate biochemistry (not required but recommended)
3. Laboratory experience
4. GRE scores of at least 158 (verbal), 158 (quantitative) and 4.0 analytical

Continuing for the Ph.D.

Students who plan to eventually work toward the Ph.D. degree in biochemistry at VCU should apply via the Biomedical Sciences Doctoral Portal (<https://medschool.vcu.edu/education/bsd/p/>). Applicants who are unsure if they want to earn a Ph.D. and who wish to gain experience in biomedical research before making this decision will be well-served by this M.S. program. Outstanding performance in the program can help students gain admittance to a doctoral program at VCU or elsewhere.

Degree requirements

In addition to the general VCU Graduate School graduation requirements (<http://bulletin.vcu.edu/academic-regs/grad/graduation-info/>), students in the M.S. in Biochemistry program must complete a minimum of 30 credit hours, including at least 24 didactic credits hours (exclusive of research credit hours).

Students in the M.S. program in biochemistry take courses designed for graduate students with an emphasis on research design and experimentation. During the first year of study, 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 thesis research. Following completion of the research project and defense of the master's thesis, graduates are equipped to participate in virtually any area of current biomedical research in the most prestigious laboratories. For more detailed information on the program, see the departmental website (<https://biochemistry.vcu.edu/Education/masters.html>).

M.S. students register for BIOC 651 and BIOC 690 for the duration of their tenure in the program. The core set of courses may be supplemented with elective courses offered by the Department of Biochemistry and Molecular Biology or other departments. Students are encouraged to

take additional courses that relate to their personal projects. Electives may include courses in techniques in molecular biology and genetics, bioinformatics, statistics, immunology, microbiology, molecular genetics, mammalian physiology and advanced organic and physical chemistry, among others.

Training in the responsible conduct of research

All M.S. 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. See the CITI requirements and access the course (https://research.vcu.edu/human_research/citi_requirements.htm) on the Office of Innovation and Research website.
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**.

Course requirements

Course	Title	Hours
Required core courses		
BIOC 503	Biochemistry, Cell and Molecular Biology	5
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BIOC 651	Biochemistry Journal Club ¹	1
BIOC 661	Critical Thinking (one-credit course repeated for two credits)	2
BIOC 690	Biochemistry Seminar ¹	1
IBMS 600	Laboratory Safety	1
IBMS 635	Cellular Signalling	3
Required additional courses		
BIOC 505	Experimental Biochemistry (research rotation, typically taken in year one)	2
or BIOC 697	Directed Research in Biochemistry	
OVPR 601	Scientific Integrity	1
or OVPR 602	Responsible Scientific Conduct	
or OVPR 603	Responsible Conduct of Research	
Elective courses ²		
ANAT 615	Techniques in Neuroscience and Cell Biology	3
BIOC 601	Membranes and Lipids	
HGEN 501	Introduction to Human Genetics	
MICR 505	Immunobiology	
MICR 605	Prokaryotic Molecular Genetics	
MICR/BNFO 653	Advanced Molecular Genetics: Bioinformatics	
PHTX 691	Special Topics in Pharmacology	

Thesis research		
BIOC 697	Directed Research in Biochemistry (variable credit course; six credits minimum)	6
Total Hours		30

1

Taken each fall and spring semester throughout the program; minimum of one credit for each course.

2

Electives are suggested, but not required. Additional credits may be taken in BIOC 651 and/or BIOC 690 to reach 30-credit minimum program requirement.

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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Program website: [biochemistry.vcu.edu](http://www.biochemistry.vcu.edu) (<http://www.biochemistry.vcu.edu>)