

BIOCHEMISTRY, MASTER OF SCIENCE (M.S.) WITH A CONCENTRATION IN MOLECULAR BIOLOGY AND GENETICS

Program goals

The molecular biology and genetics curriculum is an integrated interdisciplinary program of study that builds on the graduate programs of participating departments in the School of Medicine. The master's curriculum is designed to be an intensive course of study that will provide students with the skills required to advance to research-oriented careers in biotechnology or provide the foundation for further graduate study toward a Ph.D.

It is expected that the program should be completed in approximately two to two-and-one-half years.

1. The curriculum includes core, specialization and elective courses. Electives drawn from various departments allow individual specialization.
2. The structure of the program provides a framework for the progressive development of a mastery of the current state of the subject matter of bioscience, an ability to synthesize this information and apply this foundation to the identification of key areas of investigation and experimentation. The program relates this framework to the development of the ability to design, implement and interpret experimental approaches which address the questions identified.
3. 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.
4. The final three semesters include a research project conducted under the guidance of a selected faculty mentor and culminates in the presentation and defense of a master's thesis.

Participating faculty are associated not only with programs and departments within the School of Medicine, but also with the VCU Massey Cancer Center, the Philips Institute for Oral and Craniofacial Molecular Biology (School of Dentistry), the Institute of Structural Biology and Drug Discovery (School of Pharmacy) and the VCU Center for the Study of Biological Complexity (VCU Life Sciences).

The interdisciplinary approach to the solution of biological problems provided by this training is designed to develop in students the flexibility and problem-solving skills necessary for success in a variety of scientific career opportunities or further graduate study.

Student learning outcomes

1. 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 as measured by rubric.
2. General knowledge of sciences: 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, as measured by rubric.

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: 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, as measured by rubric.
 - b. 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 as measured by rubric.
4. 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 as measured by rubric.

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.

A master's student in the MBG curriculum must prepare a formal written research plan and make an oral presentation of their thesis research proposal and progress report to their graduate advisory committee prior to the beginning of the second year of residency. The student's knowledge in the area of the proposed research, current research

accomplishments and the feasibility of the proposed research project will be evaluated by the GAC. Successful completion of this review is required for continuance in the program and constitutes admission to candidacy.

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 at graduate.admissions.vcu.edu (<http://www.graduate.admissions.vcu.edu>).

Admission requirements

Degree:	Semester(s) of entry:	Deadline dates:	Test requirements:
M.S.	Fall	Deadline date rolling, preference given to applications received by Jan 17	GRE. TOEFL for applicants whose native language is not English

Special requirements

- Applications for the program should be submitted to Molecular Biology and Genetics – M.S. selected from the drop-down menu of programs of the VCU online graduate application form. The degree awarded will be a Master of Science in Biochemistry.

In addition to the general admission requirements of the VCU Graduate School (<http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements>), applicants must have earned or expect to earn a baccalaureate or equivalent degree, and must have demonstrated a superior knowledge of biology, chemistry, physics and mathematics. Laboratory experience is also strongly recommended. The Graduate Record Examination is required, as are letters of recommendation and a letter summarizing the applicant's goals.

International applicants who do not use English as their native language must take the Test of English as a Foreign Language examination.

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

In addition to the general VCU Graduate School graduation requirements (<http://bulletin.vcu.edu/academic-regs/grad/graduation-info>), the interdisciplinary master's curriculum in molecular biology and genetics requires a minimum of 48 credit hours, at least half of which must be course work restricted to graduate students. The curriculum includes 19 credit hours of required core course work and 29 additional credit hours of required course work, directed research and research seminar course work, and additional approved course work, as listed below. M.S. candidates must pass a final oral examination. A written thesis approved by the student's graduate advisory committee completes the requirements leading to the M.S. degree.

Curriculum requirements

Required core courses

Course	Title	Hours
BIOC 504	Biochemistry, Cell and Molecular Biology	5
BIOC 530	Biochemistry, Cell and Molecular Biology Module 1: Protein Structure and Function ¹	2
BIOC 531	Biochemistry, Cell and Molecular Biology Module 2: Basic Metabolism ¹	1
BIOC 532	Biochemistry, Cell and Molecular Biology Module 3: Central Dogma of Molecular Biology ¹	1
BIOC 533	Biochemistry, Cell and Molecular Biology Module 4: Lipids/Membranes and Bioenergetics ¹	1
IBMS 600	Laboratory Safety	1
IBMS 620	Laboratory/Clinical Rotations (sections 004 and 005; two credits taken twice) ²	4
MICR 607	Techniques in Molecular Biology and Genetics	2
MICR 693	Topics in Molecular Biology and Genetics (MBG journal club, must take at least once)	1

Select one of the following:	1
OVPR 601	Scientific Integrity
OVPR 602	Responsible Scientific Conduct
OVPR 603	Responsible Conduct of Research
Total Hours	19

Other required course work (29 credits)

Course	Title	Hours
Select a minimum of one credit hour of directed research every semester of enrollment in the program after the first year of study from:		variable

BIOC 697	Directed Research in Biochemistry	
or MICR 697	Directed Research in Microbiology	

Select a minimum of one credit hour of research seminar course work every fall and spring semester of enrollment in the program from:		variable
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MICR 690	Microbiology Research Seminar (section 002, MBG; one credit course)	
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Select any appropriate graduate-level course offered by the School of Medicine or with the course designations of BIOL, BNFO, CHEB, CHEM, CLSE, EGRB, EPID, MEDC		3
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Students may take additional course work with the approval of their graduate program directors.

Total graduate credit hours required (minimum) 48**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.

Graduate program director

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