Microbiology and Immunology, 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-regis)

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.
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/grad/candidacy), 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

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>OVPR 601</td>
<td>Scientific Integrity</td>
<td>1</td>
</tr>
<tr>
<td>OVPR 602</td>
<td>Responsible Scientific Conduct</td>
<td></td>
</tr>
<tr>
<td>OVPR 603</td>
<td>Responsible Conduct of Research</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 19

This requirement may also be satisfied with BIOC 503 (five credit hours).

This requirement may also be satisfied, under certain circumstances, with MICR 608 or MICR 609 (three credit hours; section 002). Consult with the program director.

**Other required course work (29 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICR 697</td>
<td>Directed Research in Microbiology</td>
<td>variable</td>
</tr>
</tbody>
</table>

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

Select a minimum of one credit hour of research seminar course work every fall and spring semester of enrollment in the program from:

| MICR 690 | Microbiology Research Seminar (section 002, MBG) | 3 |

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

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**

Gail E. Christie, Ph.D.
Professor, Department of Microbiology and Immunology
christie@vcu.edu
(804) 828-9093

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