PHARMACOLOGY AND TOXICOLOGY, DOCTOR OF PHILOSOPHY (PH.D.)

Program goal
The Ph.D. program is designed to provide students with the skills required to advance to positions as bioscience researchers and trainers in a broad spectrum of positions. The structure of the program provides a framework for the progressive development of 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 in bioscience. The program relates this framework to the development of the ability to design, implement and interpret experimental approaches that 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, as measured by rubric.
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 as measured by rubric.
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 as measured by rubric.
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 as measured by rubric.
5. General knowledge of science: The candidate should demonstrate a general knowledge of the elements of the sciences as related to molecular/cellular bioscience and a detailed knowledge of his or her area of research, including an appropriate familiarity with the research literature.

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 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-reggs/grad/candidacy)

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-reggs/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-reggs/grad/grad/candidacy)

Other information
Students wishing to matriculate into the Department of Pharmacology and Toxicology can contact the program director for further advice on course requirements and advising.

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 at graduate.admissions.vcu.edu (http://www.graduate.admissions.vcu.edu).
Admission requirements

<table>
<thead>
<tr>
<th>Degree</th>
<th>Semester(s) of entry</th>
<th>Deadline dates</th>
<th>Test requirements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>Fall</td>
<td>Applications received prior to Jan 15</td>
<td>GRE TOEFL (individuals for whom English is a second language)</td>
</tr>
</tbody>
</table>

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.

In addition to the general admission requirements of the VCU Graduate School (http://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. Current GRE scores (taken within the past five years), with scores at the 75th percentile or greater preferred
3. 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.)
4. 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; research experience, including dates, places and duration
5. Three letters of recommendation that speak to the scientific competency and experience of the applicant
6. 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

The broad base offered in the PhD. program in pharmacology and toxicology, together with basic training in physiology and biochemistry, provides the background for a successful career in academic institutions, industry or government. The research program of the department is sufficiently broad to provide an adequate basis for entry into a wide variety of interesting areas of modern biology and medicine.

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. With few exceptions, Ph.D. students are enrolled in the Biomedical Sciences Doctoral Portal from matriculation until matched with an adviser, usually by the summer semester of the second year. The students are moved into the Ph.D. in Pharmacology and Toxicology major after meeting program requirements. Students customarily complete formal course work in pharmacology and biochemistry during the first year of study. Participation in research also is begun early in the first year. Students interested or committed to pharmacology should take the footnoted (1) courses listed in the curriculum requirements section during the portal period to assure rapid progress toward the degree.

In the third and subsequent years, the majority of the course load is taken as PHTX 697. Advanced electives also may be taken as desired and with the approval of the adviser. Students and faculty participate in a seminar program (PHTX 690) that includes distinguished visiting scientists from the U.S. and abroad. Following completion of a qualifying examination, a degree candidate is required to submit and defend a thesis embracing an original research project conducted under the guidance and supervision of an adviser and an advisory committee. There is no foreign language requirement. The average time necessary to complete the doctoral program in pharmacology and toxicology is four to five years.

Curriculum requirements

Required courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HGEN 692</td>
<td>Special Topics (classical and near class paper; 1 credit minimum)</td>
<td>1</td>
</tr>
<tr>
<td>or IBMS 630</td>
<td>Critical Thinking</td>
<td></td>
</tr>
<tr>
<td>IBMS 600</td>
<td>Laboratory Safety</td>
<td>1</td>
</tr>
<tr>
<td>IBMS 620</td>
<td>Laboratory/Clinical Rotations (two-credit course taken for three rotations)</td>
<td>6</td>
</tr>
<tr>
<td>PHTX 630</td>
<td>Basic Concepts in Pharmacology for Graduate Students</td>
<td>3</td>
</tr>
<tr>
<td>PHTX 636</td>
<td>Principles of Pharmacology</td>
<td>5</td>
</tr>
<tr>
<td>PHTX 639</td>
<td>Principles of Pharmacology Journal Club</td>
<td>1</td>
</tr>
<tr>
<td>PHTX 690</td>
<td>Pharmacology Research Seminar</td>
<td>1</td>
</tr>
<tr>
<td>or IBMS 690</td>
<td>Basic Health Sciences Research Seminar</td>
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</tbody>
</table>

Total Hours: 18

1 Students interested in or committed to pharmacology should take these courses during the portal year to assure rapid progress toward the degree.

Recommended electives and directed research

Select a combination of the following courses as indicated below for a total of 42 credit hours to reach the required minimum of 60 credit hours:

Directed research

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHTX 697</td>
<td>Directed Research in Pharmacology</td>
<td></td>
</tr>
</tbody>
</table>

Elective courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANAT 610</td>
<td>Systems Neuroscience</td>
<td></td>
</tr>
<tr>
<td>BIOC 503</td>
<td>Biochemistry, Cell and Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>BIOC 504</td>
<td>Biochemistry, Cell and Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>BIOC 601</td>
<td>Membranes and Lipids</td>
<td></td>
</tr>
<tr>
<td>BIOC 602</td>
<td>Physical Properties of Macromolecules</td>
<td></td>
</tr>
<tr>
<td>BIOC 605</td>
<td>Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>BIOS 543</td>
<td>Graduate Research Methods I</td>
<td></td>
</tr>
<tr>
<td>CHEM 504</td>
<td>Advanced Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>EGRB 603</td>
<td>Biomedical Signal Processing</td>
<td></td>
</tr>
<tr>
<td>EGRB 610</td>
<td>Microprocessor Interfacing for Biomedical Instrumentation</td>
<td></td>
</tr>
</tbody>
</table>
IBMS 635  Cellular Signalling
MEDC 541  Survey of Molecular Modeling Methods
MEDC 601  Advanced Medicinal Chemistry I
MEDC 630  Theoretical Methods in Drug Design
MICR 505  Immunobiology
MICR/BNFO 653  Advanced Molecular Genetics: Bioinformatics
NEUS 609  Cellular and Molecular Neuroscience
PHIS 501  Mammalian Physiology
PHIS 604  Cell Physiology: Cardiovascular and Respiratory
PHIS 615  Signal Detection in Sensory Systems
PHTX 632  Neurochemical Pharmacology
PHTX 633  Behavioral Pharmacology
PHTX/FRSC 644  Forensic Toxicology
PHTX 697  Directed Research in Pharmacology (variable credits)

Total Hours 42

Total graduate credit hours required (minimum) 60

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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(804) 828-7918

Additional contact
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Coordinator, graduate programs in pharmacology and toxicology
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(804) 828-8400

Program website: pharmtox.vcu.edu (https://pharmtox.vcu.edu)