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 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 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

SLO 1.0: 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.

- Measure 1.0: Dissertation review and examination
- Measure 2.0: Oral doctoral candidacy examination
- Measure 3.0: Performance review of progress
- Measure 4.0: Written doctoral candidacy examination

SLO 2.0: Experimental skills
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.

- Measure 1.0: Dissertation review and examination
- Measure 2.0: Oral doctoral candidacy examination
- Measure 3.0: Performance review of progress
- Measure 4.0: Written doctoral candidacy examination

SLO 3.0: Integrated knowledge of biosciences
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 as measured by the rubric.

- Measure 1.0: Dissertation review and examination
- Measure 2.0: Oral doctoral candidacy examination
- Measure 3.0: Performance review of progress
- Measure 4.0: Written doctoral candidacy examination

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-reggs/)

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/graduation-info/)

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 today. (https://www.vcu.edu/admissions/apply/graduate/)

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>Dec 1 of the year before matriculation</td>
<td>TOEFL if international</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.
- Applications to the BSDP should be completed (i.e. receipt of all forms, letters, transcripts, etc.) by Dec. 1 of the year before matriculation. Applications completed after this date will be reviewed only as remaining spaces permit.

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. 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.)
3. 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
4. Three letters of recommendation that speak to the scientific competency and experience of the applicant
5. 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.

Course requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC 503</td>
<td>Biochemistry, Cell and Molecular Biology (1)</td>
<td>5</td>
</tr>
<tr>
<td>BIOC 661</td>
<td>Critical Thinking</td>
<td>1</td>
</tr>
<tr>
<td>IBMS 600</td>
<td>Laboratory Safety (1)</td>
<td>1</td>
</tr>
<tr>
<td>IBMS 621</td>
<td>Laboratory Rotation I</td>
<td>2</td>
</tr>
<tr>
<td>IBMS 622</td>
<td>Laboratory Rotation II</td>
<td>2</td>
</tr>
<tr>
<td>IBMS 623</td>
<td>Laboratory Rotation III</td>
<td>2</td>
</tr>
<tr>
<td>PHTX 630</td>
<td>Basic Concepts in Pharmacology for Graduate Students (1)</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>
</tbody>
</table>

Required additional courses

| OVPR 601 | Scientific Integrity                                   | 1     |
| or OVPR 602 | Responsible Scientific Conduct                          |       |
| or OVPR 603 | Responsible Conduct of Research                        |       |
| PHTX 690 | Pharmacology Research Seminar (2)                      | 1     |
| or IBMS 690 | Basic Health Sciences Research Seminar                |       |

Elective courses

| ANAT 610 | Systems Neuroscience                                   |       |
| BIOC 504 | Biochemistry, Cell and Molecular Biology               |       |
| BIOC 601 | Membranes and Lipids                                   |       |
| BIOC 605 | Molecular Biology                                      |       |
| BNFO 653 | Advanced Molecular Genetics: Bioinformatics            |       |
| CHEM 504 | Advanced Organic Chemistry I                           |       |
| EGRB 603 | Biomedical Signal Processing                           |       |
| EGRB 610 | Microprocessor Interfacing for Biomedical Instrumentation |       |
| FRSC 644 | Analytical Considerations in Forensic Toxicology       |       |
| IBMS 635 | Cellular Signalling                                    |       |
| MEDC 541 | Survey of Molecular Modeling Methods                   |       |
Students interested in or committed to pharmacology should take these courses during the portal year to assure rapid progress toward the degree.

Students are expected to enroll in PHTX 690 Pharmacology Seminar each semester (will accumulate more than 1.0 credit during academic years). Doctoral students are required to present a dissertation seminar prior to the final committee defense as a requirement for completion of the degree.

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

Students who complete the requirements for this degree will receive a Doctor of Philosophy in Pharmacology and Toxicology.

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.

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-pharmtox-phd/) for additional details.

Contact
Keith Shelton, Ph.D.
Director, graduate education, Department of Pharmacology and Toxicology
keith.shelton@vcuhealth.org
(804) 828-7918

Additional contact
Laura Johnson
Executive secretary