

The Pharmacology Graduate Group (PGG) at the University of Pennsylvania is a collaborative and interdisciplinary Ph.D. program that brings together over 95 faculty from 25 academic departments in the Schools of Arts and Sciences, Dental Medicine, Engineering, Medicine, and Veterinary Medicine at the University of Pennsylvania and in the associated Children's Hospital of Philadelphia. The PGG is part of an umbrella organization called Biomedical Graduate Studies (BGS), which provides financial support and administrative oversight.

**Coursework:** Every PGG student is required to take four Core courses that introduce the broad basis of modern pharmacology including Cell Biology and Fundamentals of Pharmacology (Fall, Year 1), Biological Data Analysis (Spring, Year 1), Medical Pharmacology and Medical Physiology (Fall, Year 2). The first 1.5-2 years of study are devoted to classes and laboratory rotations. For most students, this period begins with the Fall semester of the first year and ends with the Spring semester of the second year upon completion of the Candidacy (qualifying) examination. PGG students also take 1–3 elective courses, chosen from all relevant, graduate-level courses offered across campus. First year students are required to attend Journal Club to 1) gain experience presenting recent original research articles from the primary scientific literature, and 2) learn to critically evaluate the research contained in these articles with respect to their context, documentation, authentication, presentation, scientific rigor, reproducibility, inferences, and any other factors that contribute to the quality of the research and its communication.

**Laboratory Rotations:** Students complete three rotations during their first and second years in the program. Each rotation is chosen by the student, under the guidance of the Academic Review Committee. Rotations provide students with opportunities to learn a wide range of modern laboratory techniques and gain first-hand experiences that will aid in the selection of a thesis laboratory. Lab rotations are graded and end with a peer reviewed oral presentation.

**Candidacy Exam:** Candidacy exam is taken in the spring of the second year, consists of a written Proposal (in the format of an NRSA application) and an oral Defense. Both must reflect a substantial depth of knowledge in the topics covered by the proposed thesis research and an understanding of the broader significance of the work. Preparation includes a Candidacy Exam Workshop, a 10-session scientific writing/proposal development course run by experienced faculty, with input from past students and the Chair of the PGG as well as attending a workshop on “Resource Authentication and Transparency”. This workshop goes beyond the standard training in responsible conduct in science by emphasizing transparency in reporting full experimental details so that others may reproduce and extend the findings.

**Seminars/ Retreats:** Most students attend a weekly Pharmacology year-long seminar series sponsored by SPATT and attend 2-3 lunches with the seminar speaker of their choice. Students are also encouraged to attend other relevant seminars throughout the University. Students participate in retreats occurring throughout the academic year, including an annual student run Symposium.

**Research and Dissertation.** Students work with their Thesis Advisor and the student-selected Thesis Committee toward the execution of original research. The PGG expects at least one to two first authored manuscripts towards completion of the Ph.D. thesis; however, the thesis committee ultimately determines whether the student has met this requirement. An oral defense of the document, to the Thesis Committee and an additional outside judge, completes the Ph.D. The average (median) time to degree in our program over the past 10 years is 5.5 years but can vary for a program as large as ours (currently 65 students): the interquartile range for the past 10 years is 5.3 – 6.9 years.

This F31 applicant (INSERT NAME HERE) is currently a (INSERT YEAR HERE) year student in the program. Thus, HE/SHE has completed ... indicate what courses you have completed and any other educational opportunities/training opportunities ...

**Progress:** Formal monitoring and evaluation occurs via three primary mechanisms:

1. The Academic Review Committee (ARC) provides advising, monitoring, and evaluation of all students in their first and second years. The ARC reviews and addresses any concerns from the student's performance from the previous semester and helps finalize upcoming plans, including coursework, laboratory rotations, and the dissertation. The student is required to provide and be prepared to discuss an updated Individual Development Plan (IDP) which includes two distinct sections: i) "Skills and Motivations," which helps the ARC get to know the student better, and ii) "Plans/Goals for the Coming Year," which includes written lists of specific courses and laboratory rotations that are planned. The completed form is reviewed by the PGG Chair and ARC Chair.

2. The Candidacy Exam evaluates and provides feedback for students as they transition to their Thesis work. Feedback is provided via a written evaluation which is shared with the student. Possible outcomes are i) Unconditional pass, allowing the student to begin his or her Thesis work; ii) Conditional pass, which is assigned if the Committee feels that the student would benefit by, for example, re-writing and/or re-defending part or all aspects of the proposal, which typically must be completed within 1–3 months following the initial Exam; or iii) Fail, in which case the student is told why in the most specific terms possible and is a candidate for dismissal from the PGG. The PGG and ARC Chairs review all of these evaluations and provide additional feedback, as needed, including possible dismissal following failed Exams.

3. The Thesis Committee meets with Thesis-level students every 6–12 months. At each meeting, the student is required to provide: i) a written progress report describing current progress and future plans; ii) a copy of the previous Thesis Committee Report, reminding the Committee of their progress; iii) organized, well-managed lab notebooks used since the previous meeting; iv) an up-to-date copy of the student's CV; and v) an IDP, that includes sections on "Skills and Motivations and Career Planning," "Achievements and Plans/Goals," and "Skills to Improve." The IDP and a Thesis Committee Report, which is filled out by the Committee Chair and shared with the student at the end of the meeting which is reviewed annually by the PGG and ARC Chairs, who provide additional feedback and guidance as necessary.

#### **Professional Development Activities within BGS and PGG:**

Biomedical Graduate Studies (BGS) utilizes a variety of methods to promote student professional development, defined as *i*) training in skills apart from those of scientific endeavor that engender success in the workplace, whether it be academia or other, and *ii*) providing opportunities to students to evaluate career paths for which PhD training in the biomedical sciences provides a strong competitive advantage. A key resource for both students and faculty is the *BGS Career Development website* <https://bgscareerdevelopment.com/>

*Certificate programs* offer students opportunities to pursue specialized scientific and professional interests. These programs generally consist of 3–4 courses, many together with a seminar series and capstone project. Several certificate programs are closely aligned, through design, with the standards and educational mission of BGS. These are Graduate Training in Medical Science, Public Health, and Environmental Health Sciences. Other certificate programs, i.e. those elsewhere within the Perelman School of Medicine, the University, and in some cases other institutions, can be relevant as well. For example, students have expressed interest in, and BGS supports, the Wharton School's Certificate in Business Foundations Skills, the Law School's Certificate in Law, and the Institute of Translational Medicine and Therapeutics' Certificate Programs in Translational, Entrepreneurial, and Regulatory Sciences. Students in the Pharmacology Graduate Group have also organized an outreach and professional development group **Pharmacology Graduate Opportunities for Outreach and Development (Pharm4GOOD)** whose mission is to create a community for pharmacology graduate students to develop personally and professionally. Training as doctoral students is enhanced by volunteering, community outreach, and teaching principles of pharmacology to the broader community.

#### **Individual development plans (IDPs)** <https://www.med.upenn.edu/bgs/idp.shtml>

The purpose of an IDP is to provide to students the opportunity to articulate their range of career interests and to put into place short- and long-term support and resources to explore these interests. The IDP forms are split into five sections: coursework/rotations, pre-thesis research, or thesis research. IDPs evaluate research skills; professional development; achievements; and an action plan. *They are required of the students annually.* Each IDP requires the input of the mentor or advisory committee, who following the discussion helps the student craft the last section, the action plan. As noted from the section titles, the IDP formally addresses both progress in scientific training and professional development. The duality of the intent is important, as rigorous scientific training is key to the advantages students have in securing access to, and success within, careers on which they eventually set their sights.

