



**University of Pittsburgh
School of Medicine
Department of Pharmacology
& Chemical Biology**

***Guidelines and Regulations
for Doctoral Study in the
Molecular Pharmacology
Training Program***

MOLECULAR PHARMACOLOGY

University of Pittsburgh

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Molecular Pharmacology

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OVERVIEW

Molecular Pharmacology

Welcome

We would like to take the opportunity to welcome you to the Molecular Pharmacology Graduate Training Program. This is an exciting time to be a pharmacologist, and an exciting time to join the Molecular Pharmacology Graduate Program.

Pharmacology is the study of the mechanisms of drug action. The discipline resides at the important interface between the basic sciences that investigate the cellular and molecular biology of mammalian physiology and the development of clinically effective approaches to treating disease. The modern molecular and genetic approaches that are being incorporated into this discipline, combined with remarkable advances in the emerging science of drug discovery, promise a new era of therapeutics that will see the development of effective and more specific medicines based on a rational understanding of biomedical science. As pharmacologists, you will lead the way into this new era, aided by the outstanding training that can be gained in our program.

The Molecular Pharmacology Graduate Program offers didactic and research training in the fundamental aspects of this discipline. The course work in the program will educate students in the key principles of the discipline of pharmacology, as well as providing an overview of the most important clinically relevant drugs. The discipline-specific training is augmented by additional course work that can be chosen from biochemistry, molecular genetics, immunology, cell biology, physiology and neuroscience. We also continue to develop new courses so our students stay abreast of recent developments relevant to current research problems as well as to careers in pharmacology, such as the recently introduced lectures on drug discovery in our Molecular Pharmacology course. The quality of the education offered by the Program is reflected in the recent renewal of the NIH funded training grant, now in its 21st year.

The program offers an outstanding research environment, and our pharmacology department is ranked 9th nationally in NIH funding. The research of our training faculty focuses on various topics including drug discovery, cancer pharmacology, neuropharmacology, signal transduction, and cell & organ system pharmacology. The expectation is that many of the studies carried out by the faculty will facilitate the development of drugs designed to combat diseases such as cancer, Parkinson's Disease and Cardiovascular Disease, to name a few.

The Molecular Pharmacology Graduate Program is committed to providing an unsurpassed educational experience in an exceptional research environment. Recognizing the broad range of career options open to our students, we also aim to prepare those graduating from our program to enter the professional work force.

Molecular Pharmacology is an exciting place to be. Come and join us!



Dr. Patrick J. Pagano
Graduate Program
Director



Dr. Guillermo G. Romero,
Graduate Program
Vice-Director

Our integrated program broadens our students' horizons

Our highly-qualified faculty have a wide range of research interests

Our students gain a great deal of practical experience

Pharmacology encompasses a broad research base

The Department's current research trends are on the cutting edge of today's research

Every new student in the University of Pittsburgh Graduate Program of Basic Sciences is initially enrolled in the **Interdisciplinary Biomedical Graduate Program**, a unique program that allows new students to begin a research career without committing to a specific discipline. This integrated program offers flexibility while offering a first-class research experience at one of the nation's best academic medical centers. During the first year students select the discipline on which they would like to focus.

Our program features 64 highly-qualified training faculty with a wide range of research interests. In addition, our program maintains a long tradition of extending joint appointments to many University departments such as Anesthesiology, Chemistry, Medicine, Neurobiology, Neurology, Pediatrics, Psychiatry and Otolaryngology. We also work in close collaboration with the University of Pittsburgh Cancer Institute, the Center for Clinical Pharmacology, Cardiovascular Institute, the Center for Neuroscience, the Pittsburgh Institute for Neurodegenerative Diseases, Carnegie Mellon University and several local and international pharmaceutical firms.

The **Molecular Pharmacology Training Program** features a great many research and classroom opportunities for our students. Classes are taught by highly-qualified, research-active instructors. Each lab in the department offers rotations and work opportunities, often allowing students to follow their own research instincts with as much or as little guidance as they feel they need. Our students cover a lot of information quickly, developing all the skills necessary to succeed either in academia or in industrial work. Most of our graduate students begin authoring papers early in their program, and some students have already begun or completed patent and grant application processes before they graduate.

Many of our students choose the **Molecular Pharmacology Training Program** because it deals with a broad range of topics in both clinical and therapeutic areas. Some of our students focus on the molecular mechanisms of drug action and the dynamics of the resulting pharmacological effects. Others decide to concentrate on the design and testing of new chemical compounds for improved biological effects and reduced toxicity. Still others find their primary research interests tending toward clinical pharmacology, which allows them to learn more about dosage regimen choices, modifications of drug therapy in certain disease states, and the safe use of multiple drugs that interact with one another.

Biomedical research in the Molecular Pharmacology program is focused on molecular and cellular mechanisms of intracellular signaling using a combination of biochemical, molecular biological, biophysical, ultrastructural, and imaging approaches. Basic information on cellular communication in health and disease provides the basis for the development and testing of novel therapeutic agents. Applications of this common theme are directed toward research in molecular biology of cancer, neuropharmacology, drug discovery, and cell and organ system pharmacology. Formal interactions with the University of Pittsburgh Cancer Institute, the Center for Neuroscience, the University of Pittsburgh Drug Discovery Institute, the University of Pittsburgh Structural Biology Imaging Center, the Vascular Medicine Institute and the Division of Clinical Pharmacology provide a broad multidisciplinary approach to training in modern molecular pharmacology.

Research interests are mainly focused on signal transduction, the pharmacology of cancer, the pharmacology of the nervous system, drug discovery, and the pharmacology of cell and organ systems. Starting from these foundations, students can choose career paths in basic and/or clinical research.

Cancer Pharmacology

Research efforts in cancer pharmacology include studies of the basic mechanisms of signal transduction associated with cell proliferation and apoptosis, the mechanisms of action of anti-neoplastic agents, the design and discovery of new drugs, basic mechanisms of DNA repair and DNA damage tolerance and the development of novel strategies for gene therapy. Emphasis is placed on the description and characterization of basic signaling mechanisms that constitute the targets of molecules used for cancer therapy and DNA damage and repair mechanisms that contribute to anti-neoplastic drug resistance. The regulation of tyrosine kinases, processing of proto-oncogenes, regulation of small GTPases and their effectors, cell-cycle-specific kinases and DNA repair gene products are being studied as potential targets or to enhance the efficacy of existing chemotherapeutic agents. The role of growth factors in the progression of solid and hematopoietic tumors is being studied; new receptors and signal transduction pathways are being identified in normal and malignant tissues. Other areas of research include investigations on interleukin therapy, free radical generation, molecular mechanisms of antioxidant regulation and detoxification, aberrations in the mechanisms of programmed cell death (apoptosis) associated with tumoral growth and alterations in DNA repair and DNA damage response genes associated with tumor growth and chemotherapeutic resistance.

Faculty: **Altschuler, Bakkenist, Eiseman, Galbiati, Jiang, Kensler, Kim, Oesterreich, Romero, Singh, Smithgall, Steinman, Van Houten, Q. Wang, Z. Wang, Zhang**

Pharmacology of Cell and Organ Systems

Investigators in the Molecular Pharmacology program are also examining the mechanisms of autonomic synaptic transmission and the autonomic regulation of the urogenital and renal systems. These studies include: 1) neuroanatomical and neurophysiological research aimed towards the development of agents to modulate neuronal control of the urinary bladder, colon, and sex organs; 2) biochemical/molecular analysis of the role of PP-fold peptides released from autonomic synaptic junctions in the regulation of renovascular tone and arterial blood pressure in genetic hypertension; 3) the interaction between the sympathetic nervous system and estradiol on renal function; and 4) signaling roles of reactive species in tissue homeostasis and pathophysiology.

Faculty: **Birder, Bisello, de Groat, Gladwin, Isenberg, Jackson, Kanai, Lee, Lotze, Pagano, Shiva, Vilardaga, Xie**

Drug Discovery

Drug Discovery is an emerging pharmacological science that seeks to identify novel small molecule probes and to understand at a molecular level how compounds affect macromolecular process. Cell-based, in vitro mix-and-read, and whole organism assays suitable for rapid or high throughput analysis are being designed and implemented by members of the Molecular Pharmacology Program. Current molecular targets include G-protein coupled receptors, vanilloid receptors, cathepsins, apoptosis-inducing proteins, ion channels, steroid receptors, orphan nuclear receptors, kinases, phosphatases, DNA repair enzymes, and DNA polymerases. Chemical libraries and automated screening instrumentation are emphasized, which permit rapid interrogation of optimized assays. Computational approaches and high content cell screening methodologies are employed to facilitate the identification of new chemical probes. Therapies to disrupt protein-protein interactions using small molecules and biologics has become a major new area of investigation.

Faculty: **Birder, Curran, Freeman, Levitan, Pagano, Palladino, Singh, Smithgall, Sobol, Van Houten, Q. Wang, Z. Wang, Wipf**

Neuropharmacology

The physiological basis of neuronal toxicity caused by various insults including excitatory amino acids, oxidative stress and cerebral ischemia is being studied using quantitative imaging techniques, confocal microscopy, genetic approaches in model organisms, and molecular approaches in cultured cell lines, cultured primary neurons and in intact animals. These studies aim to develop an understanding of the mechanisms of neuronal injury in acute and chronic disorders. The regulation of the expression of voltage-gated ion channels in cell lines and primary cultures is being studied by molecular and patch-clamping techniques. In addition, molecular genetic, electrophysiological and cell biological approaches are being used to explore the relationships between neurotransmitter transporter structure, substrate transport, inhibitor binding and ion permeation. New quantitative imaging approaches are being used to study the basic processes of neuropeptide secretion. Investigators in the molecular pharmacology program are also examining the mechanisms of autonomic regulation and synaptic transmission of the urogenital system. These studies include neuroanatomical and neurophysiological research aimed towards the development of agents to modulate neuronal control of the urinary bladder, colon, and sex organs. Targeted disruption of gaba receptors is being used as a tool to investigate the function of these receptors and their specific components in transgenic mice. The mechanism of action of anesthetics is being studied in genetic model organisms and using techniques of magnetic resonance spectroscopy.

Faculty: **Aizenman, Birder, de Groat, DeFranco, Homanics, Horn, Jacob, Kanai, Levitan, Palladino, Roppolo, Tang, Wetzel, Xu**

Signal Transduction

The department is rich in research devoted to the analysis of signal transduction pathways and their role in normal physiological processes and disease. These include studies into the basic mechanisms of signaling by oxidizing and free radical inflammatory mediators, nitric oxide, steroids, parathyroid hormone, neurotransmitters, hypothalamic hormones, and rhodopsin. Various cell biological, forward and reverse genetic, molecular biological and biophysical approaches are used to dissect the molecular mechanisms utilized by intracellular mediators of signal transduction including cell surface receptors, nuclear receptors, caveolin, protein kinases, protein phosphatases and lipid kinases.

Faculty: **Altschuler, Bisello, Calero, DeFranco, Fernstrom, Freeman, Friedman, Galbiati, Gronenborn, Jacob, Jiang, Kagan, Kane, Kensler, Lotze, Pagano, Pitt, Romero, Shiva, Smithgall, Vilardaga, Q. Wang, Z. Wang, Xie**

For a list of faculty and their respective research interests, see:

<http://www.pharmacology.us/MPTP/Faculty>

PhD COURSE PATH

Molecular Pharmacology

YEAR 1

FALL

| | | |
|---------------|-----------------------------------|------------|
| INTBP 2000 | Foundations of Biomedical Science | 8 |
| INTBP 2005 | Foundations Conference | 4 |
| INTBP 2010 | Laboratory Research Rotation | 1 |
| Total Credits | | 9 up to 15 |

SPRING

| | | |
|---------------|---------------------------------|------------|
| MSMPHL 2310 | *Principles of Pharmacology | 3 |
| INTBP 2010 | Laboratory Research Rotation | 1 |
| MSMPHL 2360 | *Biology of Signal Transduction | 3 |
| TBD | †Elective | |
| Total Credits | | 9 up to 15 |

SUMMER

| | | |
|---------------|--|---|
| INTBP 2013 | D2K: From Data to Knowledge – Biomedical Experimental Design & Analysis | 3 |
| INTBP 2010 | Laboratory Research Rotation | 1 |
| INTBP 2290 | Scientific Ethics and the Responsible Conduct of Research | 1 |
| Total Credits | | 5 |

YEAR 3

**DISSERTATION OVERVIEW/PROSPECTUS MEETING
APPLICATION FOR ADMISSION TO CANDIDACY – COMPLETED BY
THE END OF THE SUMMER TERM – YEAR 2 (PRIOR TO FALL TERM
ADD/DROP DATE.)**

FALL

| | | |
|---------------|---|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 3320 | Journal Club | 1 |
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 3340 | Foundations of Successful Career Planning and Development Part 1 | 1 |
| Total Credits | | 9 up to 15 |

SPRING

| | | |
|---------------|---|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 3320 | Journal Club | 1 |
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 3341 | Foundations of Successful Career Planning and Development Part 2 | 1 |
| Total Credits | | 9 up to 15 |

SUMMER

| | | |
|---------------|-----------------------------|-----------|
| MSMPHL 3300 | PhD Dissertation Research | 1-2 |
| MSMPHL 2355 | Pharmacology Summer Seminar | 1 |
| Total Credits | | 1 up to 3 |

YEAR 2

FALL

| | | |
|---------------|---------------------------------|------------|
| MSMPHL 3360 | *Molecular Pharmacology | 2 |
| MSMPHL 3310 | **Cancer Biology & Therapeutics | 3 |
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 2390 | Directed Study | 1-9 |
| MSMPHL 3320 | Journal Club | 1 |
| TBD | †Elective | |
| Total Credits | | 9 up to 15 |

SPRING

| | | |
|---------------|---------------------|------------|
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 2370 | **Drug Discovery | 3 |
| MSMPHL 2390 | Directed Study | 1-9 |
| MSMPHL 3375 | **Neuropharmacology | 3 |
| MSMPHL 3320 | Journal Club | 1 |
| TBD | †Elective | |
| Total Credits | | 9 up to 15 |

**COMPREHENSIVE EXAMINATION – COMPLETED BY THE END
OF THE SPRING TERM - YEAR 2**

SUMMER

| | | |
|---------------|-----------------------------|-----------|
| MSMPHL 2390 | Directed Study | 2 |
| MSMPHL 2355 | Pharmacology Summer Seminar | 1 |
| Total Credits | | 1 up to 3 |

YEAR 4 & BEYOND

FALL

| | | |
|---------------|---------------------------|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 3320 | Journal Club | 1 |
| MSMPHL 2350 | Research Seminar | 1 |
| Total Credits | | 9 up to 15 |

SPRING

| | | |
|---------------|---------------------------|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 3320 | Journal Club | 1 |
| MSMPHL 2350 | Research Seminar | 1 |
| Total Credits | | 9 up to 15 |

SUMMER

| | | |
|---------------|-----------------------------|-----------|
| MSMPHL 3300 | PhD Dissertation Research | 1-2 |
| MSMPHL 2355 | Pharmacology Summer Seminar | 1 |
| Total Credits | | 1 up to 3 |

DISSERTATION DEFENSE

** Required courses for Molecular Pharmacology program*

*** One of these three courses (i.e. either Drug Discovery or
Neuropharmacology or Cancer Biology and Therapeutics is required)*

*†Elective- One 2 or 3 cr. Elective may be taken from either course
offerings of the Molecular Pharmacology program or other approved
offerings. (May be taken in Spring Term of year 1 or in Fall or Spring*

MD/PhD COURSE PATH

Molecular Pharmacology

YEAR 1

FALL

| | | |
|---------------|--------------------------------|------------|
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 2390 | Directed Study | 1-9 |
| MSMPHL 3320 | Journal Club | 1 |
| MSMPHL 3310 | *Cancer Biology & Therapeutics | 3 |
| MSMPHL 3360 | *Molecular Pharmacology | 2 |
| Total Credits | | 9 up to 15 |

SPRING

| | | |
|---------------|---------------------------------|------------|
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 2370 | *Drug Discovery | 3 |
| MSMPHL 2390 | Directed Study | 1-9 |
| MSMPHL 3320 | Journal Club | 1 |
| MSMPHL 2360 | *Biology of Signal Transduction | 3 |
| MSMPHL 3375 | *Neuropharmacology | 3 |
| TBD | **Elective | |
| Total Credits | | 9 up to 15 |

COMPREHENSIVE EXAMINATION – COMPLETED BY THE END OF SPRING TERM – YEAR 1

SUMMER

| | | |
|---------------|---|---|
| INTBP 2013 | D2K: From Data to Knowledge – Biomedical Experimental Design & Analysis | 3 |
| MSMPHL 2355 | Pharmacology Summer Seminar | 1 |
| Total Credits | | 4 |

DISSERTATION OVERVIEW/PROSPECTUS MEETING APPLICATION FOR ADMISSION TO CANDIDACY – COMPLETED BY THE END OF THE SUMMER TERM – YEAR 1 (PRIOR TO FALL TERM ADD/DROP DATE.)

YEAR 2

FALL

| | | |
|---------------|---------------------------|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 3320 | Journal Club | 1 |
| Total Credits | | 9 up to 15 |

SPRING

| | | |
|---------------|---------------------------|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 3320 | Journal Club | 1 |
| Total Credits | | 9 up to 15 |

SUMMER

| | | |
|---------------|-----------------------------|-----------|
| MSMPHL 3300 | PhD Dissertation Research | 1-2 |
| MSMPHL 2355 | Pharmacology Summer Seminar | 1 |
| Total Credits | | 1 up to 3 |

YEAR 3

FALL

| | | |
|---------------|---------------------------|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 3320 | Journal Club | 1 |
| MSMPHL 2350 | Research Seminar | 1 |
| Total Credits | | 9 up to 15 |

SPRING

| | | |
|---------------|---------------------------|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 3320 | Journal Club | 1 |
| MSMPHL 2350 | Research Seminar | 1 |
| Total Credits | | 9 up to 15 |

SUMMER

| | | |
|---------------|-----------------------------|-----------|
| MSMPHL 3300 | PhD Dissertation Research | 1-2 |
| MSMPHL 2355 | Pharmacology Summer Seminar | 1 |
| Total Credits | | 1 up to 3 |

YEAR 4 & BEYOND

FALL

| | | |
|---------------|---------------------------|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 3320 | Journal Club | 1 |
| Total Credits | | 9 up to 15 |

SPRING

| | | |
|---------------|---------------------------|------------|
| MSMPHL 3300 | PhD Dissertation Research | 1-14 |
| MSMPHL 2350 | Research Seminar | 1 |
| MSMPHL 3320 | Journal Club | 1 |
| Total Credits | | 9 up to 15 |

SUMMER

| | | |
|---------------|-----------------------------|-----------|
| MSMPHL 3300 | PhD Dissertation Research | 1-2 |
| MSMPHL 2355 | Pharmacology Summer Seminar | 1 |
| Total Credits | | 1 up to 3 |

DISSERTATION DEFENSE

*** Required courses for Molecular Pharmacology program (choose one) Molecular Pharmacology, Biology of Signal Transduction, Cancer Biology & Therapeutics, Drug Discovery or Neuropharmacology. (A total of 3 cr. is required)**

**** The Elective may be taken from either course offerings of the Molecular Pharmacology program or any graduate program that is included in the MD/PhD program. (A total of 4 cr. is required.)**

COURSE DESCRIPTIONS

Molecular Pharmacology

INTBP 2000 FOUNDATIONS OF BIOMEDICAL 8 CR.

Primary objectives of the course are to explore mechanisms controlling cell, tissue and organ function, and to develop an understanding of the experimental evidence supporting these concepts through an integrated presentation of material from biochemistry, cell biology, genetics, immunology, microbiology, neurobiology, pathology, pharmacology, and physiology. The development of critical thinking skills will be emphasized through an evaluation of experimental evidence and reading of the primary literature.

INTBP 2005 FOUNDATIONS CONFERENCE 4 CR.

Contemporary approaches to problem-solving in biology, as well as principles underlying modern methods of biomedical research will be integrated with the lecture component of the course through an analysis of mechanisms underlying biological phenomena. Students will present papers, critically analyze data and devise experimental approaches to biomedical problems

INTBP 2010 LABORATORY RESEARCH ROTATION 1 CR.

This lab is designed to introduce the student to relevant laboratory methods as well as the layout and conceptualization of experiments. The course will serve to acquaint the student with the laboratory process, and to facilitate his/her selection of a lab for dissertation research. Students are required to register for and complete rotations through three different laboratories, thereby ensuring broad exposure to method and practice.

INTBP 2013 D2K: FROM DATA TO KNOWLEDGE – BIOMEDICAL EXPERIMENTAL DESIGN & ANALYSIS 1 CR.

Experimental biologists formulate hypotheses and models, design experiments, collect data and conduct analyses to draw conclusions. Deep understanding on biological principles requires d2k- the translation of data into knowledge that transcends first-order conclusions. This course for first year PhD students in the biomedical sciences will examine basic principles of experimental design, together with measurement and sources of experimental error. The course will provide practical 'hands on' introduction to the quantitative tools required for experimental research using cellular, molecular, and systems based methods. Topics will include: goals of experimental design, making measurements, principles or parametric and non-parametric statistical inference, use of MS excel, GraphPad prism and r, design of publication graphics and a brief introduction to big data approaches. Students will work in small groups to construct capstone projects by making 'you tube' style videos to illustrate key principles of experimental design and analysis.

INTBP 2290 SCIENTIFIC ETHICS AND THE RESPONSIBLE CONDUCT OF RESEARCH 1 CR.

The course is an introduction to the basic ethical issues that arise in the course of conducting scientific research. It is intended for graduate students and fellows in the biomedical sciences who have completed at least one year of graduate work. The course will be composed of informal lecture presentations followed by discussion of issues in small groups.

MSMPHL 2310 PRINCIPLES OF PHARMACOLOGY 3 CR.

This course consists of a series of lectures and tutorial sessions that focus on the general principles of pharmacology. Major topics are principles of pharmacokinetics (including drug absorption, distribution, and metabolism), pharmacodynamics (quantitation of drug-receptor interactions) and mechanisms of action of cardiovascular and autonomic drugs. In addition, this course will include both animal laboratory and human simulator demonstrations that illustrate important pharmacological principles discussed in class.

MSMPHL 2350 RESEARCH SEMINAR 1 CR.

Beginning in the second year of the program students will be required to attend the Departmental Seminar Series. These seminars are held approximately once a week throughout the fall and spring semesters and include presentations by nationally and internationally recognized visiting researchers in pharmacology and related fields. In order to receive credit for the course, students must attend a minimum of 80% of the seminars.

MSMPHL 2355 PHARMACOLOGY SUMMER SEMINAR 1 CR.

Beginning in the summer of the second year, students will be required to participate annually in the Departmental Summer Research Seminar Series. These seminars will be held once a week throughout the summer and will be focused on the student's research plans and recent results. This presentation will be made to an audience with diverse research interests and should therefore include a brief summary of general background information. Each student will be required to present once each summer and attend a minimum of 80% of the summer seminars in order to receive credit for the course.

MSMPHL 2360 BIOLOGY OF SIGNAL TRANSDUCTION 3 CR.

This course will explore different types of signaling pathways activated by receptor-ligand interactions. Topics to be covered include, but are not limited to: G-protein linked receptors, adenylate cyclases, small GTPases, kinases and phosphatases, nitric oxide, phospholipases, steroid hormone signaling, and pharmacological applications of signaling pathways.

MSMPHL 2370 DRUG DISCOVERY 3 CR.

Drug discovery is an interdisciplinary science that seeks to identify small molecular and/or biologic entities for therapeutic intervention, and to understand integrated biological systems and processes at the functional and molecular levels. This comprehensive course will discuss various topics that are relevant to current approaches including fundamentals of therapeutics, traditional target-centric strategies, and preclinical and clinical drug development. Highlighted in this course will be quantitative systems pharmacology (QSP) as a new strategy for development of precision therapies. The course will include case studies intended to aid students in a full understanding of the drug discovery process.

MSMPHL 2390 DIRECTED STUDY 1-9 CR.

This course provides an opportunity for students to carry out a specific laboratory project in any area of interest in pharmacology.

MSMPHL 3300 PHD DISSERTATION RESEARCH 1-14 CR.

After advancement to candidacy for the PhD degree, students enroll in this course to pursue original experimental laboratory research, the results of which will provide the substance of their doctoral dissertation. A minimum of 40 credits of this course are required for the PhD degree in the school of medicine.

MSPHL 3310 CANCER BIOLOGY & THERAPEUTICS 3 CR.

This course presents biochemical and clinical aspects of cancer biology and therapy, and is designed for graduate students training in the basic sciences or medicine. The lectures cover the biology of normal and neoplastic cells, mechanisms of neoplastic transformation, chemical and environmental carcinogenesis, viral oncogenesis, breast and prostate cancer, radiotherapy, tumor immunology chemotherapy and chemoprevention.

MSMPHL 3320 JOURNAL CLUB 1 CR.

Beginning in the second year of the program students will participate in the Departmental Journal Club. Presentations will be held each week that the Department hosts a seminar speaker (i.e. 2-3 times/month) during the Fall and Spring semester. Students entering their fifth year of study may petition the Program Director to be excused from the Spring Session of the Journal Club. Sixth year students and beyond are not required to enroll in Journal Club although their attendance is encouraged. A log-in sheet will be available at all Journal Club meetings. All students in attendance will complete an anonymous peer-evaluation sheet that will be provided to the presenter. Students must inform the Program Director in advance if they are unable to attend a specific Journal Club. Excusable absences from Journal Club include individual or family illness or presentation (i.e. poster, platform talk) at a major scientific conference. Students are allowed two unexcused absence/semester.

The format of the Journal Club is as follows.

- Students will present a recent research article related to the topic area of the Departmental Seminar.
- Students are encouraged to contact the seminar speaker in order to get suggestions for a research article to present. It is not always necessary that an article from the seminar speaker's laboratory be chosen for the Journal Club. Importantly, the student should not choose a research article that will encompass a major segment of the seminar speaker's presentation.
- Students are required to present at least annually throughout their training.
- Once the Departmental seminar series is announced, students will submit their top three choices for presentation dates to the Director of the Graduate Program.
- The article to be presented in the Journal Club must be approved by the Graduate Program Director.
- Emphasis is placed on an illuminating presentation and critical evaluation of the research article including a discussion of the major strengths and weaknesses of the article.
- The student's thesis advisor and one other faculty member will be assigned as primary contacts for the Journal Club. In the event that a faculty member cannot attend their assigned Journal Club, he/she must arrange for a replacement. Students may seek the advice of the assigned faculty regarding choice of research article or their presentation. Assigned faculty members will provide the student with written feedback on their presentation using a standard evaluation form.*
*See Journal Club evaluation form and guidelines on next 2 pages.

MSMPHL 3330 GENOME INSTABILITY AND HUMAN DISEASE 3 CR.

Mechanisms that maintain genome stability allowed the origin of species. DNA damage is omnipresent and DNA repair and DNA damage tolerance mechanisms are interwoven in systems that control transcription, replication, cell division, signal transduction, cell death and evolution. More than 40 distinct human diseases are caused by defects in DNA repair, including syndromes of impaired development, immunodeficiency, cancer predisposition, neurodegeneration, and premature aging. This course will emphasize the molecular biology and biochemistry of DNA repair, placing these mechanisms into the context of other cellular processes as they pertain to health and disease. Environmental, clinical and endogenous sources of DNA damage will be discussed. An understanding of the fundamental role of DNA repair mechanisms in immunology, oncology, neurology, and aging will be central to all lectures.

The course comprises twenty-nine lectures that will be taught twice a week. Lectures will be fashioned around selected manuscripts and the recent text book: "DNA Repair, Mutagenesis, and Other Responses to DNA Damage (2014) Errol C. Friedberg, Stephen J. Elledge, Alan R. Lehmann, Tomas Lindahl & Marco Muzi-Falconi. Lecturers will include faculty from the Universities of Pittsburgh and Carnegie Mellon who are engaged in laboratory and clinical research at the forefront of the DNA damage and repair fields, as well as distinguished Professors visiting Pittsburgh from other Institutions.

MSMPHL 3335 DNA REPAIR JOURNAL 1 CR.

The course is a journal club on current topics in DNA repair as it relates to human disease, DNA damage processing, genome stability, telomere biology, cancer and aging (primarily designed for students in the second year of their graduate program and beyond). Presentations will be held twice per month during the fall and spring semester. In order to receive credit for the course, students must attend a minimum of 80% of the sessions, present once per semester, participate in class discussion and complete anonymous peer-evaluations for each presenter. One week prior to presentation, presenters will identify a recent publication in the field and distribute it to their classmates. Presenters must define the hypothesis of the paper, provide background and significance, describe experimental methods used, interpret the data, conclude whether the data support the authors' conclusions and propose future experiments. Grades will be determined by attendance (10%), class participation (20%) and quality of presentation (70%).

Presenter's Name: _____

Date of Presentation: _____

Please evaluate the student's Journal Club presentation using criteria appropriate for a grant proposal. Please rate the student on a scale of 1-9, where 1 is the best score, in each of the following categories.

1) Overall (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

2) Organization of Presentation (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

3) Knowledge of Background Material (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

4) Knowledge of Experimental Design/Description of Results (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

5) Ability to Answer Questions (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

Scores vs. Impact and Strength/Weakness

| Impact | Score | Descriptor | Strength/Weakness |
|-----------------|-------|--------------|---|
| High Impact | 1 | Exceptional | No weaknesses, exceptionally strong |
| | 2 | Outstanding | Negligible weaknesses, extremely strong |
| | 3 | Excellent | Some minor weaknesses, very strong |
| Moderate Impact | 4 | Very Good | Numerous minor weaknesses, strong |
| | 5 | Good | At least one moderate weakness, strong |
| | 6 | Satisfactory | Some moderate weaknesses, some strengths |
| Low Impact | 7 | Fair | At least one major weakness, some strengths |
| | 8 | Marginal | A few major weaknesses, a few strengths |
| | 9 | Poor | Numerous major weaknesses, a few strengths |

Minor Weakness: An easily addressable weakness that does not substantially lessen impact

Moderate Weakness: A weakness that lessens impact

Major Weakness: A weakness that severely limits impact

**MSMPHL 3340 FOUNDATIONS OF SUCCESSFUL
CAREER PLANNING AND
DEVELOPMENT PART 1 – 1CR.**

The goals of the fall and spring consecutive courses are to enhance the career development capacity and foster the life-long career management habits of graduate students and postdocs to maximize their scholarly training success and facilitate personal career outcomes. The courses will provide foundational background through experiential learning and small-group discussions, while facilitating peer mentoring. These approaches support the self-construction of individually relevant understandings of career development that is consistent with similar independence in scholarly expertise. The areas of focus include self-assessments, career exploration, goal setting, professional development, career planning and management, career adaptability, and additional topics identified by students. Participation in the subsequent spring course is expected for those enrolled in the fall prerequisite course.

**MSMPHL 3341 FOUNDATIONS OF SUCCESSFUL
CAREER PLANNING AND
DEVELOPMENT PART 2 – 1CR.**

The goals of the fall and spring consecutive courses are to enhance the career development capacity and foster the life-long career management habits of graduate students and postdocs to maximize their scholarly training success and facilitate personal career outcomes. The courses will provide foundational background through experiential learning and small-group discussions, while facilitating peer mentoring. These approaches support the self-construction of individually relevant understandings of career development that is consistent with similar independence in scholarly expertise. The areas of focus include self-assessments, career exploration, goal setting, professional development, career planning and management, career adaptability, and additional topics identified by students. Participation in the subsequent spring course is expected for those enrolled in the fall prerequisite course.

**MSMPHL 3360 MOLECULAR
PHARMACOLOGY 2 CR.**

This course examines molecular mechanisms of drug interactions with an emphasis on drugs that modulate cell signaling, cellular responses to drugs, and drug discovery. The course will include student participation through presentations and discussion of relevant contemporary scientific literature. Topics include: cell cycle checkpoints and anti-cancer drugs, therapeutic control of ion channels, and blood glucose, anti-inflammatory agents and nuclear receptor signaling, and molecular mechanisms of drugs used for the treatment of cardiovascular diseases.

MSMPHL 3375 NEUROPHARMACOLOGY 3 CR.

This course will broadly review neuropharmacology and neurobiology, study monoamine, cholinergic and GPCR biology, and explore the blood-brain barrier and its significance to neuropharmacology. The course will focus on the molecular mechanisms of drug action for different classes of compounds including, but not limited to, antidepressants, antipsychotics, anti-epileptics, anesthetics, weight loss, stimulants, neuroprotective, addiction, pain and migraine drugs. In addition to the formal lectures the course will emphasize critical reading of the primary literature through journal-club style discussions and cover the most recent treatment and therapeutic avenues being developed for a broad range of neurologic and psychiatric disorders.

**FTDS 0000 FULL-TIME DISSERTATION RESEARCH
STUDY 0 CR.**

Doctoral candidates who have completed all credit requirements for the degree, including any minimum dissertation credit requirements, and are working full time on their dissertations may register for this course. While the course carries no credits and no grade, students who enroll in "full-time dissertation study" are considered by the university to have full-time registration status.

ELECTIVES

Molecular

Pharmacology

Suggested Elective Courses from Molecular Pharmacology and Other Disciplines

Each student's elective curriculum will be designed according to his/her interests and needs. Other courses may be taken with the consent of the major advisor.

Molecular Pharmacology

Genome Instability and Human Disease

MSMPHL 3330

*offered in Spring alternate even years (next offered – Spring 2018)

Molecular Genetics and Developmental Biology

Developmental Mechanisms of Human Disease

MSBMG 2525 (Spring term)

Advanced Topics in Gene Expression

MSBMG 3510 (Fall term)

Cell Biology & Physiology

Cell and Molecular Physiology

MSCBMP 2830 (Spring term)

Regulation of Membrane Traffic

MSCBMP 2840

*offered in alternate odd years (next offered – Summer 2017)

Cellular & Molecular Pathology

Molecular Mechanisms Tissue Growth & Differentiation

MSCMP 2730 (Spring term)

Molecular Pathobiology

MSCMP 2740 (Spring term)

Special Topics

MSCMP 2780 (Fall term)

Topics in Experimental Neuropathology

MSCMP 3730 (Fall term)

Stem Cells

MSCMP 3740 (Fall term)

Human Genetics

Human Population Genetics

HUGEN 2022 (Spring term)

Chromosomes and Human Disease

HUGEN 2031 (Fall term)

Immunology

Comprehensive Immunology

MSIMM 2210 (Spring term)

Experimental Basis of Immunology

MSIMM 2230 (Spring term)

Contemporary Topics - Immunology

MSIMM 3220 (Fall term)

Immunology and Human Disease

MSIMM 3230 (Fall term)

Molecular Toxicology

Molecular Fundamentals

EOH 2310 (Fall term)

Molecular Virology & Microbiology

Molecular Virology

MSMVM 2410 (Spring term)

Microbial Pathogenesis

MSMVM 3410 (Spring term)

Neurobiology

Neurophysiology

MSNBIO 2001 (Spring term)

Neurobiology of Disease

MSNBIO 2112 (Spring term)

GRADUATE PROGRAM

Molecular Pharmacology

The graduate program is designed to provide a stimulating environment for highly motivated and qualified students to prepare for rewarding careers in biomedical research and teaching. The members of the faculty have a wide diversity of interests and are pursuing research projects that address fundamental, contemporary issues in pharmacology and medicine. We are committed to postgraduate education and our major objective is the integration of students into the most important aspects of our investigative work.

Program Design and Objectives

The Molecular Pharmacology Program in its affiliation with the Department of Pharmacology & Chemical Biology in the School of Medicine offers an advanced study program leading to the Doctor of Philosophy degree. Applicants enter the program through direct application to the Interdisciplinary Biomedical Science Graduate Program (IBGP) of the School of Medicine, which allows a choice of graduate training programs within any department of the Medical School. Students who are admitted to the Interdisciplinary Program are obliged to select a degree granting program early in the third term of their first year. The admission of students to the Interdisciplinary Program will be carried out by the Graduate Council of the School of Medicine, which serves as an Admissions Committee for the Graduate Division of Biomedical Sciences.

Because of the wide scope of pharmacology, applications are encouraged from persons with a bachelor's or master's degree in biochemistry, biology, microbiology, chemistry and pharmacy, as well as those with a master's degree in pharmacology or an MD degree. Students with other backgrounds will also be considered.

Graduate students who are admitted into the Interdisciplinary Biomedical Graduate Program will follow the guidelines of that program's first year curriculum. After completion of the first year curriculum, those students who have chosen to complete their graduate training in the Molecular Pharmacology Program will follow the policies of program as outlined in this handbook. Other information concerning housing, parking, and campus programs or facilities may be obtained from the relevant University offices or divisions.

The Department of Pharmacology & Chemical Biology has been given permission by the University of Pittsburgh's Office of the Provost to grant Master's Degrees to students who, for various reasons, are not able to complete their PhD degree. The Master's Degree will be awarded only to those students who have entered the doctoral program and are unable to complete their thesis research for personal, financial, or medical reasons. There will be no separate admissions to the Master's Degree program.

Admission to the Program

We welcome graduate students who have been accepted into the Interdisciplinary Biomedical Graduate Program (IBGP), which allows a choice of graduate training within any department of the Medical School. Students who are admitted into the IBGP are obliged to select a faculty advisor at the end of their first year. The admission of students into the IBGP will be carried out by the Graduate Council of the School of Medicine, which serves as an Admissions Committee for the Graduate Division of Biomedical Sciences. Information about the IBGP is available online at:

http://www.gradbiomed.pitt.edu/admissions_req.aspx

Registration Procedure

During registration for each succeeding term, each student will confer with his or her mentor about curriculum choices. Note that the Director of the Graduate Program will maintain an annotated course list to assist students and advisors in decisions about the preferability of specific course offerings as they relate to a particular student's curriculum. The student will fill out the enrollment form sign and have their mentor sign. The Graduate Program Coordinator will remove the Academic Advisor Service Indicator on the student's account once the signed enrollment form is received. After all holds have been removed from the student's account, the student may then enroll online. Online registration may be accessed at the Student Services portal (my.pitt.edu).

The Faculty Advisor

During a student's first year in the IBGP, the Director of the Molecular Pharmacology Program will act as a temporary advisor on the selection of courses for those students with a potential interest in Pharmacology. The Program Director will be cognizant of recommendations made by the Admissions Committee regarding courses to be taken for the purpose of remedying deficiencies that may exist in the record of any particular student. The Program Director will follow each student's progress through the formal course work of the first year.

Choosing a Faculty Advisor

During the first three terms in residence, students spend one term in the laboratory of three faculty members (INTBP 2010, Laboratory Research

Rotations) in order to gain a basis for choosing a thesis topic and a faculty advisor. Any qualified student in the IBGP may choose to join the Molecular Pharmacology Program even if he or she initially expressed interest in another program.

Early in the third term after completion of the lab rotations, the student will choose an advisor who will assist the student in deciding the subject of the dissertation research program, and who will remain in close consultation with the student regarding various aspects of the research as it unfolds. The student must then submit written notification of his or her faculty advisor choice to the IBGP.

Degree Requirements

The Molecular Pharmacology Graduate Program is comprised of a combination of coursework and original laboratory research which usually allows attainment of the PhD degree within 4-5 years. The University requires the minimum elapsed residence time for the PhD degree to be six terms of full-time graduate study, and the PhD degree work must be completed within a period of 10 years of full-time enrollment. It is the Department's expectation that, once enrolled, students in the Pharmacology Graduate Program do not interrupt their progress. Emergency circumstances will be evaluated and resolved by the Graduate Executive Committee on a case-by-case basis. If a student is unable to complete his or her thesis work for personal, financial, or medical reasons, a Master's Degree will be awarded to those who complete the necessary requirements. There will be no separate admissions to the Master's Degree option.

To satisfy the PhD requirement, a minimum total of 72 credits is required of which 32 credits must come from formal course work. Detailed requirements for completion of the Ph.D degree are described in the following sections.

Coursework

IBGP Requirements

All students will participate in a first-year curriculum through the INTBP and must receive a grade of B or better in INTBP required courses (i.e. INTBP 2000, INTBP 2005, INTBP 2013, INTBP 2290) before formal admissions to specialized programs. Students are expected to select elective courses in areas of particular interest or deficiency in consultation with the Director of the Graduate Program. To allow active participation in all aspects of the Graduate Program, we strongly recommend that entering graduate students who are not fluent in English take a University-level course in conversational English. This may be taken without credit, if desired, but a grade from any such course will not contribute to the student's GPA for the Graduate Program. Students must maintain an overall GPA of 3.0 to maintain good standing in the graduate school.

Molecular Pharmacology Program Course Requirements *

The Molecular Pharmacology program requires 4 courses:

1. MSPHL 2310 (Principles of Pharmacology)
2. MSPHL 2360 (Biology of Signal Transduction)
3. MSPHL 3360 (Molecular Pharmacology)
4. MSPHL 3310 (Cancer Biology and Therapeutics), MSPHL 2370 (Drug Discovery) **or** MSPHL 3375 (Neuropharmacology).

Electives

The MSMPHL 3330 (Genome Instability and Human Disease) plus additional courses taught by other Medical School basic science departments are suitable for graduate electives. Students may choose an elective course offered in another department with the approval of the Program Director.

*see Table 1, p.21

Grades

University policy dictates that the student have a cumulative quality point average (Q.P.A.) of at least 3.0 in order to graduate. This grade average is computed on the basis of course credits only, and students are graded on an A to F letter grade scale in both required and elective courses. A minimum grade of B must be attained in all IBGP and Molecular Pharmacology required courses. Advanced level courses, unless taken prior to the Preliminary Examination, will normally be graded on an S/N basis. S indicates satisfactory grade attainment. N indicates noncredit audit and does not count towards residence. Only A through F grades are employed for the Q. P. A. computation. If a student has failed to maintain the minimum grade requirement (i.e. either in required course or overall Q. P. A.), a faculty committee consisting of the Department Chair, the Director of the Graduate Program and the Vice-Director of the Graduate Program will advise and guide student progress.

Graduate Student Evaluations

The Process

The purpose of the evaluation process is to provide students with a formal assessment of their progress through the Graduate Program. Evaluation of graduate student progress will be administered by the Chairperson of Student Evaluations and Progress Committee, the Director and Vice-Director of the Graduate Program and the Department Chair.

Evaluation of Coursework

The Director of the Graduate Program will ensure that students are successfully accomplishing graduate level classes (cumulative Q.P.A. of 3.0; 3.0 in all required courses), and will recommend make-up exams or other remedial actions if necessary.

Evaluation of Lab Rotations

Students will be evaluated according to the general guidelines specified by the INTBP.

Evaluation of Seminar and Journal Club Presentations

Participating faculty will provide feedback on the quality and content of public presentations, and will grade students accordingly.

IBGP and MOLECULAR PHARMACOLOGY PROGRAM

REQUIRED CORE COURSES

| Course number | Course Names | Credits |
|---|---|----------------|
| INTBP 2000 | Foundations of Biomedical Science | 8 |
| INTBP 2005 | Foundations Conference | 4 |
| INTBP 2013 | D2K: From Data to Knowledge – Biomedical Experimental Design & Analysis | 3 |
| INTBP 2290 | Scientific Ethics | 1 |
| INTBP 2010 | Lab Rotations PhD-3 min (MSTP-2) | 3 |
| | Total in INTBP: | 19 |
| | | |
| | | |
| MSMPHL 2310 | Principles of Pharmacology | 3 |
| MSMPHL 2360 | Biology of Signal Transduction | 3 |
| MSMPHL 3360 | Molecular Pharmacology | 2 |
| MSMPHL 3310/MSMPHL 3375/MSMPHL 2370 | Cancer Biology & Therapeutics / Neuropharmacology / Drug Discovery | 3 |
| MSMPHL 3340/3341 | Foundations of Successful Career Planning and Development Part 1 & 2 | 2 |
| TBD (Mol. Pharm. or select courses from other programs) | <i>Elective (min. 2 credits)- may be taken in first year spring term or 2nd year fall or spring term</i> | 2 |
| | Total in Mol. Pharm. per se: | 15 |

Annual Progress Report

All graduate students beginning in their second year must submit a progress report summarizing activities and accomplishments during the past year and plans for the next academic year. A brief assessment of the student's progress by the student's research advisor will also be incorporated into the evaluation. On May 1, the appropriate forms will be sent to students and faculty advisors. In addition, annual reports from the student's thesis committee chairperson are included in the evaluation. The progress report will be organized as follows:

- List of prior year's goals and accomplishments. Include Program "milestones" that were completed (e.g. required coursework and grades, Comprehensive Examination, Thesis Proposal),
- List of awards, honors or other forms of recognition
- List of manuscripts and abstracts published
- List of attendance and presentations at scientific conferences
- Most recent Thesis Progress Report or Thesis Proposal (for third year students), or brief (1-2 page) description of research goals and accomplishments (for second year students)
- Specific academic training and research objectives for the coming academic year (1-2 pages).

This Annual Progress Report will have a maximum length of 10 pages (12 point Arial font, double-spaced) and are to be submitted to the Molecular Pharmacology Graduate Program Administrator (Patricia J. Smith, W1340 Biomedical Science Tower) by June 15.

Evaluation of yearly Progress Reports

All students, beginning in the 2nd year of graduate study, are evaluated annually in June by the Director of the Graduate Program and the Vice-Director of the Graduate Program. Results of these evaluations are reported to each student in a letter from the Director of the Graduate Program and may be supplemented by individual discussions. Students are encouraged to discuss evaluations with their research advisor. In evaluating students, the committee considers all aspects of graduate training: laboratory research, course work, teaching, journal club presentations, meeting presentations, mastery of the relevant scientific literature, performance on any major examinations that have been taken in the past year, timely completion of program milestones and contributions to the scientific and clinical community at large. Any thesis committee reports available will also be included.

Outcome of Student Evaluation

The Annual Progress Report for Molecular Pharmacology graduate students is designed to track student accomplishments and timely fulfillment of Program Milestones (see below). The summary evaluation reports from the Program Director to the students (provided on or about July 15) will aid in directing students towards completion of key goals and may also convey requirements and expectations for the following academic year.

Deadlines for Program Milestones

1. Completion of Required Coursework:

End of Spring Term, 2nd Year (PhD) (1st –MD/PhD)

2. Comprehensive Exam:

End of Spring Term, 2nd Year (PhD) (1st –MD/PhD)

3. Nomination of a Doctoral Dissertation Advisory and Final Examination Committee:

End of Summer Term, 2nd Year (PhD) (1st MD/PhD)

4. Dissertation Overview/Prospectus meeting:

End of Summer Term, 2nd Year (PhD) (1st MD/PhD)

5. Application for Admission to Candidacy:

End of Summer Term, 2nd Year (PhD) (1st –MD/PhD)

6. Thesis Committee Meetings:

Yearly, following Dissertation Overview/Prospectus meeting, or as often as needed if deemed helpful by thesis committee.

Comprehensive Examination Guidelines

Introduction

The comprehensive exam or (CE) is a major milestone in the Molecular Pharmacology PhD Program. The exam takes the form of a research proposal. As such it is expected to be an original, scholarly proposal that is presented in both written and oral form and defended.

This document provides the formal guidelines for completing the CE and guidance and advice for students approaching the exam process. Specific requirements of the CE process including submission deadlines are outlined below.

Subject and Scope of the Exam

Students are expected to complete the exam by the end of the second year spring semester. Typically, this means that students will have spent some time in the laboratory in which they will perform their dissertation research, and may have already identified a topic for the dissertation project. **The subject of the comprehensive exam can be derived from the student's anticipated dissertation but must be distinct from any funded or recently submitted grant proposal of the thesis advisor.** The Chair of the Graduate Student Evaluations Committee will serve as the comprehensive exam advisor (CEA), and will scrutinize the relation of the CE to grant proposals of the thesis advisor. The CEA can require the student to modify the CE subject if it is unacceptably close to a thesis advisor's grants or grant proposal.

It is important that the project presented in the CE be feasible. For this exam, "feasible" means that the project could be completed primarily by the student within three years of full-time research, with some degree of technical assistance if appropriate. There is no specified number of specific aims required, although a project of this nature will typically contain two or three aims. The project should be original, such that one would not normally expect to find published literature describing the results of the project prior to the completion of the exam.

Outline of Exam Procedure

The exam procedure involves the following steps:

- 1) The student prepares a 1-page summary of the project that includes clearly defined Specific Aims and presents it to his/her dissertation advisor.
- 2) Once approved by the student's dissertation advisor, the summary will be transmitted to the CEA. The student should also submit Specific Aims pages from his/her thesis advisor's funded or recently submitted grant applications.
- 3) The CEA may ask for modifications of the 1-page summary before assigning a CE Committee (CEC; see below). Students can recommend faculty to the CEA that could serve as members of the CEC.
- 4) The CEC has to notify the CEA, the student and thesis advisor within 1 week after receipt of the 1-page summary if changes are required. The CEA will send reminders to the CEC if this deadline is not met. The Graduate Program Director and Department Chair will be notified of any extensive delay in the meeting of this deadline (i.e. beyond 12-14 days) and take appropriate action.
- 5) Once all members of the CEC approve the 1-page summary, final approval is issued to the student.
- 6) The student then has 30 days to submit a written proposal ("6-page proposal", see below) to members of the CEC.
- 7) The CEC will provide feedback on the proposal within 15 days and the student has 5 days to incorporate the suggestions by the CEC. The CEA will send reminders to the CEC or the student if these deadlines are not met. The Graduate Program Director will be notified of any extensive delay in the meeting of these deadlines and take appropriate action.
- 8) The student will then submit the final version as the basis for the oral examination.
- 9) At the time of submission of the 6-page proposal, the student will schedule and oral defense of the proposal, which must take place within 3 weeks. A minimum of at least two hours should be scheduled for the oral defense.

This procedure varies from past practices in that it recognizes that the responsibility for preparing the CE summary rests primarily with the student under the guidance and direction of the dissertation advisor, rather than with the CEC. In this way, the subject of the CE should provide a more meaningful contribution to the student's dissertation studies. The advisor should neither suggest potential CE topics to the student nor provide a topic in the form of a previously submitted grant proposal. However, the advisor does have oversight responsibility for guiding the student toward a practical, feasible and manageable proposal, and should anticipate being an important source of advice and guidance in the preparation of both a successful 1-page summary, as well as the 6-page final proposal submitted as the basis for the oral exam.

The Comprehensive Exam Committee (CEC)

The CEA will normally select members of the CEC from the Molecular Pharmacology Training Program's training faculty, but is free to invite individuals from outside the program to participate in the process if there is a perceived need for expertise that is not represented within the program. The CEC will be composed of four members, three of whom must be members of the Molecular Pharmacology Training Program. The CEA will appoint one of the members to be the Chair of the committee, and the Chair will coordinate the activities of the CEC. The dissertation advisor **will not** be a member of the CEC. One-page summaries submitted to the CEC will have the approval of both the dissertation advisor and the CEA, and therefore will typically not require further modifications. Under exceptional circumstances, the CEC may request modifications of the 1-page proposal but only with the consent of the CEA and the student's dissertation advisor. Such requests have to be made within 1 week after receipt of the 1-page proposal by the CEC. The CEC will meet with the student formally to charge the student with the task of preparing the 6-page proposal and address any questions or concerns that the student may have.

Time Line

The student should complete the 6-page proposal and provide printed copies (unless instructed otherwise) to each member of the exam committee within 30 days of receiving approval from the CEC. The CEC Chair will indicate the start date. The CEC will provide written feedback (i.e. 1-2 paragraphs) on the proposal within 15 days after receipt of the 6-page proposal. The student will have 5 days to incorporate the suggestions by the CEC. The student will then submit the final version that will serve as the basis for the oral exam. The oral defense will be held 1-3 weeks after the final 6-page proposal has been submitted to the CEC. Faculty should make every effort to be available for the completion of the oral defense. If they anticipate not being available, they should indicate this at the time of formation of the CEC.

Format of the Written Proposal (“6-page proposal”)

The written exam should be structured like a proposal that would be submitted to the NIH in the R21 format. See <http://grants.nih.gov/grants/funding/r01.htm>

The proposal is limited to 6 single spaced pages. However, the bibliography, any illustrations or sample data do not count toward the 6 page limit. The proposal should be prepared using an 11 -point font and formatted with no less than half-inch margins, pages numbered. There is no required format for the bibliography, but it is expected that the bibliography will be complete (full citation with article title), accurate, and will use a consistent style that is taken from a specified journal. Typically, proposals of this magnitude will have a bibliography of about 2 pages.

Given that proposals may describe a hypothetical project, in some cases it is unlikely that there will be actual data presented by the student. It is anticipated that the student will be fully conversant with the measures of outcome relevant for their approach, the quantitative analysis of the results, and also their statistical interpretation and validation. Furthermore, the student should have the ability to respond to background questions that address fundamental biological or chemical principles underlying the work proposed.

Oral Defense

The oral defense is not an open exam and will typically be attended only by the student and the CEC, although the CEA or program director may be present if requested by the student or the student's advisor. The defense will include an oral presentation summarizing the project, which will typically last for 20-30 minutes, followed by questions from the CEC. The scope of the questions will usually focus on the experimental rationale, procedures, and outcomes outlined in the proposal. In addition, questions may also address any topics directly relevant to the proposal that have been covered in the core curriculum material presented during the first two years of graduate school to test the student's fundamental knowledge and scientific reasoning capabilities. A minimum of at least two hours should be scheduled for the oral defense.

Evaluation Guidelines for Students and CEC Members

The CEC will evaluate the written proposal and oral defense using criteria appropriate for any grant proposal. The project should be (1) feasible, (2) rational, (3) original, and (4) significant. To provide feedback to students, at the completion of the exam each member of the committee will score the student in each of these 4 categories on a scale of 1-9, where 1 is the best score (see score sheet). The student will receive the mean score in each category at the completion of the exam. This scoring system is intended to provide feedback to the student on the relative strengths and/or weaknesses of the proposal, and is not intended to establish an explicit scoring mechanism for passing or failing the exam.

Potential Outcomes of the Exam

Several outcomes from the CE are possible:

- Based upon the committee's evaluation of the document and the oral defense the student can be awarded a pass, which completes the CE process.
- If either the document or the oral defense is considered inadequate, the CEC can ask the student to either modify the document or repeat the oral defense. In the case of the former required modifications of the proposal document can vary in scope and include either rewriting of specific sections of the proposal or addition of supplemental text to clarify deficiencies in experimental design, background material or comprehension of basic principles covered in the oral examination. Any revised CE documents must be submitted to the CEC within 7 days of the original exam. If the student is required to repeat the oral exam, a defense must take place within 7 days of the original oral defense. In either case the Chair of the committee will provide written feedback to the student explaining what components of the exam were inadequate and why.
- The student can receive a failure grade from the CEC. Again, the Chair of the CEC will provide written feedback to the student indicating the nature of the inadequacies. In this case, the written report is also transmitted to the Program Director for further action.

The Program Director, under the guidance of the Graduate Executive Committee, will take appropriate action if a student fails the CE based on the original proposal. Typically, students failing the exam once will have the opportunity to retake the exam. This will require rewriting of a new proposal and repeating the oral defense within 3 months. Given that this is a major milestone in the PhD program, failing to pass the CE may result in a student being terminated from the program. Students will not be allowed to repeat the CE a second time.

Advice and Suggestions

In describing the CE process, we can establish reasonable guidelines describing how the process is intended to work. However, in practice there are circumstances that may not be anticipated by this document, and the resolution of such circumstances will be managed by the Program Director and the CEA.

The conceptualization of the research project and its formulation into the proposal is clearly and primarily the responsibility of the student. However, as with any grant proposal and scientific inquiry, concepts and approaches are often improved by discussion with other qualified individuals, and we fully anticipate that students will discuss their projects with both students and faculty. As this is likely to be the first major proposal prepared by the student, the student's advisor will be an important source of advice and feedback on its preparation to assure that this is an effective didactic activity as well as an evaluative process. Nevertheless, the CE should be fundamentally original work of the student and not a re-packaged proposal from the advisor or anyone else. It is also reasonable for students to consult previously successful CE documents, and these will be made available from the graduate coordinator.

While this is a major milestone in the doctoral program, it is also important to recognize that there should be reasonable limits placed on the time invested in completing the CE. Under the present guidelines we anticipate that a student will spend approximately one month actively gathering information that will help to provide the conceptual framework of the proposal, which will result in the generation of the one page proposal. The student should normally anticipate final approval of the proposal within one week from submission to the CEA. The ensuing 6 page proposal must be submitted to the CEC within 30 days of its approval. The defense must be scheduled within 3 weeks following submission of the CE to the CEC.

Comprehensive Examination Evaluation Form

Student Name (Reviewer): _____

Date: _____

Please evaluate the student's **written proposal** using criteria appropriate for any grant proposal. Please rate the student on a scale of 1-9, where 1 is the best score, in each of the following categories.

2) Overall (Including quality of writing) (Score 1-9):

Note- Overall score must be 5 or below to continue with oral defense

Comments:

2) Feasibility (Score 1-9):

Comments:

3) Rationale (Score 1-9):

Comments:

4) Originality (Score 1-9):

Comments:

5) Significance (Score 1-9):

Comments:

Comprehensive Examination Evaluation Form

Student Name (Reviewer): _____

Date: _____

Please evaluate the student's **oral proposal** using criteria appropriate for any grant proposal. Please rate the student on a scale of 1-9, where 1 is the best score, in each of the following categories.

1) Overall (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

2) Organization of Presentation (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

3) Knowledge of Background Material (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

4) Knowledge of Experimental Design/Potential Outcomes (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

5) Ability to Answer Questions (Score 1-9):

| |
|-----------|
| Comments: |
|-----------|

Scores vs. Impact and Strength/Weakness

| Impact | Score | Descriptor | Strength/Weakness |
|-----------------|-------|--------------|---|
| High Impact | 1 | Exceptional | No weaknesses, exceptionally strong |
| | 2 | Outstanding | Negligible weaknesses, extremely strong |
| | 3 | Excellent | Some minor weaknesses, very strong |
| Moderate Impact | 4 | Very Good | Numerous minor weaknesses, strong |
| | 5 | Good | At least one moderate weakness, strong |
| | 6 | Satisfactory | Some moderate weaknesses, some strengths |
| Low Impact | 7 | Fair | At least one major weakness, some strengths |
| | 8 | Marginal | A few major weaknesses, a few strengths |
| | 9 | Poor | Numerous major weaknesses, a few strengths |

Minor Weakness: An easily addressable weakness that does not substantially lessen impact

Moderate Weakness: A weakness that lessens impact

Major Weakness: A weakness that severely limits impact

The Dissertation Proposal

For the first meeting of the Doctoral Committee (i.e. **Dissertation Overview/Prospectus Meeting**), students will prepare a short written research proposal to be submitted to the committee at least one week prior to the meeting. This proposal should detail the intended course of the dissertation research and should include an indication of experimental techniques to be used, but need not provide extended experimental details or preliminary data. A minimum of at least two hours should be scheduled for the first meeting of the Doctoral Committee (i.e. Dissertation Overview/Prospectus Meeting).

At the Dissertation Overview/Prospectus Meeting, students will give a short presentation that outlines the proposal with particular emphasis on background information, rationale and feasibility of the project, and general experimental approaches that will be used for the project. Preliminary data, if available, can be included in the oral presentation. The written proposal and oral presentation must gain the unanimous approval of the Doctoral Committee to be considered acceptable. Acceptance of the proposal by the Doctoral Committee will allow students to be admitted to candidacy for the doctoral degree. The Committee will be composed of the student's PhD advisor, three faculty from the Molecular Pharmacology Training Program, and one external examiner. Approval for the inclusion of additional faculty on this committee must be obtained from the Program Director.

Thesis Committee Meetings

Students are required to have yearly Thesis Committee meetings, but additional meetings may be called if deemed necessary or helpful by the Thesis Committee. At least one week prior to meeting, students are required to submit a brief Thesis Progress Report (i.e. 3-5 pages) to their committee that briefly describes the objectives outlined from the previous committee meeting, the progress towards those objectives, any problems that may have been encountered and plans for the coming year. This Thesis Progress Report must be included in the required Annual Progress Report that is submitted to the Molecular Pharmacology Program Director.

Students should also plan to deliver a brief presentation at this meeting, which summarizes the material in the Thesis Progress Report. Special meetings could be called to address unusual circumstances such as: a) significant changes in the direction of the student's research, b) conflict resolution or c) relocation of the student's primary research advisor

The Dissertation

The University guidelines state: "Each student must write a dissertation that presents the results of a research project carried out by the student. An appropriate research project involves a substantial piece of original and independent research grounded in an appropriate body of literature. It presents a hypothesis, which is tested by data and analysis, and provides a significant contribution in that field."

It is anticipated, but not required, that most students will have published or have submitted for publication multiple peer-reviewed articles based on their thesis research at the time of the final exam. In order to facilitate preparation of the thesis, students are permitted to compile these papers into the final dissertation. This compilation should include a comprehensive introduction to the field of study and a comprehensive discussion of the body of work at the end. The dissertation should include a preface that indicates the publication status of the papers that have been compiled, as well as an indication of co-authors and their contributions to the work described. The dissertation should be compiled by assembling manuscripts into chapters of the dissertation, with each chapter including an introduction, methods, results, and conclusions. Figures and tables should be re-numbered to provide continuity throughout the dissertation, and literature citations arranged in a single bibliography at the end of the dissertation.

The Final Exam

The final copy of the dissertation will be submitted to the Doctoral Committee as noted below. The thesis defense will consist of a public seminar on the subject of the dissertation, followed by an examination from the Doctoral Committee that is chaired by a committee member other than the major advisor. This latter examination may be attended by nonmembers of the Doctoral Committee who make prior request, but such visitors may not participate in the questioning. Approval of the Thesis will be granted if there is no more than one dissenting vote by full members of the Doctoral Committee exclusive of the major advisor. Students must submit their final thesis within the same term in which the thesis defense was held. Any exceptions to this rule will require approval by the Director of the Graduate Program. The degree will be granted by the School of Medicine.

All graduate students must be on active status (i.e., must have been registered for a minimum of three credits during a twelve month period) and must register for at least one credit during the term in which they graduate. Students who complete all the degree requirements in one term but graduate in the next may petition the Dean for a waiver of this requirement. A student who is on inactive status may be readmitted and register for three credits in order to graduate.

UNIVERSITY OF PITTSBURGH
MOLECULAR PHARMACOLOGY

Name: _____
(Student)

Date: _____

Subject: Committee Selection – PhD degree

In accordance with the requirements of the Molecular Pharmacology Graduate Program, I request that my Doctoral Committee be approved. The following faculty members have agreed to be on the Dissertation committee:

(Committee requirements- Major Advisor and Committee Chair cannot be the same Faculty but both must be Molecular Pharmacology Faculty and have Graduate Faculty status; At least one more Faculty from Molecular Pharmacology; At least one more Faculty with Graduate Faculty status; External Committee Member must be Faculty outside the Molecular Pharmacology program) Graduate Faculty Status can be found: <http://ir.pitt.edu/graduate-faculty-roster/>

| | Department/Institution |
|---------------------------------------|-------------------------------|
| _____ Major Advisor | <u>Molecular Pharmacology</u> |
| _____ Committee Chair | <u>Molecular Pharmacology</u> |
| _____ | <u>Molecular Pharmacology</u> |
| _____ | _____ |
| _____ External Committee Member _____ | |

Approval of Program Director _____ Date _____

Procedures and Requirements for the Final Defense

The following procedures and requirements have been established by the School of Medicine and must be met before the last day of the term that the student applied for graduation.

First, at least one month prior to the defense, the student will make arrangements with his/her department for the final defense. A minimum of at least three hours should be scheduled for the defense. The information will be relayed to the Office of Graduate Studies in letter form, stating the student's name, department, degree sought, title of dissertation, date, time, and place. This information will then be forwarded by the Office of Graduate Studies to the University Times for publication (must be received within the stipulated time frame for this publication). The announcement will also be sent by the Office of Graduate Studies to the Graduate Faculty Members of the School of Medicine.

Second, each member of the student's Doctoral Committee (identified on form PITT-1976), Nomination of the Doctoral Thesis Defense Committee and Final Examination Committee, should be given a draft of the thesis a minimum of two weeks before the final defense.

The final approved dissertation should be in PDF format and contain bookmarks at least for every chapter and /or section and for all tables and figures.

Third, after the final defense, the following should be brought to the Graduate Studies Office (as one package):

- Three copies of the title page.
- Three copies of the abstract (350-word maximum) initialed by committee chair in upper right corner.
- Completed and signed ETD Approval Form, signatures of the dissertation committee on the first page, and Parts A and B on the second page must be signed. The dissertation director's signature must appear on Part B on the second page.
- A letter from the Program Director giving official notice that the candidate has fulfilled all the academic requirements (change of status and change of grade cards should accompany this letter).
- The forms required by the Provost's Office for acceptance of the thesis: Survey of Earned Doctorate (used by National Research Council), and the agreement form to permit publication of the dissertation by University Microfilms, Inc (UMI). If the student desires copyright registration service from UMI for the thesis, he/she should fill out that section, sign, and attach a check in the proper amount to University Microfilms, Inc.
- An official receipt [PITT-1049-1(195)] from the Student Payment Center (G7 Thackeray Hall) for payment of thesis processing fee.
- Completed and signed UMI Doctoral Dissertation Agreement Form
- Upload your ETD to D-scholarship@pitt.
- The Graduate Office should be notified of the student's ETD submission in order for your submission to be processed.

Students who have further questions or concerns regarding preparation of the final defense should contact the INTBP Office at (412) 648-8957.

MD/PHD PROGRAM

Molecular Pharmacology

Admissions

The University of Pittsburgh School of Medicine offers an MD/PhD program that requires a minimum of six years of study. This section provides a summary description of the program as it applies to students who choose to pursue PhD training within Molecular Pharmacology. While working towards a PhD degree, the MD/PhD candidate will be eligible for graduate student tuition remission and stipend support, the same as available to students in the PhD program. More complete information regarding details of the MD requirements and additional financial aid can be obtained from the admissions office of the Director of the MD/PhD Program in the School of Medicine. Prospective students who apply to the MD/PhD program will be reviewed by the Office of Admissions in the School of Medicine and by a Scientific Review Committee made up of chairmen or other representatives of the participating basic science and engineering departments. If qualified, a physician/ scientist candidate will be admitted to Medical School and to a graduate program in one of the participating departments at the same time. Thus, there will be two “admission committees” advising the Dean about the admission of MD/PhD candidates to the School of Medicine. The Scientific Review Committee will coordinate its review of MD/PhD candidates with that of the Medical School Admissions Committee.

The Director of the MD/PhD Program in the School of Medicine will serve as the temporary advisor for admitted students during their first year. This advisor will aid the student in planning his/her scientific work in the department selected by the student during the summer following the first year of medical school, and will urge the student to select a permanent thesis advisor as early as possible during the second year of the program. It is expected that most of these students will finish the first two years of Medical School with their classmates and take the National Board Examinations Part I at the usual time.

Requirements

The overall University and Molecular Pharmacology program requirements for obtaining a PhD as described in this manual, are the same for MD/PhD students. However, MD/PhD students obtain advance credit for medical school coursework and laboratory rotations completed prior to enrollment.

MD/PhD Students: Coursework

MD/PhD students entering the Molecular Pharmacology program receive 16 credit hours for their MD coursework that is applied towards the 32 credit hours of coursework required by the University. In addition, prior to entering the Molecular Pharmacology program formally, students will have received 9 additional credit hours derived from the completion of INTBP required courses. These include 4 credits for Foundations of Biomedical Sciences Conference (INTBP 2005), 2 credit hours for two laboratory rotations (INTBP 2020; 1 credit hour each) and 3 credits for INTBP 2013 D2K: From Data to Knowledge – Biomedical Experimental Design & Analysis. INTBP 2013 is required in addition to the Clinical Epidemiology and Biostatistics course taken during the first year of medical school. If an equivalent graduate level statistics course has already been completed with a grade of B or better, the Associate Dean of Graduate Studies may be petitioned in writing for permission to opt out of this course. Documentation to support the petition must include a textbook used for the course or a syllabus that includes a detailed description of the course. Thus, MD/PhD students will enter the Molecular Pharmacology Program with 25 of their 32 required credit hours of coursework already completed.

The remainder of the 7 credit hours of required coursework will be taken from core Molecular Pharmacology elective courses (3 total credit hours) and approved elective courses (4 total credit hours). Electives can be taken from either course offerings of the Molecular Pharmacology program or any graduate program that is included in the MD/PhD program.

Choice of Courses for MD/PhD Students in Molecular Pharmacology Program

Molecular Pharmacology Required Core Courses-choose minimum 3 credit hours.

Either Molecular Pharmacology (2 credit hours)
Biology of Signal Transduction (3 credit hours)
Cancer Biology & Therapeutics (3 credit hours)
Drug Discovery (3 credit hours)
OR Neuropharmacology (3 credit hours).

Electives – See ELECTIVES section

Examination

The examinations set for PhD students will be taken by MD/PhD students as follows:

All MD/PhD students in the Molecular Pharmacology program are required to complete their comprehensive examination during their first graduate year. A full description of the Comprehensive Examination is contained in the Molecular Pharmacology Graduate Student Handbook. A minimum of at least two hours should be scheduled for the oral defense. After completing the Comprehensive Examination, students may submit the Application to Candidacy form. This ensures that students can obtain PhD Dissertation Credit Hours beginning in Fall term of the second year. The University requires that PhD students accumulate at least 40 credit hours of PhD Dissertation Research, which requires a minimum of 1.5 years to complete. A Doctoral Committee is formed according to program guidelines (see Graduate Student Handbook) and will meet with the student soon after completion of the Comprehensive Examination.

MD/PhD Students: PhD Dissertation Proposal

At the first meeting of the Doctoral Committee, the students must present a written research proposal (i.e. Dissertation Proposal). This proposal should detail the intended course of the dissertation research, and should include an indication of experimental techniques to be used, but need not provide extended experimental details or preliminary data. The proposal must gain the unanimous approval of the Doctoral Committee to be considered acceptable. If deemed unacceptable, the student will be given an opportunity to present the proposal at a later date. A minimum of at least two hours should be scheduled for the first meeting of the Doctoral Committee (i.e. Dissertation Overview/Prospectus Meeting).

MD/PhD Students: PhD Dissertation Proposal

At the first meeting of the Doctoral Committee, the students must present a written research proposal (i.e. Dissertation Proposal). This proposal should detail the intended course of the dissertation research, and should include an indication of experimental techniques to be used, but need not provide extended experimental details or preliminary data. The proposal must gain the unanimous approval of the Doctoral Committee to be considered acceptable. If deemed unacceptable, the student will be given an opportunity to present the proposal at a later date.

MD/PhD Students: Subsequent Years and Completion

Students focus on dissertation research and are required to meet with their Doctoral Committee every six months to discuss progress and future plans. The final copy of the dissertation will be submitted to the Doctoral Committee. The thesis defense will consist of a public seminar on the subject of the dissertation, followed by an examination by the Doctoral Committee, and chaired by a committee member other than the major advisor. A minimum of at least three hours should be scheduled for the defense. Nonmembers of the Doctoral Committee who make a prior request may attend this latter examination, but such visitors may not participate in the questioning. Approval of the Thesis will be granted if there is no more than one dissenting vote by full members of the Doctoral Committee exclusive of the major advisor. Additional details regarding content and style of the dissertation are provided in the Molecular Pharmacology Graduate Student Handbook.

CONTACTS:

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