PHARMACOLOGY (PHRM)

PHRM 309. Principles of Pharmacology. 3 Units.
Principles of Pharmacology introduces the basic principles that underlie all of Pharmacology. The first half of the course introduces, both conceptually and quantitatively, drug absorption, distribution, elimination and metabolism (pharmacokinetics) and general drug receptor theory and mechanism of action (pharmacodynamics). Genetic variation in response to drugs (pharmacogenetics) is integrated into these basic principles. The second half of the course covers selected drug classes chosen to illustrate these principles. Small group/recitation sessions use case histories to reinforce presentation of principles and to discuss public perceptions of therapeutic drug use. Graduate students will be expected to critically evaluate articles from the literature and participate in a separate weekly discussion session. Recommended preparation for PHRM 409: Undergraduate degree in science or permission of instructor. Offered as PHRM 309 and PHRM 409. (CHEM 223 and CHEM 224), or (CHEM 323 and CHEM 324), or (EBME 201 and EBME 202), or (BIOL 116 and BIOL 117).

PHRM 400. Research Experience in Pharmacology. 0 - 1 Units.
Research rotation in pharmacology.

PHRM 401. Principles of Pharmacology I: The Molecular Basis of Therapeutics. 3 Units.
This core course focuses on the chemical and biochemical properties of therapeutic agents and molecular mechanisms of therapeutic action, including kinetic and thermodynamic principles of enzyme catalysis and drug-receptor interactions. Moreover, emphasis is placed on fundamental principles of pharmacokinetics, including the absorption, distribution, metabolism, and excretion of drugs. Mathematical concepts needed to understand appropriate administration of drugs and maintaining therapeutic concentrations of drugs in the body are discussed. A second broad area of emphasis is on fundamental principles of pharmacodynamics, including drug-receptor theory, log dose-response relationships, therapeutic index, receptor turnover, and signal transduction mechanisms. The primary learning objective is to develop a self-directed, critical approach to the evaluation and design of experimental research in the broad context of receptor interactions with endogenous ligands and therapeutic agents in the context of disease models. This is a team-coordinated course involving session organized by faculty to facilitate student-directed learning experiences including discussion of study questions, problem solving applications, and primary literature presentations. A two-part laboratory exercise introduces experimental methodologies widely applied during the study of molecular interactions between therapeutic agents and receptor targets to reinforce fundamental principles of drug action. This 3-credit hour course meets 3 hr per week during the spring semester of year 1.

PHRM 402. Principles of Pharmacology II: The Physiological Basis of Therapeutics. 3 Units.
This course focuses on human physiology of organ systems including the central nervous system, cardiovascular system, and those systems (gastrointestinal, hepatic, and renal) that are involved in determining the pharmacokinetics or time course of drug action in vivo. A second major emphasis is placed on disease-based sessions where normal physiology, pathophysiology, and key drug classes to treat pathophysiologies are discussed. The students learn key concepts in endocrine pathologies, inflammatory disorders, pulmonary diseases, infectious diseases, and cancer. The main learning objectives are for the student to gain an understanding of basic principles of modern pharmacology and physiology and to build self-directed learning skills. This is a highly interactive course in which faculty lectures are minimized. A heavy emphasis is placed on student-directed learning experiences including presentation and discussion of primary literature, problem solving applications, small group discussion and team-based learning. This 3-credit hour course meets 3 hr per week during the fall semester of year 2.

PHRM 409. Principles of Pharmacology. 3 Units.
Principles of Pharmacology introduces the basic principles that underlie all of Pharmacology. The first half of the course introduces, both conceptually and quantitatively, drug absorption, distribution, elimination and metabolism (pharmacokinetics) and general drug receptor theory and mechanism of action (pharmacodynamics). Genetic variation in response to drugs (pharmacogenetics) is integrated into these basic principles. The second half of the course covers selected drug classes chosen to illustrate these principles. Small group/recitation sessions use case histories to reinforce presentation of principles and to discuss public perceptions of therapeutic drug use. Graduate students will be expected to critically evaluate articles from the literature and participate in a separate weekly discussion session. Recommended preparation for PHRM 409: Undergraduate degree in science or permission of instructor. Offered as PHRM 309 and PHRM 409.

PHRM 420. Current Topics in Cancer. 3 Units.
The concept of cancer hallmarks has provided a useful guiding principle in our understanding of the complexity of cancer. The hallmarks include sustaining proliferative signaling, evading growth suppressors, enabling replicative immortality, activating invasion and metastasis, inducing angiogenesis, resisting cell death, deregulating cellular energetics, avoiding immune destruction, tumor-promoting inflammation, and genome instability and mutation. The objectives of this course are to (1) examine the principles of some of these hallmarks, and (2) explore potential therapies developed based on these hallmarks of cancer. This is a student-driven and discussion-based graduate course. Students should have had some background on the related subjects and have read scientific papers in their prior coursework. Students will be called on to present and discuss experimental design, data and conclusions from assigned publications. There will be no exams or comprehensive papers but students will submit a one-page critique (strengths and weaknesses) of one of the assigned papers prior to each class meeting. The course will end with a full-day student-run symposium on topics to be decided jointly by students and the course director. Grades will be based on class participation, written critiques, and symposium presentations. Offered as BIOC 420, MBIO 420, PATH 422, and PHRM 420. Prereq: IBMS 453 and IBMS 455.

PHRM 432. Current Topics in Vision Research. 3 Units.
Vision research is an exciting and multidisciplinary area that draws on the disciplines of biochemistry, genetics, molecular biology, structural biology, neuroscience, and pathology. This graduate level course will provide the student with broad exposure to the most recent and relevant research currently being conducted in the field. Topics will cover a variety of diseases and fundamental biological processes occurring in the eye. Regions of the eye that will be discussed include the cornea, lens, and retina. Vision disorders discussed include age-related macular degeneration, retinal ciliopathies, and diabetic retinopathy. Instructors in the course are experts in their field and are members of the multidisciplinary visual sciences research community here at Case Western Reserve University. Students will be exposed to the experimental approaches and instrumentation currently being used in the laboratory and in clinical settings. Topics will be covered by traditional lectures, demonstrations in the laboratory and the clinic, and journal club presentations. Students will be graded on their performance in journal club presentations (40%), research proposal (40%), and class participation (20%). Offered as NEUR 432, PATH 432, PHRM 432 and BIOC 432.

PHRM 466. Cell Signaling. 3 Units.
This is an advanced problem set and research paper-based discussion format course that covers cell signaling mechanisms; there are no lectures. Included are discussions of neurotransmitter-gated ion channels, growth factor receptor kinases, cytokine receptors, G protein-coupled receptors, steroid receptors, heterotrimeric G proteins, ras family GTPases, second messenger cascades, protein kinase cascades, second messenger regulation of transcription factors, signals for regulation of cell growth, division, tissue development and cell death. Offered as CLBY 466, NEUR 466, PHOL 466 and PHRM 466.

PHRM 475. Protein Biophysics. 3 Units.
This course focuses on in-depth understanding of the molecular biophysics of proteins. Structural, thermodynamic and kinetic aspects of protein function and structure-function relationships will be considered at the advanced conceptual level. The application of these theoretical frameworks will be illustrated with examples from the literature and integration of biophysical knowledge with description at the cellular and systems level. The format consists of lectures, problem sets, and student presentations. A special emphasis will be placed on discussion of original publications. Offered as BIOC 475, CHEM 475, PHOL 475, PHRM 475, and NEUR 475.

PHRM 511. Frontiers in Pharmacology. 0 - 1 Units.
Current topics of interest in the pharmacologist sciences.

PHRM 520. The Cellular and Molecular Hallmarks of Cancer. 3 Units.
This course is a comprehensive overview of cancer biology led by faculty content experts. The objective of this course is for students to gain an understanding of the complex properties that define cancer through team-based learning, critical reading of literature, and an introduction to grant writing for future NIH grant submissions. Specific goals include: - To review current concepts and hallmarks of cancer as defined by Dr. Robert Weinberg's The Biology of Cancer, 2nd edition (suggested reading). - To learn tools and approaches to critically read and review cancer biology literature. - To understand the NIH scoring system and use this to develop preliminary grant proposal ideas regarding cancer hallmarks. - To gain experience in presenting scientific ideas, and leading group discussions on topics related to cancer biology. - To discuss ethical and societal issues related to emerging technologies in cancer research. Offered as PHRM 520 and PATH 520.

PHRM 521. Special Topics in Cancer Biology and Clinical Oncology. 1 Unit.
This one credit hour course in Cancer Biology is intended to give students an opportunity to do independent literature research while enrolled in PHRM 520/PATH 520. Students must attend weekly Hematology/Oncology seminar series and write a brief summary of each of the lectures attended. In addition, students must select one of the seminar topics to write a term paper which fully reviews the background related to the topic and scientific and clinical advances in that field. This term paper must also focus of Clinical Oncology, have a translational research component, and integrate with concepts learned in PHRM 520/PATH 520. Pharmacology students must provide a strong discussion on Therapeutics, while Pathology students must provide a strong component on Pathophysiology of the disease. Recommended preparation: CBIO 453 and CBIO 455, or concurrent enrollment in PHRM 520 or PATH 520. Offered as PATH 521 and PHRM 521.

PHRM 522. Therapeutic Targeting of the Hallmarks of Cancer. 3 Units.
Therapeutic Targeting of the Hallmarks of Cancer is a comprehensive overview of therapeutic strategies to treat and cure cancer. Led by faculty content experts, students will explore the history of cancer therapy development, current therapies, patient experiences, translation of research discovery into new therapeutic strategies, and clinical trials. The goal of this course is for students to conceptualize the translation of research discovery into novel, effective cancer therapeutics. The course will focus on the Hallmarks of Cancer that represent vulnerabilities to be exploited for successful treatment of cancer. In addition to didactic coursework, students will also be exposed to current cancer treatment in a variety of clinical settings observing clinical faculty. Offered as PATH 522 and PHRM 522.

PHRM 525. Topics in Cell and Molecular Pharmacology. 0 - 18 Units.
Individual library research project under the guidance of a pharmacology sponsor. Projects will reflect the research interest of the faculty sponsor, including molecular endocrinology, neuropharmacology, receptor activation and signal transduction, molecular mechanisms of enzyme action and metabolic regulation.

PHRM 526. Grant Writing Tutorial. 1 - 3 Units.
Students will be expected to provide critiques of a grant proposal to bring to a workshop. At the workshop, a faculty review panel will discuss the grant proposal and provide critiques to illustrate the key components that are necessary for any grant proposal, and the specific items that enhance the quality of the proposal or detract from it. The students will be able to compare what they emphasized in their critiques to what the expert panel focused on. After completing the workshop, each student will prepare a proposal based on their thesis topic; this document will be scored, and the student will also be evaluated for an oral defense of the proposal.

PHRM 527. Pathways to Personalized Medicine. 3 Units.
This is a course of independent study designed to take the student from the bedside to the bench and back again. Students will select a problem from a list of important therapeutic issues related to variability in drug responsiveness and design a research program to elucidate its molecular, biochemical, genetic and pathophysiological basis. The resulting research proposal is expected to be multidimensional and include molecular, cellular, whole animal and clinical investigations. To guide the process students will assemble a mentoring group including at least one member of the Translational Therapeutics Track Faculty, a clinician working in the clinical realm in which the problem originates and a basic scientist with relevant experience. The written proposal will be defended orally. Recommended preparation: 1st year Pharm Graduate required courses.

PHRM 528. Contemporary Approaches to Drug Discovery. 3 Units.
This course is designed to teach the students how lead compounds are discovered, optimized, and processed through clinical trials for FDA approval. Topics will include: medicinal chemistry, parallel synthesis, drug delivery and devices, drug administration and pharmacokinetics, and clinical trials. A special emphasis will be placed on describing how structural biology is used for in silico screening and lead optimization. This component will include hands-on experience in using sophisticated drug discovery software to conduct in silico screening and the development of drug libraries. Each student will conduct a course project involving in silico screening and lead optimization against known drug targets, followed by the drafting of an inventory disclosure. Another important aspect of this course will be inclusion of guest lectures by industrial leaders who describe examples of success stories of drug development. Offered as BIOC 528, PHOL 528, PHRM 528, and SYBB 528.

PHRM 529. FDA Regulation in Entrepreneurship and Clinical Research. 0 - 3 Units.
The FDA Regulation in Entrepreneurship and Clinical Research course is designed to provide foundational knowledge in the FDA approval and regulatory process while highlighting scientific, clinical, ethical, and other related emergent factors for consideration. The course includes a series of lecture-based classes delivered by content experts and interdisciplinary team-based learning discussions of case studies designed for the application of lecture content. Students who elect to take the course for three credits as opposed to one credit will go through the process of reviewing an example Investigational New Drug (IND) or Investigational Drug Exemption (IDE) Application (midterm project) and preparing an IND or IDE for submission (final project) with the guidance of nationally renowned experts in FDA regulation and law. The primary goal of this course is that upon completion, students will be able to take the knowledge gained from content experts and apply it to facilitate the movement of their current or future technologies through the FDA approval process. Offered as CRSP 529, PHRM 529 and RGME 529.

PHRM 600. Preparation for Qualifying Exam. 1 Unit.
Students pursuing the M.S. or Ph.D. degrees in Pharmacology are required to prepare systematically for the comprehensive qualifying exam by reviewing the concepts of cellular and molecular biology and pharmacology. The qualifier is comprised of a two-part written exam administered simultaneously to all eligible students. It is designed to evaluate their understanding of concepts presented in the various core courses. It also assesses their skills in critical reading of research articles and design of experiments. The division into two parts allows each student to receive feedback on deficient areas and work toward improvement on the second segment. Eligibility: Students may register for the exam when they have fulfilled two criteria: (a) Successful completion (grade B or better) in all of the Core Courses, and an overall GPA of 3.0 or better. (b) Satisfactory performance in all research rotations and consistent research effort in the thesis laboratory as documented formally by the Ph.D. mentor. No student on probation may sit for the Qualifying Exam (Prelim I). Prereq: CBIO 453, CBIO 455, PHRM 401 and PHRM 402.

PHRM 601. Independent Study and Research. 1 - 18 Units.

PHRM 602. Translational Pharmaceutical Science: Culminating Research Experience. 3 - 6 Units.
This courseis a research experience that may serve as the culminating experience for master's students in the Department of Pharmacology.

PHRM 603. Translational Pharmaceutical Science: Culminating Internship Experience. 3 - 6 Units.
This course is an internship experience that may serve as the culminating experience for master's students in the Department of Pharmacology.

PHRM 610. Internship in Experimental Biotechnology. 3 Units.
This course is the culminating experience of the Biotechnology MS program. It gives students a substantive hands-on experience in biotechnology research, providing with real-world experience to enhance their resumes and future employment prospects. The internship may be completed in a laboratory at a university or biotechnology company and must include some hands-on benchwork. The internship will strengthen the skills students have learned in the laboratory-focused coursework in the Biotechnology MS program. The goals are to i) enhance their laboratory research skill set, ii) learn about the responsibilities of laboratory workers, iii) learn how research problems are formulated and approached by research teams, iv) hone interpersonal skills and learn how research is done by collaborative teams, and v) gain insights into the careers of biotech workers and the careers they would like to pursue. This course is open only to students in the Biotechnology MS program. Offered as BIOC 610, NEUR 610, and PHRM 610.

PHRM 651. Thesis M.S.. 1 - 18 Units.
(Credit as arranged.)

PHRM 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.