

## PHARMACOLOGY PHM AND TOXICOLOGY

### Department of Pharmacology and Toxicology College of Veterinary Medicine

#### 211 Pharmacology and Toxicology in Society

Fall of odd years, Summer. 2(2-0)  
Introduction for non-science or science students to the field of pharmacology and toxicology. History of pharmacology and toxicology. Present issues and future possibilities. Society and systems of drug development and delivery. Drug abuse and policies.

#### 321 Common Drugs

Spring. 3(3-0) P: (PSL 250) or (PSL 431 and PSL 432) or PSL 310 R: Open to juniors or seniors or approval of department.  
Introduction to commonly used drugs. Emphasis on over-the-counter medications and frequently prescribed prescription drugs. Selected natural products also will be covered. How commonly used drugs affect the body to treat or cure various conditions and how the body handles drugs. Principles of appropriate drug use and consequences of misuse.

#### 350 Introductory Human Pharmacology

Fall, Spring, Summer. 3(3-0) P: (PSL 250 or PSL 310) or (PSL 431 and PSL 432) R: Not open to freshmen.  
General principles of pharmacology. Central nervous system, autonomic nervous system, cardiovascular, renal, cancer, microbial, and endocrine pharmacology.

#### 351 Fundamentals of Drug Safety

Spring. 2(2-0) P: (BS 161 and BS 162) or (LB 144 and LB 145) or (BS 181H and BS 182H) R: Open to juniors or seniors or approval of department.  
How and why drugs are tested and monitored for safety. The roles of the FDA, USDA, and EPA to ensure drug safety.

#### 421 Clinical Toxicology

Fall. 3(3-0) P: ((CEM 251 or CEM 351) and PSL 310) or (PSL 431 and PSL 432) R: Open to seniors or approval of department.  
Basic methods and procedures commonly employed in clinical toxicology will be introduced and explained. Mechanisms of toxicity, symptoms, diagnostics, and treatment of the most commonly encountered toxins in clinical exposure will be reviewed in detail.

#### 422 Fundamentals of Neuropharmacology

Spring. 2(2-0) Interdepartmental with Neurosciences. Administered by Pharmacology and Toxicology. P: NEU 301 or PSL 250 or PSL 310 or PSL 431 R: Open to juniors or seniors or approval of department.  
Mechanisms and uses of action of drugs on neurons and neuron-controlled activities

#### 430 Human Pharmacology

Summer. 3 credits. RB: Molecular biology, biochemistry, chemistry, physiology, and/or human biology. R: Open to masters students in the Integrative Pharmacology major or in the Pharmacology and Toxicology major. Approval of department. Not open to students with credit in PHM 350 or PHM 440.  
General principles of pharmacology. Central nervous system and autonomic nervous system, cardiovascular, renal, cancer, microbial, and endocrine pharmacology.

#### 431 Pharmacology of Drug Addiction

Fall. 3(3-0) RB: Zoology or Human Biology or Psychology or Biochemistry or Physiology.  
Introduction to pharmacology and neuropharmacology. Understanding of the biological basis for drug abuse and addiction.

#### 440 Principles of Drug Action

Summer. 1 credit. RB: Chemistry, molecular biology, biochemistry, physiology, and/or human biology. R: Not open to masters students in the Integrative Pharmacology Major or in the Pharmacology and Toxicology Major. Not open to students with credit in PHM 430 or PHM 350.  
Factors influencing drug action. Absorption, distribution, and elimination. Factors controlling intensity, selectivity and nature of drug action. Mismatches of drug presence and drug action including receptor-effector coupling mechanisms and mechanisms of drug tolerance. Offered first half of semester.

#### 450 Introduction to Chemical Toxicology

Fall, Spring, Summer. 3(3-0) P: BS 161 and BS 162 and CEM 251 R: Not open to freshmen or sophomores.  
Mammalian toxicology. Disposition of chemicals in the body, detoxication, elimination, and mechanisms of toxicity in major organ systems. Selected toxic agents.

#### 454 Leadership and Teams for Scientists and Health Professionals

Fall, Spring. 3(3-0) R: Open to juniors or seniors or approval of department.  
Engage in self-reflection within the context of relating to others within a team setting; carry out appropriate leadership models suited to given contexts; evaluate change options as a leader in an organizational setting; and continue to grow as a lifelong learner. Not open to students who have completed PHM 854.

#### 480 Special Problems

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Approval of department.  
Individual work on selected research problems.

#### 486 Pharmacology Laboratory

Spring. 3 credits. P: PHM 350 or PHM 431 or PHM 450  
Research techniques, core pharmacology principles, and mechanisms of drug modulation of select physiological systems.

#### 487 Current Topics in Pharmacology and Toxicology

Fall, Spring. 2(2-0) RB: College level physiology and/or biochemistry  
Therapeutic drugs and toxins for human or veterinary clinical medicine have generated significant attention in the non scientific news media. Reasons for societal attention, therapeutic breakthroughs, therapeutic needs, drug marketing, and drug regulatory policies.

#### 552 Veterinary Pharmacology I : Principles and Neuropharmacology

Spring. 2(2-0) R: Open to graduate-professional students in the College of Veterinary Medicine. SA: PHM 556  
Basic principles of pharmacology and mechanisms of action of drugs used to affect nervous system function.

#### 553 Veterinary Pharmacology II: Systems and Infectious Diseases

Fall. 3(3-0) RB: Completion of Year 1 of the graduate-professional program in the College of Veterinary Medicine. R: Open to graduate-professional students in the College of Veterinary Medicine. SA: PHM 556  
Principles of pharmacology of infectious disease and specific organ systems, including mechanisms of action and adverse effects of drugs.

#### 557 Veterinary Toxicology

Fall. 2(2-0) RB: Completion of Year 1 of the graduate-professional program in the College of Veterinary Medicine. R: Open to graduate-professional students in the College of Veterinary Medicine.  
Determinants of toxic responses, analytical toxicology, genetic toxicology, and toxin management. Diagnosis, prevention, and treatment of common toxicoses.

#### 563 Medical Pharmacology

Summer. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. R: Open to graduate-professional students in the College of Human Medicine.  
General principles of pharmacology and toxicology and selected drugs. Rational drug therapy.

#### 564 Basic Principles of Medical Pharmacology

Fall. 2(2-0) R: Open to graduate-professional students in the College of Osteopathic Medicine.  
Basic principles of pharmacology and toxicology and selected drugs.

#### 590 Case Studies in Clinical Pharmacology

Spring. 2(2-0) P: PHM 563 RB: Completion of Year 2 in the College of Osteopathic Medicine or College of Human Medicine. R: Open to graduate-professional students in the College of Osteopathic Medicine or in the College of Human Medicine or approval of department.  
Selected case studies emphasizing clinical applications of pharmacological principles. Evaluation of new drugs, drug advertising, and adverse drug reactions.

## Pharmacology and Toxicology—PHM

- 658 Research Problems in Pharmacology or Toxicology**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. RB: Completion of Semester 4 of the graduate-professional program in the College of Veterinary Medicine. R: Approval of department.  
Selected research problems in pharmacology or toxicology.
- 659 Regulatory Affairs and Project Management in Clinical Research**  
Fall. 3(3-0) RB: Participants are not required but are encouraged to have a basic background in biology, chemistry and mathematics. R: Approval of department. Not open to students with credit in PHM 857 or PHM 858.  
Principles and activities involved in drug development, the regulatory process for obtaining marketing authorization, the fundamental aspects of project management including work breakdown structure, scheduling, earned value analysis, and risk management.
- 801 Fundamental Principles of Pharmacology and Toxicology**  
Fall. 1 to 2 credits. R: Open to doctoral students or approval of department.  
Core principles of pharmacology and toxicology including pharmacokinetics, toxicokinetics (drug/toxicant absorption, distribution, metabolism, elimination, modeling), pharmacodynamics (drug-receptor and drug-enzyme interactions), and drug discovery.
- 802 Cellular, Molecular and Integrated Systems Pharmacology**  
Spring. 4(4-0) P: (BMB 801 or BMB 802) and (PHM 827 or PSL 828 or PSL 829) R: Open to doctoral students or approval of department.  
Cellular and molecular mechanisms of drug actions on organ systems of humans and other mammals.
- 804 Molecular and Developmental Neurobiology**  
Fall. 3(3-0) Interdepartmental with Neuroscience and Pathobiology and Diagnostic Investigation and Psychology and Zoology. Administered by Neuroscience. RB: Bachelor's degree in a Biological Science or Psychology. R: Open to graduate students in Neuroscience major.  
Nervous system specific gene transcription and translation. Maturation, degeneration, plasticity, and repair in the nervous system.
- 810 Synaptic Transmission**  
Spring of odd years. 3(3-0) R: Open to graduate students or approval of department.  
Chemical and electrical aspects of nerve impulse transmission at synaptic and neuroeffector junctions. Influence of drugs.
- 813 Cardiovascular Pharmacology and Toxicology**  
Summer. 3(3-0) R: Open to graduate students or approval of department.  
Cardiovascular signal transduction and control in normal and pathophysiological states.
- 816 Integrative Toxicology: Mechanisms, Pathology and Regulation**  
Fall of odd years. 3(3-0) Interdepartmental with Animal Science and Biochemistry and Molecular Biology and Pathobiology and Diagnostic Investigation. Administered by Pharmacology and Toxicology. P: PHM 819  
Biochemical, molecular, and physiological mechanisms of toxicology. Functional and pathological responses of major organ systems to chemical insult. Mechanisms of mutagenesis, carcinogenesis, and reproductive toxicology. Concepts in risk and safety assessment.
- 817 Neurotoxicology**  
Spring. 2(2-0) RB: PHM 819 and PHM 450 or equivalent introductory pharmacology and toxicology courses; undergraduate biochemistry and cell biology R: Open to graduate students. Approval of department.  
Biochemical, molecular, physiological mechanisms and assessment of neurotoxicity. Factors predisposing the nervous system to selective toxicants. Pathophysiology and models of toxicant-induced neurodegenerative diseases.
- 819 Principles of Drug-Tissue Interactions**  
Fall, Spring, Summer. 1 to 2 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Open to graduate students or lifelong graduate students.  
General principles relevant to the interaction of chemicals with biological systems. Topics include pharmacokinetics and/or pharmacodynamics.
- 822 Academic and Research Integrity**  
Fall, Spring, Summer. 1(1-0)  
Guidelines for research and academic integrity focusing on issues pertinent to biomedical graduate students and scientists.
- 827 Physiology and Pharmacology of Excitable Cells**  
Fall. 4(4-0) Interdepartmental with Neuroscience and Physiology and Zoology. Administered by Pharmacology and Toxicology. RB: PSL 431 or PSL 432 or BMB 401 or BMB 461 or ZOL 402  
Function of neurons and muscle at the cellular level: membrane biophysics and potentials, synaptic transmission, sensory nervous system function.
- 828 Concepts in Carcinogenesis**  
Fall. 2 credits. P: (BLD 830 or BMB 801 or approval of department) and (PHM 819 or approval of department) RB: (BMB 801 or BLD 830) and PHM 819 R: Open to masters students or doctoral students or lifelong graduate students. Approval of department.  
Mechanisms underlying malignant transformation of a cell. Carcinogenic potential of chemicals.
- 829 Neuropharmacology**  
Fall. 2(2-0) P: PHM 819 RB: Some background in physiology. R: Open to masters students or doctoral students or lifelong graduate students.  
Mechanisms of action of drugs on the central nervous systems, targets, clinical use and side effects.
- 830 Experimental Design and Data Analysis**  
Fall, Summer. 3(3-0) RB: Undergraduate degree in biology, chemistry or related field.  
Practical application of statistical principles to the design of experiments and analysis of experimental data in pharmacology, toxicology, and related biomedical sciences.
- 831 Endocrine Pharmacology and Toxicology**  
Spring. 2(2-0) P: PHM 819  
Physiology, pharmacology, and toxicology of the endocrine system. Endocrine diseases, pharmacological intervention, hormone therapy, endocrine disruptors, role of hormones in normal metabolism and metabolic disorders, and animal models of endocrine and metabolic disorders.
- 832 Applied Integrative Pharmacology Laboratory**  
Summer. 4(2-4) P: PHM 819 and PHM 830 RB: Undergrad degree in biology, chemistry or related field. Prior biomedical lab experience helpful. R: Not open to undergraduate students. Approval of department.  
Integrative and organ-level pharmacology. Regulatory issues in the use of experimental animals, animal models of diseases, animal and tissue preparation for whole-animal and organ-level pharmacology experiments, experimental design, data collection, data analysis, and data interpretation.
- 833 Gastro-Intestinal and Liver Pharmacology and Toxicology**  
Spring. 2(2-0) RB: (PHM 350 or PHM 819) or Some pharmacology background.  
Specific drugs and their mechanisms of action in the treatment of gastrointestinal and liver diseases. Toxic effects of drugs and other xenobiotics on the gastrointestinal tract, including the liver.
- 834 Respiratory Pharmacology**  
Spring. 2(2-0) RB: Some prior course work in physiology or pharmacology.  
Integrative study of drugs, their mechanism of action, and their side effects in the treatment of major diseases and pathologies of the respiratory system.
- 835 Biopharmaceuticals: From Development to Manufacturing**  
Fall. 3(3-0) P: PHM 819 RB: Undergraduate degree in biology, chemistry, or related field is recommended. R: Not open to undergraduate students.  
Biopharmaceutical development and manufacturing processes for recombinant proteins, monoclonal antibodies, vaccines and cell-based therapeutics (stem cells). Emphasis on real-world case studies and group projects.
- 837 Autonomic Pharmacology**  
Spring. 1 credit. P: PHM 819  
Effects of drugs having therapeutic potential and potential for adverse side effects within the autonomic nervous system and organs controlled by this system. Comparison with drugs having therapeutic potential and potential adverse side effects on muscle function.
- 839 Systems Neuroscience**  
Spring. 4(4-0) Interdepartmental with Human Anatomy and Neuroscience and Physiology and Psychology and Zoology. Administered by Neuroscience. R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Agriculture and Natural Resources, Natural Science, Social Science, and Veterinary Medicine. SA: ANT 839  
Anatomy, pharmacology, and physiology of multicellular neural systems. Sensory, motor, autonomic, and chemo-regulatory systems in vertebrate brains.

- 840 Safety Pharmacology**  
 Spring. 2(2-0) RB: Undergraduate degree in biology, chemistry or related area. Prior coursework in physiology useful.  
 Systems study of current experimental models, risk assessment, and regulatory guidelines for evaluating drug candidates for pharmacologic effects unrelated to therapeutic effects.
- 841 Cellular and Molecular Toxicology**  
 Fall. 3(3-0) RB: PHM 819 and PHM 450 or equivalent introductory pharmacology and toxicology courses; undergraduate biochemistry and cell biology R: Open to graduate students or approval of department.  
 Mechanistic concepts and techniques of toxicology at the cellular and molecular levels. Various molecular events and cellular modifications that result from and/or are associated with chemical/environmentally induced toxicity and disease.
- 850 Communications for Biomedical Researchers**  
 Fall, Summer. 2(2-0) R: Open to masters students or lifelong graduate students in the College of Osteopathic Medicine or in the Department of Pharmacology and Toxicology or in the Integrative Pharmacology Major or in the Pharmacology and Toxicology Major.  
 Effective research and business communication, including written and verbal skills for a variety of audiences and purposes.
- 851 Intellectual Property and Patent Law for Biomedical Sciences**  
 Fall. 2(2-0) RB: Strong reading and writing skills helpful.  
 Fundamentals of intellectual property and patent law encountered by biomedical scientists, including issues of prevention, patent prosecution, and enforcement of patents in a litigation setting.
- 854 Leadership and Team-Building for Biomedical Research**  
 Spring. 2(2-0) RB: Experience supervising others and/or participation in workplace teams is strongly suggested.  
 Evaluation of current leadership methods. Models of leadership. Practice of specific skills and development of a plan to increase their influence and extend learning beyond the class.
- 855 The Business of Biomedical Research Organizations**  
 Spring. 2(2-0)  
 Theories, methods, terminology, and culture of business as used in biomedical research and development environments.
- 857 Project Management**  
 Summer. 2(2-0)  
 Formal project management culture, principles, knowledge areas, and terminology. Specific tools and techniques including work breakdown structure, earned value analysis, risk management, and quality control for managing scientific research. Offered first ten weeks of semester.
- 858 Drug Development Process**  
 Spring. 3(3-0) RB: Some experience working with laboratory or clinical research projects.  
 Project management standards and best practices in drug development process, including clinical trials.
- 870 Research Rotation**  
 Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. RB: Open only to first year graduate students in Pharmacology and Toxicology. R: Approval of department.  
 Individual work on selected research problems.
- 895 Applied Project in Integrative Pharmacology**  
 Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P: PHM 819 and PHM 830 and PHM 832 RB: All coursework for the MS in Integrative Pharmacology should be completed prior to beginning the Applied Project unless there is Departmental approval to complete final courses concurrently with the Applied Project. R: Open to masters students in the Department of Pharmacology and Toxicology. Approval of department.  
 An on-site project that addresses a research, theoretical, or applied problem in whole-animal or organ level pharmacology, in cooperation with the students' employer or laboratory partner.
- 899 Master's Thesis Research**  
 Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in the Department of Pharmacology and Toxicology. Approval of department.  
 Master's thesis research.
- 910 Seminar**  
 Fall, Spring, Summer. 1(1-0) A student may earn a maximum of 3 credits in all enrollments for this course. R: Open only to graduate students. Approval of department.  
 Discussion of recent topics in pharmacology and toxicology by faculty or invited outside speakers. Students research reports.
- 980 Problems**  
 Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 20 credits in all enrollments for this course. R: Open to doctoral students. Approval of department.  
 Limited work in selected research projects.
- 999 Doctoral Dissertation Research**  
 Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open to doctoral students in the Department of Pharmacology and Toxicology or in the Pharmacology and Toxicology-Environmental Toxicology major. Approval of department.  
 Doctoral dissertation research.