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.

301  Fundamental Principles of Pharmacology and Toxicology  
Fall. 3(3-0) R: Open to graduate students in the College of Natural Science or in the Department of Pharmacology and Toxicology 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.

804  Molecular and Developmental Neurobiology  
Fall. 3(3-0) Interdepartmental with Neuroscience and Pathology and Diagnostic Investigation and Psychology and Integrative Biology. Administered by Neuroscience. RB: Bachelor’s degree in a Biological Science or Psychology. R: Open to graduate students in Neuroscience major.

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 pathophysiologic 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 Biochemistry, molecular, and physiological mechanisms of toxicity. 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) R: 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. Sumner. 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 Integrative Biology and Neuroscience and Physiology. Administered by Pharmacology and Toxicology. R: Open to graduate students in the College of Natural Science or in the Department of Pharmacology and Toxicology or approval of department.

828  Concepts in Carcinogenesis  
Fall. 2 credits. P: (BLD 830 or BMB 801 or approval of department) and (PHM 819 or approval of department) R: (BMB 801 or BLD 830) and PHM 819 R: Open to master’s 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 master’s students or doctoral students or lifelong graduate students.

830  Experimental Design and Data Analysis  
Fall, Summer. 3(3-0) RB: Undergraduate degree in biology, chemistry or related field.

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: Undergraduate degree in biology, chemistry or related field. Prior biomedical lab experience helpful. R: Not open to undergraduate students. Approval of department.

833  Gastro-Intestinal and Liver Pharmacology and Toxicology  
Spring. 2(2-0) R: (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) R: 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.

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 Integrative Biology. Administered by Neuroscience. R: Open 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) R: 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 chemically/environmentally induced toxicity and disease.

850 Communications for Biomedical Researchers
Fall, Summer. 2(2-0) R: Open to master's 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) R: Experience supervising others and/or participation in workplace teams is strongly suggested.
Theories, methods, terminology, and culture of business as used in biomedical research and development environments.

857 Project Management
Summer. 2(2-0) R: Strong experience working with laboratory or clinical research projects.
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. R: 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 master's 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.

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. R: 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 master's 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. 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.