Pharmaceutical and Pharmacological Sciences, Ph.D.

Degree Offered

- Doctor of Philosophy

The Pharmaceutical and Pharmacological Sciences Graduate Program is housed in the School of Pharmacy and associated with the Department of Pharmaceutical Sciences. The program is one of the Ph.D. degree-granting programs in Biomedical Sciences at the WVU Health Sciences Center (HSC).

The Pharmaceutical and Pharmacological Sciences Graduate Program at West Virginia University is an interdisciplinary program that prepares students for a future in a variety of employment settings, ranging from academic research and industry to federal positions. Our students have a unique and rich training environment, which gives them a basis in such pharmaceutical sciences disciplines as drug development and discovery, pharmaceutics, pharmacology, toxicology, therapeutic development and regulatory affairs. Students can take additional graduate courses in drug delivery systems, drug metabolism, molecular modeling, bench to bedside and biotechnology.

The core areas of Ph.D. training in Pharmaceutical and Pharmacological Sciences are:

1. pharmacology and therapeutic development,
2. drug delivery, and,
3. drug discovery and biotechnology.

The students are mentored by experts with an international reputation and publish in prestigious journals. They also have opportunities to present their research at national and international scientific meetings and to enroll in internships with pharmaceutical or biotech companies.

Upon completion of the second year of study, students must submit a formal plan of study and a research plan that is approved by their Ph.D. committee. Progress is expected to continue with guidance from the student’s research committee. Final admission to candidacy requires satisfactory performance on written and oral qualifying examinations, including a dissertation proposal defense. Subsequent to admission to candidacy, a substantial part of the program is devoted to an original research project which culminates in a first-authored publication and dissertation. To be recommended for a Ph.D., the dissertation must be satisfactorily completed and defended at an oral examination. Typically, four to five years are needed to graduate.

Academic Standards

No credits are acceptable toward a graduate degree with a grade lower than a C. A graduate student is expected to have a cumulative grade point average of at least 3.0 in all graduate courses to continue in the program and to qualify for a Ph.D. degree.

Introduction

The WVU School of Pharmacy offers graduate programs in the pharmaceutical and pharmacological sciences for the Ph.D. degree. The school is advantageously located in the Health Sciences Center complex which also houses all departments of the Schools of Medicine, Nursing, and Dentistry, as well as a comprehensive medical library, audio-visual and computer-based learning center, research core facilities, and laboratory animal quarters. State-of-the-art research laboratories are located throughout the Health Sciences Center complex to facilitate interactions with the Mary Babb Randolph Cancer Center, Center for Neuroscience, and Center for Cardiovascular and Respiratory Sciences. In addition, the Health Sciences Center has easy access to the Evansdale and Downtown campuses of WVU through a personal rapid transit (PRT) system. The scientific community, which is especially well-developed, draws on area scientists throughout WVU, the Centers of Disease Control/National Institute on Occupational Safety and Health (CDC/NIOSH), Federal Bureau of Investigation (FBI), and a variety of research centers supported by the National Institutes of Health (NIH), National Science Foundation (NSF), and the Department of Energy (DOE). A CDC/NIOSH research facility is two blocks away, and Mylan Pharmaceuticals, a leading generic drug producer in the world, is located across the street from the Health Sciences Center. In addition, the school has long-standing collaborations with several state agencies and multinational pharmaceutical companies.

Admissions

Applicants for admission into the graduate program must satisfy the WVU and Health Sciences Center general requirements for admission as a graduate student. Applicants interested in this program must apply through a common admissions portal. Choice of this graduate program occurs during the first year of graduate study after selection of an advisor for your dissertation research. Applications include a personal statement, transcripts from all Colleges or Universities attended, and 2 letters of recommendation. Applicants must arrange to have official copies of transcripts sent directly to the WVU Office of Graduate Admissions and Recruitment. Competitive applicants have a STEM GPA of 3.5 or higher and possess a baccalaureate degree that provides sufficient scientific background the basic sciences. Note that the graduate record exam (GRE) is not required and will not be considered in evaluating applications. TOEFL scores are required of international students from countries where English is not the primary language.

To review the application process, please visit:
To obtain specific information related to the school’s graduate programs, graduate faculty research interests, and availability of graduate assistantships or fellowships, applicants may contact program directors.

**Graduate Director:**
Werner J. Geldenhuys, B.Pharm., Ph.D.
Phone: 304-581-1683
Email: werner.geldenhuys@hsc.wvu.edu

**Co-Director:**
Grazyna D. Szklarz, Ph.D.
Phone: 304-293-1473
Email: gszklarz@hsc.wvu.edu

**Major Code:** 8975

**Doctor of Philosophy**

The School of Pharmacy offers a doctor of philosophy (Ph.D.) degree in pharmaceutical and pharmacological sciences aimed at training competent researchers and educators.

**MAJOR REQUIREMENTS**

<table>
<thead>
<tr>
<th>Course</th>
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<td>BMS 700</td>
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<td>BMS 701</td>
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<td>Principles of Drug Action</td>
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Qualifying Exams
Dissertation Proposal Defense
Dissertation Defense
*Note: Other graduate courses at WVU may be taken as an elective with the permission of the student’s advisory committee.

Total Hours 90-92

### PHARMACEUTICAL AND PHARMACOLOGICAL SCIENCES PATHWAY SUGGESTED PLAN OF STUDY

#### First Year

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#### Second Year

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Proposal Defense

*Students must sign up for a minimum of 9 hours

*Students must sign up for a minimum of 9 hours

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Total credit hours: 90-92

**Major Learning Outcomes**

**DOCTOR OF PHILOSOPHY (PHD)**

Student Learning Outcomes of the Pharmaceutical & Pharmacological Sciences graduate education program are focused on preparing students to become independent researchers. To be successful in our program pathways, students will need to develop competencies in the scientific research process through didactic studies in an area of emphasis and then conceptualizing, designing, conducting, and reporting original research.

**Student Learning Outcomes**

1. Demonstrate competency in the 6 content areas of pharmaceutical and pharmacological sciences:
   - a. Drug Chemistry
   - b. Pharmacokinetics
   - c. Principles of Drug Action
   - d. Approaches to Drug Discovery
   - e. Biopharmaceutics
   - f. Pharmacology
2. Independently design experimental protocols that include the principles of rigor and reproducibility, conduct the experiments, analyze the results, and defend the experimental approach to other scientists.
3. Develop and plan the test of hypotheses regarding significant problems in the student’s chosen area of specialization
4. Demonstrate critical thinking/problem solving ability by effectively criticizing the relevant literature and by asking relevant questions in seminars.
5. Ability to effectively reference the relevant literature in support of the student's research project. Ability to identify significant gaps in knowledge on this scientific topic.
6. Effectively communicate scientific information in written abstracts for research presentations, manuscripts for publication, research grant proposals, and the dissertation.
7. Effectively communicate scientific information in both formal and informal oral presentations.

**COURSES**

**PHAR 691. Advanced Topics. 1-6 Hours.**
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

**PHAR 693. Special Topics. 1-6 Hours.**
A study of contemporary topics selected from recent developments in the field.

**PHAR 694. Seminar. 1-6 Hours.**
Seminars arranged for advanced graduate students. Grading may be S/U.
PHAR 696. Graduate Seminar. 1-3 Hours.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

PHAR 697. Research. 1-9 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.)

PHAR 703. Pharmacy Practice Experience 1. 1 Hour.
PR: First professional year standing or consent. Introduces student to the practice of pharmacy with a focus on career exploration. Pharmacy Practice Experience (PPE) 1 is the first course in a sequence that introduces students to the roles of pharmacists in a variety of practice settings. Interprofessional education (IPE) is introduced and emphasized throughout the course.

PHAR 704. Introduction to Research. 1 Hour.
Provides pharmacy students with a forum for the discussion of a wide variety of research activities and careers. Also provides an appreciation for the science on which the pharmacy profession is based and continually evolves.

PHAR 705. Advanced Cardiology Pharmacotherapy. 2 Hours.
PR: PHAR 824. For students with an interest in cardiology pharmacotherapy and will be highly useful for prospective pharmacy residents. This course serves as a bridge between the cardiology system-based teaching course PHAR 824 and advanced pharmacy practice experiences rotations. This class will contain didactic lectures, small group discussions, pros and cons clinical controversy debate, and patient case-based applied therapeutics.

PHAR 706. Biopharmaceutics. 2 Hours.
Introduces the fundamental principles of biopharmaceutics. This area of knowledge deals with the drug performance at the delivery system – human body interface, and addresses how physico-chemical drug properties, delivery system characteristics, and physiological processes influence drug distribution and affect the body, as well as drug bioavailability.

PHAR 707. Drug-Induced Diseases. 2 Hours.
Focused study of adverse effects of prescription and non-prescription medications designed for practical application across multiple disease states.

PHAR 708. Pharmacy Practice Experience 2. 1 Hour.
PR: PHAR 703 or consent. Introduces student to the practice of pharmacy with a focus on career exploration. Pharmacy Practice Experience (PPE) 2 is the second course in a sequence that introduces students to the roles of pharmacists in a variety of practice settings. Interprofessional education (IPE) is introduced and emphasized throughout the course.

PHAR 713. Oncology Pharmacotherapy. 2 Hours.
PR or CONC: PHAR 853. Provides practical aspects to oncology pharmacy practice including clinical decision making and more in-depth review of specialty areas of practice within hematology/oncology.

PHAR 718. Pediatric Pharmacotherapy. 2 Hours.
PR: Second professional year standing or consent. Overview of common pathophysiology and pharmacotherapy principles in the pediatric population and selection of drug therapy to treat the pediatric patient.

PHAR 721. Advocacy and Leadership. 2 Hours.
PR: Second and third professional year standing or consent. The course will focus on developing the student’s leadership skills as an advocate for the profession of pharmacy.

PHAR 722. Weapons of Mass Destruction and Disaster Planning. 1 Hour.
Through didactic, hands on instruction, and participation in real world disaster planning sessions and/or drills, students learn about weapons of mass destruct (WMD) surveillance and mitigation in addition to disaster planning principles.

PHAR 743. Teach to Learn: Learn to Teach. 2 Hours.
Provides pharmacy students the opportunity to learn how to teach in higher education/pharmacy and develop their teaching skills by participating in select teaching and learning activities.

PHAR 744. Education Journal Club. 1 Hour.
PR: PHAR 743 or Consent. Evaluate educational research articles from pharmacy education and other healthcare disciplines. Students will present and critically analyze educational literature and develop presentation skills.

PHAR 745. Critical Care Pharmacotherapy. 2 Hours.
PR: Third professional year standing or consent. Gain knowledge in multiple facets of critical care pharmacotherapy, particularly for students interested in pharmacy residency training in a clinical setting.

PHAR 747. History of Pharmacy. 2 Hours.
Gives the student a deeper appreciation of the background of pharmacy and its development from ancient times to present.

PHAR 748. Acute Care Case Studies. 2 Hours.
PR: Third professional year standing or consent. Gain experience developing pharmaceutical care plans in an acute care setting. Further prepares students interested in pursuing pharmacy residency training.

PHAR 749A. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).
PHAR 749B. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy or clinical pharmacy. (Grading may be P/F.).

PHAR 749C. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy or clinical pharmacy. (Grading may be P/F.).

PHAR 749D. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy or clinical pharmacy. (Grading may be P/F.).

PHAR 749E. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be S/U.).

PHAR 749F. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749G. Pharmaceutical Investigation. 2-3 Hours.
PHAR 749G. Pharmaceutical Investigation. 2-3 Hr, PR: Consent. Original Investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749H. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749I. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749J. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749K. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749L. Pharmaceutical Pharmacy. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749M. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749N. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749O. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749P. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749Q. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749R. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).

PHAR 749S. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy. (Grading may be P/F.).
PHAR 749T. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy.
(Grading may be P/F.).

PHAR 749U. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy.
(Grading may be P/F.).

PHAR 749V. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy.
(Grading may be P/F.).

PHAR 749W. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy.
(Grading may be P/F.).

PHAR 749X. Pharmaceutical Investigation. 2-3 Hours.
PR: Consent. Original investigation in pharmaceutics, medicinal chemistry, pharmacology, pharmaceutical systems and policy, or clinical pharmacy.
(Grading may be P/F.).

PHAR 751. Geriatrics. 2 Hours.
PR: Second or third year pharmacy students. A review of common pharmacotherapeutic and social issues of importance to older adult patients.

PHAR 752. History of Drug Discovery. 2 Hours.
This course is concerned with the way in which advances in chemistry and biochemistry have influenced advances in drug discovery and therapeutics beginning with the late 18th century through today.

PHAR 753. Social and Behavioral Theory and Health Outcomes Research. 3 Hours.
Basic social and behavioral theories related to the health behavior change and health outcomes. Open to graduate students in pharmacy, public health, or other health care fields.

PHAR 754. Decision Analysis in Healthcare. 3 Hours.
Core skills in clinical decision analysis which builds on concepts derived from epidemiology, biostatistics, computing, economics and operations research and applies them to medical and pharmacological decisions.

PHAR 755. Pharmacoeconomics. 3 Hours.
This graduate-level course is intended to train graduate students in evaluating and conducting pharmacoeconomic research.

PHAR 756. Health Survey Research Methods. 3 Hours.
This course seeks to increase students’ understanding of survey research methods and to develop basic skills in survey development and administration.

PHAR 757. Patient Reported Outcomes. 3 Hours.
Provides a foundation in health outcomes research with an emphasis on patient reported outcomes in health service research.

PHAR 758. Ethical and Regulatory Aspects of Clinical Research. 2 Hours.
Provides overview of ethical and regulatory aspects of clinical research.

PHAR 759. Clinical and Population Practicum. 1 Hour.
Expose students to a population of interest in preparation for a research project. This course will help students to understand the lived experience of the population of interest and expose students to aspects of the healthcare system. Students will either work with a clinical population or community-based population to address one or more disease states. Grading will be Pass/Fail.

PHAR 760. Acute Care Rotation 1. 5 Hours.
PR: Fourth year professional standing or consent. Five-week experience in the delivery of pharmaceutical care in an acute care setting.

PHAR 761. Acute Care Rotation 2. 5 Hours.
PR: Fourth year professional standing or consent. Experience in the delivery of pharmaceutical care in an acute care setting.

PHAR 762. Ambulatory Care Rotation 1. 5 Hours.
PR: Fourth year professional standing or consent. Experience in the delivery of pharmaceutical care in an ambulatory care setting.

PHAR 763. Ambulatory Care Rotation 2. 5 Hours.
PR: Fourth year professional standing or consent. Five-week experience in the delivery of pharmaceutical care in an ambulatory care setting.
PHAR 764. Elective Rotation 1. 5 Hours.
PR: Fourth year professional standing or consent. Five-week experience in a pharmacy practice setting, such as acute care, ambulatory, community, hospital, poison center, drug information, home health, long term care, or research.

PHAR 765. Elective Rotation 2. 5 Hours.
PR: Fourth year professional standing or consent. Five-week experience in a pharmacy practice setting, such as acute care, ambulatory, community, hospital, poison center, drug information, home health, long term care, or research.

PHAR 766. Selective Rotations. 5 Hours.
PR: Fourth year professional standing or consent. Five-week experience in a pharmacy practice setting, selected from a list and includes: pharmacy administration, discharge counseling, drug information, informatics, long term care, managed care, medication reconciliation, medication safety, nuclear pharmacy, clinical toxicology, and quality outcomes.

PHAR 767. Scientific Writing: Health Services and Outcomes Research. 3 Hours.
Students will be trained in effective written communication skills by developing scientific journal articles in health services and outcomes research.

PHAR 768. HEOR/HSOR Internship. 1-6 Hours.
Strengthen practical knowledge and hands-on experience in the areas of Health Services and Outcomes Research/Health Economics and Outcomes Research by working with pharmaceutical companies, clinical research organizations, federal, state, and local governments, policy think tanks, or health care systems.

PHAR 769. Advanced Health Service Research Methods. 3 Hours.
Provides a working knowledge of health services research methods and how to apply these methods to answer typical research questions in health services research. The course will examine concepts but will have an applied focus with hands-on research using publicly available datasets or those that students have access for their dissertations/manuscripts.

PHAR 770. Community Rotation. 5 Hours.
PR: Fourth year professional standing or consent. Five-week experience in the delivery of pharmaceutical care in a community pharmacy setting.

PHAR 772. Institutional Rotation. 5 Hours.
PR: Fourth year professional standing or consent. Five-week experience in the delivery of pharmaceutical care in a health system setting.

PHAR 776. Preparing Residency Applicants. 2 Hours.
Increase knowledge and skills needed to pursue postgraduate residency training in pharmacy, and implement measures to increase pharmacy residency competitiveness.

PHAR 777. Health Outcomes Research Designs. 2 Hours.
Focuses on the skills required to design, conduct, and analyze research topics in health outcomes research. Includes a study of statistics, analysis of research design and methodology, use of library resources, and evaluation of current literature.

PHAR 778. Travel Medicine and Global Pharmacy Practice. 2 Hours.
Identifies and explores major issues in global health with a specific focus on global pharmacy practice and medication therapy. Students will also learn fundamentals in travel medicine so they can assist international travelers in preventing and treating travel-related maladies.

PHAR 779. Drug Discovery. 3 Hours.
PR: Graduate Standing or permission of instructor. Instruction in the process of drug discovery to the development of new forms for therapeutic use. Topics covered included drug design/discovery, target identification and development, lead optimization, and pre-clinical and clinical development.

PHAR 780. Introduction to Molecular Modeling. 4 Hours.
PR: Graduate standing or permission of instructor. Introduction to molecular modeling describes computational methods for chemical and biological problems and is designed to enable the student to use molecular modeling methods as a research tool in their current or future research activities.

PHAR 781. Drug Metabolism. 3 Hours.
PR: Graduate standing or permission of instructor. This course presents a comprehensive review of the field of drug metabolism with an emphasis on the chemistry and enzymology of drug biotransformation, and current methods in drug metabolism research.

PHAR 782. Tumors of the Central Nervous System Journal Club. 1 Hour.
(May be repeated for a maximum of 15 credit hours.) Fundamental and advanced topics focused on drug distribution into normal brain, brain pathology and brain cancers. Other areas of focus include, advanced drug delivery methods, pharmacokinetics, experimental design and statistical analysis. Students will present and critically analyze scientific literature and develop presentation skills.

PHAR 783. Pharmacy Cell Biology Seminar. 1 Hour.
A literature review course in which each student will present and critically analyze primary literature in cell and molecular biology as pertinent to pharmaceutical and biomedical sciences.

PHAR 784. Pharmacology Journal Club. 1 Hour.
A primary literature based course that critically evaluates the latest findings and methods used in pharmacological research.

PHAR 785. Pharmacoepidemiology. 3 Hours.
This course covers basic principles and research study designs used in pharmacoepidemiology, as well as a review of the primary literature that details case examples of drugs withdrawn from the US drug market.
PHAR 786. Health Services Research and Secondary Database. 3 Hours.
PR: PHAR 785. This course presents various topics related to large databases including common study designs, advantages and limitations, and basic steps to extracting and analyzing large databases.

PHAR 787. Drug Discovery and Development. 1 Hour.
This seminar will teach students in the Pharmaceutical Sciences and related disciplines the current state-of-the-art of drug discovery, design, and development, develop student presentation skills, and convey the importance of staying current with key developments.

PHAR 788. Graduate Seminar in Health Outcomes Research. 1 Hour.
(May be repeated for credit toward graduation.) Forum for graduate students to present research, discuss research issues and contemporary topics of interest, develop an understanding of research methods through discussion, while focusing on scientific presentation skills. Topics vary from semester to semester.

PHAR 789. Seminar in Nanoscience. 2 Hours.
(May be repeated for a maximum of 4 hours.) Facilitates interdisciplinary research at the nanoscale by providing a forum for discussion and exploration of nanoscale science and engineering from a variety of perspectives including research and development of nanoscale devices and systems. Grading will be Pass/Fail.

PHAR 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of pharmacy. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading will be P/F.)

PHAR 791. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

PHAR 792. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

PHAR 793. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

PHAR 795. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

PHAR 800. Introduction to Pharmacy. 4 Hours.
PR: First professional year standing or consent. Introduces students to the profession and practice of pharmacy. Students will gain an understanding of the history of pharmacy, the role of pharmacists in the US healthcare system, and the foundations of pharmacy law. Students develop hands-on skills in patient communication and drug information retrieval.

PHAR 801. Drug Delivery. 5 Hours.
An introduction to the concepts and techniques involved in the design and evaluation of pharmaceutical dosage forms, principles of physical pharmacy and drug delivery, and their applications in patient care.

PHAR 802. Preparation of Pharmaceutical Products. 1 Hour.
Preparation of sterile and non-sterile dosage forms. Students will apply the principles of pharmaceutics to the preparation of pharmaceutical products.

PHAR 803. Physical Pharmacy. 2 Hours.
Provides an overview of the principles of physical pharmacy and their application in drug formulation and administration. Topics include: drug dissolution, acid-base chemistry, drug solubility, diffusion, distribution, and drug stability.

PHAR 804. Drug Delivery Systems. 3 Hours.
Introduces the students to the principles and technologies involved in the preparation and evaluation of pharmaceutical dosage forms and drug delivery systems. Students will develop skills in dosage form design and evaluation, as well as their applications in patient care. The course integrates and applies basic physicochemical and biological principles to solve problems in drug delivery in pharmacy practice.

PHAR 805. Drug Chemistry. 2 Hours.
Introduces principles of chemical stability and chemical properties as they relate to drugs and to the basic metabolic processes observed for drug molecules. Topics include functional group analysis, solubility, oil/water partitioning, organic acids/bases, drug decomposition, basic metabolic processes including oxidation, reduction, hydrolysis, and conjugation.

PHAR 806. Pharmaceutical Biotechnology. 1 Hour.
Basic principles of biotechnology with an emphasis on pharmaceutical applications is addressed. Knowledge from cell and molecular biology will be applied to solve biomedical problems and to make useful products for diagnostic and therapeutic purposes. Key processes used in the making, analysis, and application of biopharmaceuticals, such as proteins and nucleic acids as well as their stability, delivery, and handling.
PHAR 807. Pharmacy Calculations. 1 Hour.
Gain experience in pharmaceutical calculations that reflect activities in a variety of practice settings.

PHAR 808. Pharmacogenomics. 2 Hours.
Introduces the fundamental principles of pharmacogenomics and individualized medicine. It provides a basis for understanding how an individual's genetic background affects their response to a specific drug or class of drugs. Pharmacogenomic principles include pharmacogenetic characteristics of drug metabolizing enzymes, drug transporter activity, and receptor sensitivity. Other basic concepts of genetic counseling, personalized medicine, ethics and costs will be discussed.

PHAR 809. Principles of Drug Action. 2 Hours.
Provides a basis for understanding the biochemical and molecular mechanisms by which drugs and the body interact. This course will use drug classes to introduce foundational concepts of drug action and the application of pharmacological tools to better understand how drugs work in the body.

PHAR 810. Community Pharmacy Practice. 2 Hours.
PR: First professional year standing or consent. Focuses on the various roles of a pharmacist including the prescription dispensing and medication management processes in the community pharmacy setting. Legal aspects of community pharmacy practice are also discussed.

PHAR 811. Foundational Pharmacy Skills. 1 Hour.
PR: First professional year standing or consent. Provides students with foundational skills necessary for the provision of patient care including physical assessment, point of care testing, and oral and written communication. Many skills learned during this course will be further strengthened throughout pharmacy school.

PHAR 812. Drug Chemistry and Biotechnology. 3 Hours.
PR: First professional year standing or consent. Introduces principles of chemical stability and chemical properties as they relate to drugs and to the basic metabolic processes observed for drug molecules. Biotechnology will focus on pharmaceutical applications of cell and molecular biotechnology.

PHAR 813. Biopharmaceutics and Pharmacogenomics. 4 Hours.
PR: First professional year standing or consent. Develops an understanding of fundamental principles of biopharmaceutics and pharmacogenomics.

PHAR 814. Biochemical Pharmacology. 4 Hours.
PR: First professional year standing or consent. Provides a basis for understanding the biochemical and molecular mechanisms by which drugs and the body interact. This course will use drug classes to introduce foundational concepts of drug action and the application of pharmacological tools to better understand how drugs work in the body.

PHAR 815. Self-Care. 3 Hours.
PR: First professional year standing or consent. Provides an introduction to nonprescription medications and the application to patient care. Learners will assess the patient, make appropriate recommendations, and educate the patient on self-care treatment options for commonly encountered disease states and patient complaints.

PHAR 816. Pharmacokinetics. 2 Hours.
Introduces fundamental principles of the pharmacokinetic and biological processes that the drug undergoes once it enters the body. The students will be exposed to various pharmacokinetics techniques and problem-solving methods, which should prepare them to design and refine drug therapeutic regimens.

PHAR 817. Principles of Immunology and Microbiology. 2 Hours.
PR: First professional year standing or consent. Introduces scientific principles of immunology as well as introduces students to the pharmacist's role as vaccination advocate, and provides the knowledge and skills required to safely administer vaccines. Lastly, it provides an introduction to microbiology and mechanisms of action of antibiotics.

PHAR 818. Intro Community Rotation. 1-4 Hours.
PR: PHAR 800 and PR or CONC: PHAR 810. Introductory pharmacy practice experience in a community pharmacy setting.

PHAR 820. Population Health and Policy. 3 Hours.
PR: Second professional year standing or consent. Introduces the role of the pharmacist in population-based care and promoting preventative health services. Includes epidemiology and public policy in the healthcare system, and integrates content with interprofessional service outreach projects.

PHAR 821. Pain. 1 Hour.
PR: Second professional year standing or consent. A course in the systems-based therapy series with a focus on pain management and treatment of associated disorders, including addiction therapy. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with pain-associated disorders.

PHAR 822. Service Learning Practice Experience 1. 1 Hour.
PR: Second professional year standing or consent. The first course in a 2-semester series that introduces students to the basic principles of service learning through on-site healthcare-related service projects. Interprofessional education is a component of the course.

PHAR 823. Pulmonology. 3 Hours.
PR: Second professional year standing or consent. First course in the systems-based therapy series with a focus on pulmonology. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with pulmonary diseases.

PHAR 824. Cardiology. 5 Hours.
PR: Second professional year standing or consent. Second course in the systems-based therapy series with a focus on cardiology. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with cardiovascular diseases.
PHAR 825. Nephrology. 2 Hours.
PR: Second professional year standing or consent. Third course in the systems-based therapy series with a focus on nephrology. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with kidney diseases.

PHAR 826. Evidence-Based Practice. 3 Hours.
PR: Second professional year standing or consent. The components of evidence-based practice are reviewed. Emphasis is placed on the appropriate use of information resources in practice and the critical analysis and evaluation of primary literature and other types of information.

PHAR 830. Health Systems Pharmacy Practice. 2 Hours.
PR: Second professional year standing or consent. Introduces and reinforces the distributive, clinical, and administrative roles of pharmacists with a focus on health-systems pharmacy practice and management.

PHAR 832. Service Learning Practice Experience 2. 1 Hour.
PR: PHAR 822. The second course in a 2-semester series that introduces students to the basic principles of service learning through on-site healthcare-related service projects.

PHAR 833. Endocrinology. 3 Hours.
Fourth course in the systems-based therapy series with a focus on endocrinology. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with endocrine diseases.

PHAR 834. Immunology. 3 Hours.
Fifth course in the systems-based therapy series with a focus on immunology. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with immunological diseases and hypersensitivities.

PHAR 835. Autoimmune Diseases. 2 Hours.
A course in the systems-based therapy series with a focus on management of autoimmune diseases. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with these diseases.

PHAR 836. Research in the Pharmaceutical Sciences. 2 Hours.
An overview of the process of conducting health-related research focusing on concepts, principles and methodology involved with the research process. Students gain experience in research proposal development and practice writing skills. Student learning is facilitated by didactic lectures, active learning and independent small group sessions.

PHAR 837. Quality and Outcomes in Pharmacy Practice. 2 Hours.
PR: Second professional year standing or consent. Emphasizes the implementation of quality improvement in pharmacy practice, monitoring outcomes of drug therapy to ensure optimal patient care, and implementation of systems to prevent and minimize patient risk. Application of pharmacoeconomic principles to daily pharmacy practice are discussed.

PHAR 838. Intro Institutional Rotation. 1-2 Hours.
PR or CONC: PHAR 830. Gain experience in an institutional pharmacy setting.

PHAR 840. Pharmacy Practice Management. 3 Hours.
PR: Third professional year standing or consent. Focuses on pharmacy management related to financial and operational management of pharmacies, marketing of pharmacy services, and human resources management.

PHAR 843. Gastroenterology and Nutrition. 3 Hours.
Seventh course in the systems-based therapy series with a focus on gastroenterology and nutrition. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with gastrointestinal diseases and nutrition support.

PHAR 844. Infectious Diseases. 3 Hours.
Eighth course in the systems-based therapy series with a focus on infectious diseases. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with infectious diseases.

PHAR 845. Neurology and Psychiatry. 4 Hours.
Ninth course in the systems-based therapy sequence with a focus on neurology and psychiatry. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with neurologic and psychiatric diseases.

PHAR 848. Acute Care Practice Experience. 2 Hours.
Gain knowledge as well as hands-on experience in the acute care setting. Students will learn the key components of acute care practice, perform activities that would be expected to be completed in acute care experiential rotations (such as medication reconciliation and formulary monographs), and simulate rounding experiences in an interprofessional environment. Interprofessional education is a component of this course.

PHAR 849. Ambulatory Care Practice Experience. 2 Hours.
Gain knowledge as well as hands-on experience in the ambulatory care setting. Activities will include ambulatory patient assessment, medication regimen evaluation, patient presentations, direct patient education, and targeted group education. Interprofessional education is a component of this course.

PHAR 853. Hematology/Oncology. 3 Hours.
PR: Third professional year standing or consent. A course in the systems-based therapy series with a focus on hematology-oncology. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems in patients with hematological diseases and cancer.
PHAR 854. Special Populations. 3 Hours.
The final course in the systems-based therapy series that addresses special populations such as geriatrics, pediatrics and women’s health (pregnancy, lactation, menopause) as well as disease processes that involve multiple body systems. Integrates scientific principles with clinical practice to enable students to prevent, identify, and resolve drug therapy problems.

PHAR 858. Comprehensive Assessment of Practice. 3 Hours.
Assess students’ readiness for successful completion of the upcoming advanced pharmacy practice experiences curriculum. Provides focused reinforcement of essential material relative to ensuring a student is practice ready, as well as reviewing difficult material from throughout the curriculum. Students complete a final objective structured clinical examination, which requires the demonstration of specific skills, including communication.

PHAR 859. Pharmacy Law and Ethics. 3 Hours.
PR: Third professional year standing or consent. The legal and ethical basis of pharmacy practice. Students learn about federal and state statutes, rules, and regulations that affect pharmacy practice. Ethics related situations that can arise during pharmacy practice will also be discussed.

PHAR 860. Current Topics in Pharmacy. 1 Hour.
PR: Fourth professional year standing or consent. Discussion of current topics in pharmacy practice. Core components of giving a seminar and journal club will be practiced.