

PHARMACEUTICAL SCIENCES (PHM SCI)

PHM SCI 254 – TINY EARTH GENOMICS - RESEARCHING UNCULTURED ANTIBIOTIC-PRODUCING MICROBES

3 credits.

Collaborate on a research project from the conception of research questions through data analysis and the effective communication of results. Explore the biosynthesis of antibiotics and other small molecules by uncultured bacteria through the analysis of culture-independent DNA sequencing (metagenomics) data, learning about bioinformatics and genomics along the way. Make new discoveries of microbial species and biochemical pathways.

Requisites: ZOOLOGY/BIOLOGY 101, ZOOLOGY/BIOLOGY/BOTANY 151, MICROBIO 101, 303, or BIOCORE 381

Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Navigate genomic databases to find required information and data

Audience: Undergraduate

2. Interpret results using available bioinformatic tools

Audience: Undergraduate

3. Formulate a research question and testable hypothesis

Audience: Undergraduate

4. Refute or support a hypothesis using evidence

Audience: Undergraduate

5. Interpret data and draw conclusions

Audience: Undergraduate

6. Communicate research design and results in written and oral forms

Audience: Undergraduate

PHM SCI 310 – DRUGS AND THEIR ACTIONS

2 credits.

Introduces students to the biological effects of drugs on human health. Emphasis on how drugs, especially those used in diseases of major human health significance, act in the body. Drugs that are abused also will be covered. This course is not intended for medical, nursing, pharmacy, and physician assistant students.

Requisites: Not open to students declared in the Nursing, Physician Assistant, or Doctor of Pharmacy programs

Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Define basic principles of pharmacology including pharmacokinetics and pharmacodynamics

Audience: Undergraduate

2. Memorize examples of drugs, drug classes, and pharmacology of drugs used to treat various disease states including anxiety, depression, pain, schizophrenia, Alzheimer's disease, cancer, and infectious diseases

Audience: Undergraduate

3. Describe examples of drugs, drug classes, and pharmacology of drugs used for non-medical purposes including alcohol, caffeine, nicotine, barbiturates, amphetamine, marijuana, cocaine, and opiates

Audience: Undergraduate

4. Describe examples of drugs, drug classes, and pharmacology of drugs used as PEDs including anabolic steroids and blood doping drugs

Audience: Undergraduate

PHM SCI 420 – PHYSICOCHEMICAL PRINCIPLES OF DRUG FORMULATION AND DELIVERY

3 credits.

Applications of physicochemical principles to pharmaceutical systems.

Requisites: Declared in Doctor of Pharmacy program

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. State the major physical and chemical properties of drugs and excipients that influence the performance of drugs and dosage forms.

Audience: Graduate

2. Apply the different expressions for the concentrations and doses of drug products, and convert different expressions for concentrations and doses.

Audience: Graduate

3. Apply thermodynamic principles to important equilibria in pharmaceutical systems, including isotonicity, acid-base equilibrium, binding equilibrium, partition, hygroscopicity, and solubility.

Audience: Graduate

4. Propose procedures to prepare isotonic solutions and buffered solutions.

Audience: Graduate

5. Understand suspensions and colloids and their role in drug formulations

Audience: Graduate

6. Calculate the distribution of drugs between aqueous and lipid phases based on the principle of partition.

Audience: Graduate

7. Identify the different solid phases of the same drug and predict their impact on drug performance.

Audience: Graduate

8. Predict the aqueous solubility of drugs and its dependence on pH, common ions, and solid forms, and understand its impact on drug performance.

Audience: Graduate

9. Predict shelf life and suggest storage conditions from reaction rate constants and orders of reactions.

Audience: Graduate

10. State the major factors that influence the chemical stability of drugs (e.g., temperature, humidity, light, pH, oxygen, and free radicals) and the common reaction mechanisms (e.g., hydrolysis and oxidation), and propose approaches to stabilization and extending the expiration date of drug products (e.g., pH control, antioxidants, and packaging).

Audience: Graduate

PHM SCI/B M E 430 – BIOLOGICAL INTERACTIONS WITH MATERIALS

3 credits.

Addresses the biological systems governing biomaterial applications, a select range of materials currently being utilized for various biomedical applications, analytical techniques pertinent to biomaterial evaluation, and select major medical applications in which biomaterials play an important role.

Requisites: (ZOOLOGY/BIOLOGY 101 and 102, ZOOLOGY/BIOLOGY/BOTANY 151, ZOOLOGY 153, or BIOCORE 383) and (CHEM 341 or 343), or graduate/professional standing

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Integrate biology, material science, and engineering

Audience: Undergraduate

2. Evaluate the design of materials for specific biomedical applications

Audience: Undergraduate

3. Formulate experimental designs and demonstrate data analyses to assess biological responses to materials

Audience: Undergraduate

4. Describe the clinical utility and limitations of various materials for specific biomedical applications

Audience: Undergraduate

5. Demonstrate practical understanding of biomaterial-based laboratory safety and techniques

Audience: Undergraduate

PHM SCI 432 – BIOCHEMICAL PRINCIPLES OF DRUG TREATMENT

3 credits.

Basic biochemistry as the biochemical basis for drug action. Focus on biopolymers (proteins, nucleic acids) as intended and unintended targets of current drug therapy and the major biochemical pathways in which they operate. Review of protein structure, enzymatic activity, metabolic pathways, membrane biochemistry, mechanism of drug action, DNA mutation and repair.

Requisites: Declared in Doctor of Pharmacy program

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Deduce aspects of protein structure and catalysis from kinetics and other data

Audience: Graduate

2. Summarize how nucleic acids are used to store information in living organisms, including the molecular mechanisms for replication and protein expression

Audience: Graduate

3. Apply knowledge of the pathways by which energy is derived from fats and carbohydrates to both the clinical progression of diabetes and its treatment

Audience: Graduate

4. Differentiate between the different methods of biosignaling, in terms of whether energy is required and whether molecules are physically moved through membrane barriers

Audience: Graduate

5. Integrate understanding of biochemical systems and the ways that drugs are able to target them to therapeutic effect

Audience: Graduate

PHM SCI 490 – SELECTED TOPICS IN PHARMACEUTICAL SCIENCES

1-4 credits.

Specialized subject matter of current interest to undergraduate and professional students.

Requisites: Consent of instructor

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2023

PHM SCI 493 – SELECTED TOPICS IN PHARMACEUTICAL SCIENCES

1-4 credits.

Specialized subject matter of current interest to graduate students.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2026

PHM SCI 510 – PHARMACOLOGY PRINCIPLES AND APPLICATIONS

2 credits.

Underlying science and pharmacological actions of drugs and the biological effects of drugs on human health. Covers drugs used to treat common illnesses and diseases as well as commonly abused drugs.

Requisites: Declared in Pharmacology and Toxicology BS. Not open to students with credit for PHM SCI 310.

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Explain principles of pharmacology
Audience: Undergraduate

2. Apply chemistry and biology knowledge to pharmacokinetics and pharmacodynamics

Audience: Undergraduate

3. Identify types of drugs used to treat various disease states

Audience: Undergraduate

PHM SCI 521 – PHARMACOLOGY I

3 credits.

Pharmacological actions of important drugs, including drugs that affect the peripheral and central nervous systems.

Requisites: Declared in the Doctor of Pharmacy program with second year standing; or declared in Pharmacology and Toxicology BS, BIOCHEM 508, PATH 404, and (ANAT&PHY 335, 435, or BIOCORE 486)

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Describe the neurotransmitters of the central and autonomic nervous systems including their physiologic role, distribution, location, synthesis, storage, release, receptor activation and transmitter inactivation which may serve as sites for drug action
Audience: Undergraduate

2. Describe and differentiate the drug pharmacology of drugs that act in the central and autonomic nervous systems

Audience: Undergraduate

PHM SCI/PHM COL-M 522 – PHARMACOLOGY II

3-4 credits.

Pharmacological actions of important drugs, including hematopoietic, thrombolytic, antihyperlipidemic, immunopharmacologic, anticancer, anti-inflammatory, diuretic, antihypertensive, antianginal, and anti-arrhythmic agents, and agents used to treat congestive heart failure.

Requisites: PHM SCI 521

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Recall the names of different drugs, and be able to link these drug names to not only specific uses, but also to more general concepts about physiology, disease, and drug mechanism of action

Audience: Undergraduate

2. Describe and differentiate the pharmacology of drugs that act on organ systems, including the endocrine, gastrointestinal, cardiovascular, renal, hematopoietic, and immune systems

Audience: Undergraduate

PHM SCI 531 – MEDICINAL CHEMISTRY I

3 credits.

Basic concepts in the chemistry of small molecule medicinal products. Structure activity of cholinergic, adrenergic, serotonergic and dopaminergic agents, antidepressant, antianxiety drugs, opioids, and antihistamines. Overview of drug metabolism and the clinical effects of metabolic drug interactions and genetic variability in drug metabolism genes.

Requisites: PHM SCI 432

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Identify drugs, their therapeutic use, and side effects based on drug name and structure

Audience: Undergraduate

2. Use pharmacophoric drug models to predict potency, metabolism, or side effects

Audience: Undergraduate

3. Apply mechanisms of drug/xenobiotic biotransformation to parent drugs

Audience: Undergraduate

4. Explain factors affecting drug/xenobiotic metabolism in humans, including both environmental and genetic effects and the resulting clinical implications

Audience: Undergraduate

PHM SCI 532 – MEDICINAL CHEMISTRY II

2 credits.

Chemistry of medicinal products, including antihyperlipidemics, glucocorticoids, estrogens, progestins, nonsteroidal anti-inflammatories, antitumor agents, and enzyme inhibitors.

Requisites: PHM SCI 531

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Explain basic chemical principles as they apply to drug SAR

Audience: Undergraduate

2. Identify drug classes and origin based in part on drug structures

Audience: Undergraduate

3. Recognize the mechanism of drugs that act via enzyme inhibition

Audience: Undergraduate

4. Explain the difficulty of drug design in light of side effects and complexity of possible drug targets

Audience: Undergraduate

5. Apply the knowledge of structural modifications to enhance drug delivery via increased solubility, metabolic stability and bioavailability

Audience: Undergraduate

PHM SCI 540 – DRUG DELIVERY SYSTEMS FOR PHARMACOTHERAPY

3 credits.

A series of lectures by experts covering: i) introductory drug development and delivery system development processes; ii) various drug delivery routes (oral, topical, rectal, vaginal, urethral, nasal, and pulmonary); iii) various delivery systems (conventional, ophthalmic, CNS, and recent advances); iv) delivery systems related to biofilms, infection, and vaccines.

Requisites: Declared in the Doctor of Pharmacy program with second year standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Describe theories, approaches, concepts, and current research findings in the area of drug delivery.

Audience: Graduate

2. Apply knowledge of drug development, dissolution, and dosage forms to delivery systems.

Audience: Graduate

3. Identify the characteristics of various common dosage forms and describe/recognize/explain how composition impacts drug release, stability, and bioavailability.

Audience: Graduate

4. Demonstrate, using knowledge of mathematics, chemistry, and biology, concepts of solubility, stability, drug release, dissolution, diffusion, partitioning, dose, absorption, and disposition as related to pharmacology and pharmacokinetics.

Audience: Graduate

5. Demonstrate underlying principles of advanced drug delivery systems which are either entering clinical practice or on the advanced stage in clinical trials/development phase.

Audience: Graduate

6. Identify the rationale for therapeutic use, administration route, formulation, and manufacture of common dosage forms.

Audience: Graduate

7. Utilize proper techniques and skills to be able to advise patients and health care professionals on drug storage, handling, and administration, as well as be able to identify factors that influence bioavailability and related safety issues.

Audience: Graduate

8. Demonstrate professional and ethical responsibility.

Audience: Graduate

PHM SCI 541 – PHARMACEUTICAL CALCULATIONS, DISPENSING AND COMPOUNDING

3 credits.

Introductory laboratory course in compounding and dispensing of pharmaceutical dosage forms, including sterile products. Includes practice in interpretation of prescription orders, pharmaceutical calculations, compounding procedures, physical manipulation of drugs and dosage form components, and product packaging and labeling.

Requisites: PHM SCI 420

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Read and accurately interpret prescription and medication orders

Audience: Undergraduate

2. Correctly identify, interpret and utilize for calculation, the information presented in a written problem, a prescription or medication order, and directions taken from the labeling of a container

Audience: Undergraduate

3. Accurately calculate the quantities needed to compound a dosage form, the dosage of ingredients, and the amount of any drug source required to fulfill the dosing needs of the patient

Audience: Undergraduate

4. Know the dimensions or units of measurements for drugs and chemicals, expressions of quantity and concentration for drug products and preparations, and appropriate methods of expressing doses and dosing regimens for patients

Audience: Undergraduate

5. Perform the accepted techniques used for extemporaneous compounding of non-sterile drug products

Audience: Undergraduate

6. Identify the physical and chemical properties of drugs, pharmaceutical necessities, excipients, and dosage forms, and practice with handling and manipulating them

Audience: Undergraduate

7. Use a variety of pharmacy references for determining appropriate doses and dosage regimens, and drug delivery systems

Audience: Undergraduate

PHM SCI 542 – PARENTERAL THERAPY AND NUTRITION

3 credits.

An introduction to parenteral therapy and nutrition focusing on the fundamental properties, calculations involved and the methods to prepare safe and reliable injectable medications for patients.

Requisites: PHM SCI 541 and concurrent registration in PHM SCI 540

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Become proficient in solving mathematical problems for determining appropriate dosing of medications, for compounding prescription orders, and for providing safe and accurate drug therapy for patients

Audience: Undergraduate

2. Improve compounding skills and ability to critically analyze prescription and medication orders for compounded drug preparations

Audience: Undergraduate

3. Develop competence in aseptic processing and in dealing with intravenous solutions, IV admixtures, reconstitution of parenterals and total parenteral nutrition solutions

Audience: Undergraduate

4. Utilize pharmacy reference books to determine which references to use for specific problems or questions

Audience: Undergraduate

5. Illustrate practical aspects of compatibility and stability of compounded prescriptions and parenteral products, including the application of scientific principles, legal standards, and use of published literature in assigning beyond-use dates to drug preparations

Audience: Undergraduate

6. Explain the pharmacists' responsibility for handling and dispensing quality pharmaceutical drug products and preparations as promulgated in the USP

Audience: Undergraduate

PHM SCI 558 – LABORATORY TECHNIQUES IN PHARMACOLOGY AND TOXICOLOGY

2 credits.

Basic laboratory techniques employed in pharmacological and toxicological research.

Requisites: Declared in the Pharmacology and Toxicology undergraduate program

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Demonstrate procedural knowledge of general laboratory skills

Audience: Undergraduate

2. Explain the processes and applications related to science subjects

Audience: Undergraduate

3. Handle basic scientific equipment carefully and correctly

Audience: Undergraduate

4. Demonstrate a scientific understanding of molecular biological concepts

Audience: Undergraduate

5. Coherently convey scientific data and results in a written report

Audience: Undergraduate

6. Define principles of evidence-based data interpretation and scientific integrity

Audience: Undergraduate

PHM SCI 581 – MOLECULAR AND CELLULAR PRINCIPLES IN PHARMACOLOGY

4 credits.

In-depth introduction to the molecular and cellular principles of pharmacology. Emphasis on the mechanisms of drug and small molecule action in cells, with a focus on downstream signaling pathways, second messenger systems, protein kinase cascades, and the regulation of gene transcription.

Requisites: Declared in Pharmacology and Toxicology BS, BIOCHEM 508, PATH 404, and (ANAT&PHY 335, 435, or BIOCORE 486)

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Recognize the fundamental principles of drug actions at their target sites (e.g. receptors, enzymes, etc.)

Audience: Undergraduate

2. Recognize the various mechanisms by which drugs can mediate their pharmacological effect.

Audience: Undergraduate

3. Describe how drugs mimic or modify physiological function, including the various actions and clinical uses.

Audience: Undergraduate

4. Describe the major classes of therapeutic drugs that affect the primary systems within the body.

Audience: Undergraduate

5. Choose a relevant experimental system to test experimental hypotheses (e.g. in vitro or in vivo; animal species, etc.)

Audience: Undergraduate

6. Design experiments which are properly controlled and which use appropriate statistical methods of data analysis.

Audience: Undergraduate

PHM SCI 623 – PHARMACOLOGY III

3 credits.

Pharmacological actions and underlying basic and clinical science of antimicrobial and antiviral drugs. Pharmacology of hormones and other drugs affecting the endocrine system.

Requisites: PHM SCI/PHM COL-M 522

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Classify the physiologic and pathophysiologic features of the human endocrine system and the pancreas

Audience: Undergraduate

2. Connect the drugs/drug classes to the pharmacology of drugs used to manage diseases relating to the functions of the endocrine pancreas

Audience: Undergraduate

3. Classify physiologic and pathophysiologic features of the human thyroid gland

Audience: Undergraduate

4. Connect the drugs/drug classes to the pharmacology of drugs used to manage diseases relating to the functions of the thyroid gland

Audience: Undergraduate

5. Classify the physiologic and pathophysiologic features of endocrine sex hormones and human reproduction

Audience: Undergraduate

6. Connect the drugs/drug classes to the pharmacology of drugs used to manage diseases and/or functions of the human reproductive tract

Audience: Undergraduate

7. Describe the physiologic and pathophysiologic features of Calcium Homeostasis

Audience: Undergraduate

8. Connect the drugs/drug classes to the pharmacology of drugs used to manage diseases relating to imbalances of Calcium Homeostasis

Audience: Undergraduate

PHM SCI/M&ENVTOX/ONCOLOGY/PHM COL-M/POP HLTH 625 – TOXICOLOGY I

3 credits.

Basic principles of toxicology and biochemical mechanisms of toxicity in mammalian species and man. Correlation between morphological and functional changes caused by toxicants in different organs of the body.

Requisites: (BIOCHEM 501 or 508) and (ANAT&PHY 335, 435, or (BIOCORE 485 and 486)) and PATH 404; or graduate/professional standing

Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Discuss the physiology and pathology of toxicology, understanding the basic fundamentals of toxicology and toxic agents

Audience: Both Grad & Undergrad

2. Demonstrate metabolism and breakdown of toxicants using a given dataset

Audience: Both Grad & Undergrad

3. Recognize various experimental models to obtain scientific results

Audience: Both Grad & Undergrad

4. Implement knowledge to design experiments applicable to one's own research

Audience: Both Grad & Undergrad

5. Critique an example of toxicology in media and develop a presentation of this example

Audience: Both Grad & Undergrad

6. Explore new areas to assist in career development via journal club

Audience: Graduate

PHM SCI/M&ENVTOX/PATH/PHM COL-M/POP HLTH 626 – TOXICOLOGY II

3 credits.

Survey of the basic methods and fundamental biochemical mechanisms of toxicity. Toxicity in mammalian organ systems, techniques for evaluating toxicity, as well as mechanisms of species specificity, and environmental interactions (with toxicant examples) are presented.

Requisites: POP HLTH/M&ENVTOX/ONCOLOGY/PHM SCI/PHM COL-M 625

Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Explain and identify the effects of toxicants on specific organs within the human body

Audience: Both Grad & Undergrad

2. Demonstrate metabolism and reactions of toxicants within organ systems using a given dataset

Audience: Both Grad & Undergrad

3. Classify different means of risk assessment and the conceptual rationale behind these methods

Audience: Both Grad & Undergrad

4. Implement knowledge to design experiments applicable to one's own research

Audience: Both Grad & Undergrad

5. Relate specific organ concepts with conceptual examples from M&ENVTOX 625 to enhance scientific understanding

Audience: Undergraduate

6. Appraise concepts to research to identify future research concepts.

Audience: Graduate

PHM SCI 679 – PHARMACOLOGY AND TOXICOLOGY SEMINAR

1 credit.

Senior student presentations of independent research or of published papers on a specific topic approved by the course coordinator. Faculty-led seminars on selected topics regarding responsible conduct of research. The course also provides a venue for career talks by Pharmacology and Toxicology alumni and guests working in a variety of professional settings - research, industry (pharmaceutical; biotech; contract research; consumer products; etc.), a variety of healthcare professions, and law.

Requisites: Declared in the Pharmacology and Toxicology undergraduate program

Repeatable for Credit: Yes, for 2 number of completions

Last Taught: Spring 2026

Learning Outcomes: 1. Design and give a verbal scientific presentation that explains the scientific method as it applies to a real-life research project

Audience: Undergraduate

2. Identify and appraise strengths and weaknesses of scientific presentations

Audience: Undergraduate

PHM SCI 680 – PRINCIPLES OF PHARMACEUTICAL SCIENCES

3 credits.

Learn about essential components of drug development and cutting-edge research in drug discovery, drug action, and drug delivery. Focus on useful and practical information and essential underpinnings in chemistry, biology, physical chemistry, and engineering.

Requisites: (BIOCHEM 508 and declared in Pharmacology and Toxicology BS) or graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Demonstrate knowledge in a diverse range of drug discovery areas, both from academic and industry settings

Audience: Both Grad & Undergrad

2. Identify mechanisms of action for major drug targets, with emphasis on receptor proteins that constitute targets for a majority of FDA-approved drugs

Audience: Both Grad & Undergrad

3. Explain model systems and methods used for discovery of novel drug targets

Audience: Both Grad & Undergrad

4. Demonstrate knowledge of the basic principles of drug formulation and delivery

Audience: Both Grad & Undergrad

5. Demonstrate knowledge of the current research in drug delivery

Audience: Both Grad & Undergrad

6. Apply knowledge to solve related problems in drug discovery

Audience: Graduate

PHM SCI 691 – SENIOR THESIS

2 credits.

Individual study for seniors completing theses as arranged with a faculty member.

Requisites: Consent of instructor

Repeatable for Credit: No

Last Taught: Fall 2023

PHM SCI 692 – SENIOR THESIS

2 credits.

Individual study for seniors completing theses as arranged with a faculty member.

Requisites: Consent of instructor

Repeatable for Credit: No

Last Taught: Spring 2024

PHM SCI 699 – ADVANCED INDEPENDENT STUDY

1-6 credits.

Directed study projects as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2026

Learning Outcomes: 1. Execute a hypothesis-driven research or scholarly project that integrates foundational and advanced concepts in pharmaceutical sciences

Audience: Undergraduate

2. Analyze and interpret experimental or computational data using appropriate scientific methodologies, tools, and ethical practices

Audience: Undergraduate

3. Communicate scientific findings effectively through written, oral, or visual formats tailored to academic, professional, or public audiences

Audience: Undergraduate

PHM SCI 741 – PHARMACEUTICAL SCIENCES GRANT WRITING

1 credit.

Develop a National Institutes of Health (NIH) F31-style predoctoral fellowship grant proposal in pharmaceutical sciences, suitable for external submission or a preliminary exam. Participate in peer review, small group collaboration, and proposal critique.

Requisites: Declared in Pharmaceutical Sciences PhD

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Summarize scientific logic and planned experiments through an abstract, narrative, and specific aims page

Audience: Graduate

2. Articulate background, significance, and innovation of proposed work

Audience: Graduate

3. Outline methodologies to address a specific set of research questions that include proper controls and analysis methods

Audience: Graduate

4. Describe the NIH grant review process

Audience: Graduate

5. Assess the scientific merit of a grant through preparing written and verbal feedback of peer proposals

Audience: Graduate

PHM SCI 751 – INTRODUCTION TO REGULATORY PRACTICE

3 credits.

Identifies and examines the key regulatory agencies and practices that govern the highly regulated and diverse pharmaceutical industry. Highlights current and emerging FDA and ICH regulations and guidance documents to successfully navigate meeting with the agencies and to submit required documentation for successful product development.

Requisites: Declared in MS Pharmaceutical Sciences or Capstone Certificate in Applied Drug Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Describe the laws and regulations associated with drugs, biologics, and medical devices in the United States.

Audience: Graduate

2. Justify the importance of regulatory affairs in Life Sciences.

Audience: Graduate

3. Develop a meeting and communication strategy for interacting with the FDA and submitting appropriate documentation

Audience: Graduate

4. Analyze the regulations that impact drug and biologics development, dietary supplements, medical devices, and diagnostics.

Audience: Graduate

5. Analyze and compare nonclinical and clinical product development.

Audience: Graduate

PHM SCI 752 – GXP (GOOD PRACTICE): WORKING IN A REGULATED ENVIRONMENT

3 credits.

The pharmaceutical and biopharmaceutical industries have strict documentation and production requirements. Prepares the learner to work in a regulated environment. Explains roles and responsibilities across multiple disciplines and proper documentation practices. Prepares learner for protocol, report creation and audit responses. Discusses specifications, guidances and root-cause analysis.

Requisites: Declared in MS Pharmaceutical Sciences or Capstone Certificate in Applied Drug Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Describe the laws, processes, and regulations associated with drugs, biologics, and medical devices in the United States.
Audience: Graduate

2. Articulate and apply quality based systems in a GxP regulated environment.
Audience: Graduate

3. Explain and analyze when and how the GxP requirements are applied over the course of the product life cycle.
Audience: Graduate

4. Identify the key factors in GxP facility and equipment design, qualification, and maintenance.
Audience: Graduate

5. Identify the key elements required to operate a compliant control laboratory.
Audience: Graduate

PHM SCI 753 – PROJECT MANAGEMENT IN DRUG DEVELOPMENT

3 credits.

Key concepts and body of knowledge of Project Management (PM) applied to the specifics of the drug development process. PM theory and language. The life cycle of a project: Initiating, Planning, Executing, Monitoring and Control, and Closing. Predictive, adaptive and hybrid PM frameworks and tools. Project Charter, statement-of-work, scope of work, work-breakdown structure, project network and timelines. Critical path method and earned value analysis to adjust schedules, allocate resources, and implement corrective actions. Risk management in pharmaceutical projects. An overview of documents management and decision-making strategies.

Requisites: Declared in MS Pharmaceutical Sciences, Capstone Certificate in Applied Drug Development, or Capstone Certificate in Psychoactive Pharmaceutical Investigation

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Explain the concepts, principles and language of PM and its impact and role in the pharmaceutical industry.
Audience: Graduate

2. Describe the functions of a Project Manager in general and within the drug development process (pre-clinical and clinical phases).
Audience: Graduate

3. Compare and contrast different frameworks and tools of PM to make informed decisions on tailoring the PM approach to suit the project needs.
Audience: Graduate

4. Develop a project charter, statement-of-work, scope of work, work-breakdown structure, a resource-loaded timeline, and a project plan.
Audience: Graduate

5. Apply the critical path method and earned-value analysis to track progress and forecast outcomes against a project's plan baseline.
Audience: Graduate

6. Weight proper corrective measures according to earned-value analysis forecast methods, to ensure a project's outcomes and deliverables.
Audience: Graduate

7. Implement risk identification, mitigation and management strategies during project planning (pre-mortem), life cycle, and project closeout (post-mortem).
Audience: Graduate

8. Consolidate the PM concepts and principles studied during the course by developing a Project Plan as Final Project.
Audience: Graduate

PHM SCI 754 – BUSINESS TOOLS FOR PHARMACEUTICAL SCIENTISTS

3 credits.

Explores business aspects of pharmaceutical product development and post-approval product maturation. Covers startup financing, risk management, intellectual property considerations, supply chain management, and strategic decision-making, as applied to both large and small pharmaceutical companies.

Requisites: Declared in Pharmaceutical Sciences MS

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Identify the essential features of a well-constructed life cycle management plan for different types of pharmaceutical products (small molecules, biologics, in vitro diagnostics, and medical devices).

Audience: Graduate

2. Analyze the elements of business development for a novel therapeutic and contrast the differences between a startup effort vs. one from an established company.

Audience: Graduate

3. Describe the key business considerations involved in pharmaceutical product development.

Audience: Graduate

4. Justify strategies for mitigating scientific and business risks.

Audience: Graduate

5. Predict and evaluate how different market forces and business decisions impact supply chains.

Audience: Graduate

6. Explain the role of intellectual property during pharmaceutical product development and post-approval lifecycle.

Audience: Graduate

PHM SCI 755 – LABORATORY AND INSTRUMENTATION METHODS

3 credits.

Teaches the theory and application of many common laboratory techniques and instruments used in drug discovery and development. Includes a laboratory component to teach safety and basic techniques necessary for working in a lab. Instruction begins with basic techniques and builds upon these techniques to instruct in proper sample preparation and handling for analysis using a variety of analytical instrumentation.

Requisites: Declared in the MS Pharmaceutical Sciences: Applied Drug Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Practice good laboratory techniques including proper handling of instrumentation, aseptic methods, and record keeping

Audience: Graduate

2. Explain the fundamentals of DNA science and be able to isolate genomic DNA and perform allelic discrimination

Audience: Graduate

3. Describe the fundamentals of chromatography and be able to apply them to small molecule analysis

Audience: Graduate

4. Practice routine cell culture techniques including aseptic methods, passaging cells and performing routine toxicity assays

Audience: Graduate

5. Know the different methods to quantify and visualize protein and be able to quantify and visualize proteins in biological samples

Audience: Graduate

6. Recognize the basic mechanisms of cellular toxicity and be able to measure toxic effects of compounds on cells grown in culture

Audience: Graduate

7. Describe the fundamentals of mass spectrometry and be able to apply these to both small molecules and proteins

Audience: Graduate

PHM SCI 756 – INTRODUCTION TO DATA ANALYSES IN DRUG DEVELOPMENT

3 credits.

Provides a high-level overview of how data analysis techniques augment the drug discovery and development process. Focuses on project-based skills-building through the application of industry-standard software and use of public databases. Explores best practices for data processing and management to ensure experimental reproducibility. Develops troubleshooting skills through critical evaluation of data analysis results and root cause analysis.

Requisites: Declared in MS Pharmaceutical Sciences: Applied Drug Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Identify relevant software platforms, programming tools, and databases relevant to various drug development tasks.

Audience: Graduate

2. Apply best practices, critical thinking skills, and troubleshooting techniques to data analysis projects.

Audience: Graduate

3. Complete data analysis projects representative of those used in drug target characterization.

Audience: Graduate

4. Analyze large high throughput screening (HTS) datasets to confirm positive hits and identify common issues that arise in these datasets.

Audience: Graduate

5. Perform chemical similarity searches and hits triage by applying industry-standard tools and practices.

Audience: Graduate

6. Conduct physiologically-based pharmacokinetic (PBPK) modeling and simulation projects using industry-standard software packages.

Audience: Graduate

PHM SCI 757 – INTRODUCTION TO DRUG DEVELOPMENT

2 credits.

Scientific process of drug development from discovery through clinical trials. Brief history of drug development, along with an overview of drug discovery, preclinical, and clinical activities that take place during development. Application to real-world drug development scenarios and challenges, especially as they apply to development of drugs to treat neurological diseases.

Requisites: Declared in MS Pharmaceutical Sciences: Psychoactive Pharmaceutical Investigation

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Provide historical context for the modern drug discovery and development process.

Audience: Graduate

2. Describe the high-level goals and activities that take place during discovery, preclinical development, and clinical development and the different functional areas that perform this work.

Audience: Graduate

3. Apply the knowledge learned throughout the course to address specific drug development scenarios.

Audience: Graduate

4. Propose novel strategies to address current drug development challenges.

Audience: Graduate

5. Evaluate scientific literature and regulatory documents to find important information about specific drugs.

Audience: Graduate

PHM SCI 759 – CURRENT TRENDS IN DRUG DISCOVERY AND DEVELOPMENT

1 credit.

Provides the experience and skill to find, read and critically analyze scientific and regulatory literature in the field of drug discovery and development.

Requisites: Declared in MS Pharmaceutical Sciences or Capstone Certificate in Psychoactive Pharmaceutical Investigation

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Know where to search for appropriate primary literature and guidance documents associated with drug discovery and development

Audience: Graduate

2. Critically analyze primary research literature and guidance documents in the field of drug discovery and development and neuroscience

Audience: Graduate

3. Succinctly and accurately communicate the merits and limitations of primary drug discovery and development research publications and guidance documents

Audience: Graduate

PHM SCI 760 – SUMMATIVE RESEARCH INTERNSHIP

3-4 credits.

Summation of core coursework to a real-world project and/or internship experience. Synthesis of knowledge, skills and abilities to demonstrate aptitude for careers in respective industries.

Requisites: Declared in MS Pharmaceutical Sciences

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Demonstrate critical knowledge and in-depth understanding of principles in pharmaceutical sciences and its application in drug development.

Audience: Graduate

2. Identify important research questions, formulate testable hypotheses, design experiments to test those hypotheses and use appropriate statistical methods for analyzing data

Audience: Graduate

3. Conduct research that contributes to the student's field of study

Audience: Graduate

4. Communicate technical knowledge and research results effectively to a range of audiences

Audience: Graduate

5. Apply ethical principles in all work in both independent and collaborative settings

Audience: Graduate

6. Demonstrate comprehension of business principles and the ability to apply them to the pharmaceutical industry

Audience: Graduate

PHM SCI 761 – INTRODUCTION TO PHARMACOLOGY

1 credit.

Introduction to basic concepts of drug delivery and action, methods used to study drug action. Includes a brief survey of drugs acting on the cardiovascular system, the central nervous system and other drug targets.

Requisites: Declared in MS Pharmaceutical Sciences: Applied Drug Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Describe how different dosage forms of drugs are used to deliver drugs to specific organs and sites of action and how drugs are removed from the body.

Audience: Graduate

2. Identify how drugs interact with specific target receptors to produce physiological responses, including desired and undesired effects.

Audience: Graduate

3. Analyze how microbes such as viruses and bacteria evade drug treatment.

Audience: Graduate

4. Specify how drugs are used to affect the cardiovascular system.

Audience: Graduate

5. Specify how drugs are used to treat disorders of the CNS.

Audience: Graduate

6. Explain how “drugable targets” have been used to create new drugs.

Audience: Graduate

PHM SCI 762 – THE DRUG DEVELOPMENT PROCESS FROM DISCOVERY TO INVESTIGATIONAL NEW DRUG APPLICATION (IND)

3 credits.

Overview of the drug development process from discovery to investigational new drug application (IND). Drug discovery (target identification, target validation, and hit-to-lead) preclinical CMC activities, and preclinical pharmacology, pharmacokinetic, and toxicology studies as they apply to both small and large molecule drugs.

Requisites: Declared in Pharmaceutical Sciences: Applied Drug Development MS or Capstone Certificate in Applied Drug Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Describe the phases of drug development from target discovery to investigational new drug (IND) submission and the different functional areas involved.

Audience: Graduate

2. Explain how target pharmacology and drug safety are assessed using both in vitro and in vivo preclinical models.

Audience: Graduate

3. Explain the chemistry, manufacturing, and controls (CMC) activities that take place during discovery and preclinical development.

Audience: Graduate

4. Apply the knowledge learned throughout the course to address specific drug development challenges and propose novel solutions.

Audience: Graduate

5. Evaluate how preclinical development might differ between small molecule drugs and protein therapeutics.

Audience: Graduate

6. Create a preclinical drug development strategy for a specific drug modality and disease combination.

Audience: Graduate

PHM SCI 763 – THE DRUG DEVELOPMENT PROCESS FROM FIH TO BLA/NDA

3 credits.

Overview of the drug development process from first-in-human (FIH) to submission of a new drug application (NDA) or biologics license application (BLA). Phases of clinical development and the role of biomarkers, companion diagnostics, statistical analysis, and CMC in clinical trials. Both small molecule and protein therapeutics will be addressed.

Requisites: Declared in MS Pharmaceutical Sciences: Applied Drug Development or Capstone Certificate in Applied Drug Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Describe the phases of drug development from first-in-human (FIH) studies to NDA/BLA submission and the different functional areas involved.

Audience: Graduate

2. Explain the goals, expectations, and objectives for the different phases of clinical development and describe innovative trial design

Audience: Graduate

3. Define a biomarker, a companion diagnostic, and a statistical analysis plan (SAP) and describe the important elements of all three.

Audience: Graduate

4. Explain the chemistry, manufacturing, and controls (CMC) activities that take place during clinical phases of drug development and pre-launch.

Audience: Graduate

5. Apply the knowledge learned throughout the course to address specific drug development challenges and propose novel solutions.

Audience: Graduate

6. Evaluate how clinical trial design and execution might differ between different therapeutic areas and between small molecule drugs and protein therapeutics.

Audience: Graduate

7. Create a clinical development strategy for a specific drug modality and disease combination.

Audience: Graduate

PHM SCI/CHEM 766 – MOLECULAR RECOGNITION

2-3 credits.

Origin, nature, classification, and description of intermolecular forces.

The hydrophobic effect. Molecular complexes, binding constants, and their measurements. General principles of self-assembly, molecular recognition, complex formation, host design. Supramolecular systems and their dynamics. Micelles, bilayers, vesicles, biological membranes.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

PHM SCI 768 – PHARMACOKINETICS

3 credits.

Quantitative aspects of drug absorption, distribution, metabolism, and excretion. Philosophy and applications of pharmacokinetic modeling and its use in clinical practice.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Analyze and interpret pharmacokinetic profiles following different routes of drug administration and differing dosing regimens

Audience: Graduate

2. Conduct a noncompartmental pharmacokinetic analysis and interpret resulting pharmacokinetic parameter data in context of fundamental pharmacokinetic principles learned

Audience: Graduate

3. Identify the key features of clinical pharmacology studies and how this data will be used to inform drug labeling

Audience: Graduate

4. Describe the importance of a statistical analysis plan and implement key information that should be included

Audience: Graduate

5. Demonstrate their understanding of pharmacokinetic concepts by application to review, analysis, interpretation and reporting from example clinical study data

Audience: Graduate

6. Utilize industry standard software (e.g. Phoenix, R) to review, analyze and report clinical study data

Audience: Graduate

7. Identify regulatory requirements for reporting pharmacokinetic data

Audience: Graduate

8. Describe population pharmacokinetics and physiologically based pharmacokinetic modeling and demonstrate how these approaches may be used in drug development

Audience: Graduate

PHM SCI 773 – MOLECULAR SOLIDS

2-3 credits.

Science and technology of molecular solid materials with applications in medicine, food, energetic materials, and organic electronics.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Identify the molecules in molecular solids, including the active pharmaceutical ingredients

Audience: Graduate

2. Use molecular structures to predict solid-state properties

Audience: Graduate

3. Solve crystal structures and use the information to predict the properties of crystals

Audience: Graduate

4. Describe the elemental steps of crystallization and their distinct kinetics and use the information to control a crystallization process

Audience: Graduate

5. Identify, discover and predict crystal polymorphs and predict the effect of polymorphism on material properties, including dissolution and bioavailability

Audience: Graduate

6. Predict aqueous solubility and its dependence on pH, complexing agents, common ions, and solid forms, and understand its impact on drug performance

Audience: Graduate

7. Prevent crystallization and prepare amorphous solids and glasses and describe areas of applications where amorphous materials outperform crystalline materials

Audience: Graduate

8. Design strategies to stabilize molecular solid materials against physical and chemical changes

Audience: Graduate

PHM SCI 775 – POLYMERIC DRUG DELIVERY

3 credits.

Introduces synthetic and biological polymers applied for drug targeting and controlled drug release, focusing on injectable drugs, including biologics.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Classify polymeric drug delivery systems.

Audience: Graduate

2. Differentiate bioconjugation, complexation and encapsulation.

Audience: Graduate

3. Describe major sterile product requirements.

Audience: Graduate

4. Differentiate major mechanisms of drug release.

Audience: Graduate

5. Relate physicochemical properties to biodistribution, metabolism, and clearance.

Audience: Graduate

6. Predict rates of drug absorption after SC injection.

Audience: Graduate

7. Describe peptide long-acting injectables.

Audience: Graduate

8. Describe antibody-drug conjugates.

Audience: Graduate

PHM SCI 786 – NATURAL PRODUCT SYNTHESIS, BIOSYNTHESIS AND DRUG DISCOVERY

3 credits.

Synthesis and biosynthesis of natural products in drug discovery. Topics include: natural products in drug discovery; biosynthetic pathways and synthetic strategies for major natural product classes; and basic bioorganic chemistry and enzyme mechanisms in biosynthesis.

Requisites: CHEM 345 and BIOCHEM 508

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

PHM SCI 931 – PHARMACEUTICAL SCIENCES SEMINAR

1 credit.

Weekly series that provides exposure to a diverse array of research topics. Students enroll in one of three sections, corresponding to their research core (Drug Action, Drug Discovery, or Drug Delivery). Students in their 2nd year and beyond present their research progress or review literature. The course includes talks from nationally and internationally recognized scientists from academia and industry.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2025

Learning Outcomes: 1. Evaluate how important research questions are identified, hypotheses are formulated, and experiments are designed to test those hypotheses by attending the research presentations of fellow students and outside invited seminar speakers and will use this knowledge to shape their own research ideas

Audience: Graduate

2. Communicate scientific knowledge and research ideas, methodology, models, and results effectively to a range of audiences by presenting a seminar of their original research (in either 931 or 932) with relevant background information and by incorporating changes to their slide design and/or presentation style as they receive feedback from faculty and students

Audience: Graduate

3. Evaluate how existing principles in pharmaceutical sciences intersect with cutting edge research by asking seminar-specific questions and participating in discussions in civil, constructive ways

Audience: Graduate

PHM SCI 932 – PHARMACEUTICAL SCIENCES SEMINAR

1 credit.

Weekly series that provides exposure to a diverse array of research topics. Students enroll in one of three sections, corresponding to their research core (Drug Action, Drug Discovery, or Drug Delivery). Students in their 2nd-year and beyond present their research progress or review literature. The course includes talks from nationally and internationally recognized scientists from academia and industry.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2026

Learning Outcomes: 1. Evaluate how important research questions are identified, hypotheses are formulated, and experiments are designed to test those hypotheses by attending the research presentations of fellow students and outside invited seminar speakers and will use this knowledge to shape their own research ideas

Audience: Graduate

2. Communicate scientific knowledge and research ideas, methodology, models, and results effectively to a range of audiences by presenting a seminar of their original research (in either 931 or 932) with relevant background information and by incorporating changes to their slide design and/or presentation style as they receive feedback from faculty and students

Audience: Graduate

3. Evaluate how existing principles in pharmaceutical sciences intersect with cutting edge research by asking seminar-specific questions and participating in discussions in civil, constructive ways

Audience: Graduate

PHM SCI 990 – RESEARCH

1-12 credits.

Independent research and writing for graduate and students under the supervision of a faculty member.

Requisites: Consent of instructor

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2026

PHM SCI 999 – ADVANCED INDEPENDENT STUDY

1-12 credits.

Directed study projects for graduate students as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2025