Website (http://www.northeastern.edu/bouve/pharmacy/)

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The School of Pharmacy is dedicated to excellence in pharmacy-related education, research, and service, including the provision of patient care. We seek to prepare students with knowledge, skills, and values for careers in pharmacy practice and the pharmaceutical sciences. Our programs promote intellectual growth, professionalism, and lifelong learning. Through the generation and dissemination of new knowledge and through scholarship and community service, the school contributes to improved individual and population health.

Programs

Doctor of Philosophy (PhD)
- Biomedical Sciences (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/biomedical-sciences-ms/)
- Medicinal Chemistry (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/medicinal-chemistry-ms/)
- Pharmaceutical Sciences (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/pharmaceutical-sciences-ms/)
- Pharmacology (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/pharmacology-ms/)

Doctor of Pharmacy (PharmD)
- Doctor of Pharmacy (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/pharmd/)
- Doctor of Pharmacy—Direct Entry (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/pharmd-direct-entry/)

Master of Science (MS)
- Biomedical Sciences (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/biomedical-sciences-ms/)
- Medicinal Chemistry (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/medicinal-chemistry-ms/)
- Pharmaceutical Sciences (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/pharmaceutical-sciences-ms/)
- Pharmacology (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/pharmacology-ms/)

Dual Degree
- Pharmacy, PharmD—Direct Entry / Public Health, MPH (http://catalog.northeastern.edu/graduate/health-sciences/pharmacy/pharmd-direct-entry-public-health-mph/)

Courses

Pharmacy Practice Courses
Search PHMD Courses using FocusSearch (http://catalog.northeastern.edu/class-search/?subject=PHMD)

PHMD 5223. Evidence-Based Medicine. 2 Hours.
Studies the principles of evidence-based medicine and how to apply them to patient-centered care. Offers students an opportunity to develop skills in critical appraisal of the scientific literature and practical application of the evidence to clinical decision making. Consists of didactic instruction, in-class group projects, and a group-based written assignment. Applies principles of research methodology, biostatistics, and professional writing.

PHMD 5250. Pharmacy Care Management. 3 Hours.
Focuses on the managerial and administrative skills required by a contemporary pharmacist practicing in either a community or hospital setting. Covers classical management principles of planning, decision making, organizing, hiring, and controlling. Case study methods are used as an interactive teaching tool. Also covers pertinent current events.

PHMD 5270. Economic Evaluation of Pharmaceuticals and Pharmacy Practice. 2 Hours.
Introduces the principles of economic theory of healthcare markets and economic evaluation of health products and services. Economic theory topics include fundamentals of supply and demand, market structure, market failure, and the role of government. Economic evaluation topics include measuring costs and benefits of a specific treatment, types of formal decision analysis, ethical considerations, and implementation in the real world. Restricted to students with fifth-year PharmD standing.

PHMD 5330. Jurisprudence. 3 Hours.
Examines how federal and state regulatory bodies, statues, laws, regulations, policies, guidance, and practice guides set the standard for the present-day practice of pharmacy.

PHMD 5438. Advanced Pharmacy Practice Experience Preparatory Seminar 1. 0.5 Hours.
Seeks to provide relevant information to enable fifth-year students to make informed decisions concerning the selection and completion of the advance pharmacy practice experiences (APPEs). Using the professional portfolio as a catalyst for exploration, students are required to examine and discuss the variety of APPEs offered. The review of APPE types includes utilizing effective strategies to identify appropriate APPE selections. Students are guided by faculty on how to make APPE selections based on student-identified professional career goals.

PHMD 5439. Advanced Pharmacy Practice Experience Preparatory Seminar 2. 0.5 Hours.
Designed to provide students with opportunities to apply concepts from PHMD 6438 and to continue to provide relevant information to enable fifth-year students to make informed decisions concerning the selection and completion of the advance pharmacy practice experiences (APPEs). Seeks to provide new knowledge and strengthen existing knowledge to ensure a smooth transition from the didactic courses to APPEs.

PHMD 5450. Advanced Pharmacy Practice Experience Preparatory Seminar. 1 Hour.
Offers students an opportunity to collect relevant information to make informed decisions concerning the selection of advanced pharmacy practice experiences (APPEs). Designed to provide new knowledge (e.g., what is expected of a P4 student) and to strengthen existing knowledge (e.g., from didactic courses) to offer a smooth transition from the didactic courses to APPEs.
PHMD 5560. Applied Drug Information. 2 Hours.
Offers students an opportunity to obtain the skills necessary to become effective providers of drug information. An effective provider assesses drug information needs and evaluates, applies, and communicates data from the published literature and other sources to optimize patient care. Designed to help students develop applied drug information skills important to the pharmacist in areas of formulary support, health informatics, medication error and adverse event reporting, and quality assurance. Students complete a variety of active learning exercises, including multiple evidence-based written drug information responses and a current events analysis. Emphasizes writing for a variety of audiences, including pharmacists, other healthcare providers, and the lay public, as well as use of peer review.

PHMD 5575. Pharmaceutical Industry. 2 Hours.
Offers a global overview of pharmaceutical industry career options and pathways. Focuses on all major functions of the industry, such as clinical research and medical affairs. Additional areas covered include regulatory affairs, health economic and outcomes research, marketing, sales, scientific liaisons, and pharmacovigilance. Explores the phases of drug development and how these phases interact with different departments.

PHMD 5600. Pharmacy Capstone. 4 Hours.
Acts as a final integrator of the major, general education, and experiential aspects of the student’s education. Expects students to demonstrate motivation and initiative and to work cooperatively with their faculty mentor, community partners, and fellow students (where applicable) in order to complete a comprehensive, high-quality scholarly work (e.g., a research project, educational project, administrative project, business plan, case report, or community-service learning project or professional manuscript) appropriate for dissemination to the university and professional community. The timeline for completion is set by the faculty mentor and agreed to by the individual or all members of the student group. May be repeated once.

PHMD 5675. Ambulatory Care Pharmacy Practice in Urban Health. 2 Hours.
Introduces various aspects of ambulatory care pharmacy practice and social, economic, cultural, and psychological intricacies. Covers chronic disease management and prevention and wellness. Offers students an opportunity to gain insight into the pharmacist’s role as part of a patient-centered medical home model and/or an interdisciplinary primary care team, with an emphasis on urban health.

PHMD 5880. Special Topics. 2,3 Hours.
Explores topics germane to medication and medication use, as established by the course instructor.

PHMD 5900. Self-Care and Nonprescription Medications: A Team-Based Approach. 2 Hours.
Focuses on the clinical use, safety, and efficacy of common nonprescription medications and complementary alternatives (vitamins, minerals, supplements, herbs, etc.) used in the outpatient setting to treat minor medical problems. Pharmacists are often approached by members of the community to recommend treatments for common ailments. It is important for pharmacists to quickly and accurately assess patients to determine if they are candidates for self-care or if a referral to another healthcare provider is warranted. Offers students an opportunity to develop the necessary skills to determine if self-care treatment is an option for patients and to make appropriate self-care and nonprescription product selection recommendations based on the assessment of a patient’s health status, medical problems, and current practice of self-treatment through case-based examples.

PHMD 5976. Directed Study. 1-4 Hours.
Offers independent work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated for up to 4 total credits.

PHMD 5984. Research. 1-4 Hours.
Offers an opportunity to conduct research under faculty supervision. May be repeated without limit.

PHMD 6440. Internal Medicine Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients in the hospital setting. In collaboration with other members of the healthcare team, and under the supervision of a clinical preceptor, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients.

PHMD 6441. Acute Care Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients. In collaboration with other members of the healthcare team, and under the supervision of a clinical preceptor, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients.

PHMD 6442. Ambulatory Care Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients in an ambulatory clinic environment. In collaboration with other members of the healthcare team, and under the supervision of a clinical preceptor, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients.

PHMD 6443. Community Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients in a community setting. In collaboration with other members of the healthcare team, and under the supervision of a clinical preceptor, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients.

PHMD 6445. Ambulatory Care Elective Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients in an ambulatory clinic environment. In collaboration with other members of the healthcare team, and under the supervision of a clinical preceptor, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.
PHMD 6446. Psychiatry Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients under
psychiatric care. In collaboration with other members of the healthcare
team, and under the supervision of a clinical preceptor, offers
identification of appropriate drug therapy and monitoring requirements
for common pathophysiologic processes, and, when indicated,
modification of population-based treatment strategies based on the
unique characteristics of individual patients. May be repeated without
limit.

PHMD 6447. Community Elective Advanced Pharmacy Practice
Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients in a community
setting. In collaboration with other members of the healthcare team,
and under the supervision of a clinical preceptor, offers identification
of appropriate drug therapy and monitoring requirements for common
pathophysiologic processes, and, when indicated, modification
of population-based treatment strategies based on the unique
characteristics of individual patients. May be repeated without limit.

PHMD 6448. Long Term Care Advanced Pharmacy Practice
Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients in a nursing
home or rehabilitation center. Under the supervision of a clinical
preceptor and, when appropriate, in conjunction with other members
of the healthcare team, offers identification of appropriate drug therapy and
monitoring requirements for common pathophysiologic processes, and,
when indicated, modification of population-based treatment strategies
based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6449. Geriatrics Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients in a geriatric
practice setting. Under the supervision of a clinical preceptor, and,
when appropriate, in conjunction with other members of the healthcare
team, offers identification of appropriate drug therapy and monitoring
requirements for common pathophysiologic processes, and, when indicated,
modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6450. Pediatrics Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients in a pediatric
practice setting. Under the supervision of a clinical preceptor, and,
when appropriate, in conjunction with other members of the healthcare
team, offers identification of appropriate drug therapy and monitoring
requirements for common pathophysiologic processes, and, when indicated,
modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6451. Neonatology Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients in a neonatal
practice setting. Under the supervision of a clinical preceptor, and,
when appropriate, in conjunction with other members of the healthcare
team, offers identification of appropriate drug therapy and monitoring
requirements for common pathophysiologic processes, and, when indicated,
modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6452. Critical Care Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients in a critical-care
practice setting. Under the supervision of a clinical preceptor, and,
when appropriate, in conjunction with other members of the healthcare
team, offers identification of appropriate drug therapy and monitoring
requirements for common pathophysiologic processes, and, when indicated,
modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6453. Surgery Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients in a surgical
practice setting. Under the supervision of a clinical preceptor, and,
when appropriate, in conjunction with other members of the healthcare
team, offers identification of appropriate drug therapy and monitoring
requirements for common pathophysiologic processes, and, when indicated,
modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6454. Cardiology Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication
to the pharmacy-care management of individual patients in a cardiology
practice setting. Under the supervision of a clinical preceptor, and,
when appropriate, in conjunction with other members of the healthcare
team, offers identification of appropriate drug therapy and monitoring
requirements for common pathophysiologic processes, and, when indicated,
modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6456. Drug Information Advanced Pharmacy Practice Experience.
6 Hours.
Applies drug information skills to site-specific drug information requests
under the supervision of a clinical preceptor, and, when appropriate, in
conjunction with other members of the site team. Using appropriate
sources, the student analyzes drug information findings, such as dosing,
monitoring, indications, efficacy, and adverse drug reactions. May be repeated without limit.
PHMD 6457. Oncology Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients in an oncology practice setting. Under the supervision of a clinical preceptor, and, when appropriate, in conjunction with other members of the healthcare team, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6466. Transplantation Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients in a transplantation unit. Under the supervision of a clinical preceptor, and, when appropriate, in conjunction with other members of the healthcare team, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6461. Infectious Disease Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients on an infectious disease consult service. Under the supervision of a clinical preceptor, and, when appropriate, in conjunction with other members of the healthcare team, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6467. Directed Practice Advanced Pharmacy Practice Experience. 6 Hours.
Offers nontraditional experience with an approved preceptor at an appropriate site. Based on availability. May be repeated without limit.

PHMD 6462. Pharmacy Industry Advanced Pharmacy Practice Experience. 6 Hours.
Focuses on the application of regulatory affairs and healthcare principles in the pharmaceutical industry. Under the supervision of a preceptor, and, when appropriate, in conjunction with other members of the site team, participates in appropriate activities, such as drug research and development, marketing, medical affairs, regulatory affairs, and information service. May be repeated without limit.

PHMD 6463. Pharmacy Administration Advanced Pharmacy Practice Experience. 6 Hours.
Applies healthcare and management principles, with emphasis on pharmacy administration, under the supervision of a preceptor, and, when appropriate, in conjunction with other members of the site team. May be repeated without limit.

PHMD 6464. Regulatory Advanced Pharmacy Practice Experience. 6 Hours.
Participates in appropriate activities including but not limited to principles of and compliance with pharmacy law and review of regulations governing the FDA’s mandatory reporting of adverse drug reactions under the supervision of a preceptor, and, when appropriate, in conjunction with other members of the site team. In addition, students may have the opportunity to be given a step-by-step introduction to public record laws, Board Regulations at 247 CMR, and pharmacy statutes at Massachusetts General Laws, Chapter 112, 24(A)–42(A). May be repeated without limit.

PHMD 6465. Managed Care Advanced Pharmacy Practice Experience. 6 Hours.
Applies principles of pathophysiology, therapeutics, and communication to the pharmacy-care management of individual patients in a managed-care practice setting. Under the supervision of a clinical preceptor, and, when appropriate, in conjunction with other members of the healthcare team, offers identification of appropriate drug therapy and monitoring requirements for common pathophysiologic processes, and, when indicated, modification of population-based treatment strategies based on the unique characteristics of individual patients. May be repeated without limit.

PHMD 6468. International Advanced Pharmacy Practice Experience. 6 Hours.
Provides an international experience with an approved preceptor at an appropriate site. Based on availability. May be repeated without limit.

PHMD 6469. Management Advanced Pharmacy Practice Experience. 6 Hours.
Offers students an opportunity to apply healthcare and management principles, with an emphasis on pharmacy management, under the supervision of a preceptor and, when appropriate, in conjunction with other members of the site management team. May be repeated up to two times.

PHMD 6470. Education Advanced Pharmacy Practice Experience. 6 Hours.
Offers students an opportunity to teach in the pharmacy curriculum under the supervision of a faculty member. Students have an opportunity to examine how teachers use experience-based and problem-based approaches to engage the range of student learners (third- through fifth-year pharmacy students) to attain their learning goals. May be repeated up to two times.

PHMD 6471. Research 1 Advanced Pharmacy Practice Experience. 6 Hours.
Offers students interested in gaining basic or clinical research experience an opportunity to work under the direction of an experienced researcher at an appropriate site. Students can elect either a basic science (lab-based) preceptor or a clinical (patient-based) preceptor. Students can expect to be an active participant in a variety of different research activities and experiences that are deemed appropriate by the preceptor. The research efforts of the student may result in a peer-reviewed research abstract and/or presentation. May be repeated up to two times.

PHMD 6472. Research 2 Advanced Pharmacy Practice Experience. 6 Hours.
Offers students an opportunity to further develop research skills and experience gained in PHMD 6471. Intended for those students interested in pursing a postgraduate research training program (e.g., fellowship or graduate school). The research efforts of the student in the course may result in authorship opportunities on a peer-reviewed research abstract and/or manuscript. May be repeated up to two times.
PHMD 6473. Radiopharmacy Advanced Pharmacy Practice Experience. 6 Hours.
Offers students an opportunity to examine the application of radiopharmaceuticals in medical imaging methods. Includes but is not limited to computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), and single-photon tomography (SPECT). Students completing this course may cover aspects of product preparation, administration, and data interpretation. May be repeated up to two times.

PHMD 6474. Public Health Advanced Pharmacy Practice Experience. 6 Hours.
Offers students an opportunity to apply knowledge of public health and policy skills to site-specific needs to advance pharmacy practice within the health system. Seeks to increase knowledge in the principles of public health, with opportunities to work on program implementation and evaluation, policy formation, public health research, and participate in planning and administrative meetings within the public health environment. Offers each student an opportunity to participate as a member of a team to complete group and individual assignments. May be repeated up to two times.

PHMD 6962. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHMD 6964. Co-op Work Experience. 0 Hours.
Provides eligible students with an opportunity for work experience. May be repeated without limit.

PHMD 6999. Advanced Pharmacy Practice Continuation. 0 Hours.
Continues clinical requirements.

Pharmaceutical Science Courses

Search PHSC Courses using FocusSearch (http://catalog.northeastern.edu/class-search/?subject=PHSC)

Introduces new students in the Pharmaceutical Science Graduate Program to important concepts in medicinal and combinatorial chemistry as they relate to drug discovery, and a brief overview of pharmacology, drug metabolism, pharmacokinetics, and toxicology. Also introduces the major drug receptor families and their signaling pathways.

PHSC 5102. Concepts in Pharmaceutical Science 2. 2 Hours.
Presents key concepts and challenges of drug design, development, and evaluation. Integrates the principles of drug design, development, and delivery in a discussion of both small-molecule formulations and biologics. Contextualizes the hallmarks along the path of preclinical drug design to clinical translation. Components of the course include Team-Based Learning (TBL) and professionalism. The TBL sessions offer students an opportunity to work on course-related team applications and include graded peer evaluations.

PHSC 5212. Research Skills and Ethics. 2 Hours.
Teaches students the basics of laboratory safety, safekeeping laboratory data, and the process of writing a grant proposal. Also, case studies explore the concepts of data distortion or fabrication, conflicts of interest, confidentiality, ethical aspects of peer review, and the attribution of credit in science.

PHSC 5300. Pharmaceutical Biochemistry. 2 Hours.
Offers students an opportunity to obtain an understanding of the principles of physiological chemistry. Focuses in-depth on the major topics of physiological chemistry, including general chemistry and biomolecules, peptide synthesis and protein structure, carbohydrates and nucleic acids, thermodynamics and kinetics of molecular interactions, and colloids and micelles. Relates biochemical information to the specific areas of pharmacology, pharmaceutics, and drug discovery/development.

PHSC 5305. Professional Development for Pharmaceutical Sciences. 1 Hour.
Introduces and examines the goals, expectations, policies, and procedures of the Masters’ in Pharmaceutical Sciences internship program and professionalism in the field. Discusses the role and involvement of internship employers. Offers students an opportunity to develop job search and career management skills; assess their workplace skills, interests, and values; discuss how those qualities impact career decisions; prepare a professional résumé; and learn proper interviewing techniques. Issues of ethics and professionalism are designed to inform students of issues they will face in the pharmaceutical field. Content of this course is geared to students’ participation in the internship program and overall professional development in pharmaceutical sciences.

PHSC 5310. Cellular Physiology. 2 Hours.
Focuses in-depth on the major cellular physiological mechanisms, including physiology of the cell membrane, ion channels and transport phenomena, energy production, signal transduction, synapses, and physiological processes in the cytosol. Relates physiological information on the specific areas of pharmacology, pharmaceutics, and drug discovery/development. Offers students an opportunity to obtain an understanding of the principles of cellular physiology.

PHSC 5360. Anti-Infectives. 4 Hours.
Reviews the structure and physiology of bacteria, fungi, and viruses and surveys significant organisms of medical importance. Introduces specific antibiotic, antifungal, and antiviral agents and classes of agents once a foundation of knowledge of the microorganisms that cause disease is established. Discusses concepts of pharmacology, pharmacokinetiics, antimicrobial resistance, pharmacodynamics of antimicrobial agents, and spectra of activity.

PHSC 5400. Principles of Drug Design. 3 Hours.
Studies important aspects of drug discovery and development with a focus on drug design. Covers basic organic medicinal chemistry concepts and seeks to build students’ skills in lead compound discovery, structure-activity relationship studies, and lead optimization strategies. Topics include the fundamentals of pharmacology, pharmacokinetics, and pharmacodynamics of therapeutic agents relevant to the drug-structure optimization. These skills often help develop a strong foundation in the concepts that govern the multidisciplinary process of drug discovery. Uses lectures and peer-reviewed seminar presentations to help students to incrementally increase their knowledge required to identify new, marketable therapeutic agents. Requires organic or medicinal chemistry at the undergraduate level.
PHSC 5500. Repurposing Drugs for Cancer Immunotherapies. 2 Hours.
Offers a multidisciplinary course targeted to students interested in recent advances in biomedical research, clinical practice, and personalized medicine as related to cancer immunotherapies. Describes current promises and disappointments with cancer immunotherapies and recent FDA drug approvals for personalized cancer therapies. Explains the role of immunological and physiological negative regulators of antitumor and tumor biology as needed. Explains underlying principles of immunology, biochemistry, genetics, and preclinical and clinical studies when introducing new concepts. Assigned detailed study of specific areas and discussion of assigned papers are designed to complement classroom material.

PHSC 5555. Pharmaceutical Toxicology. 3 Hours.
Covers fundamental concepts of toxicology and technical methods in toxicology along with comprehensive analysis of both in-vitro and in-vivo toxicity in drug discovery and development. Through lectures given by experts in various fields in toxicology on several topics required for specialized work in research, industrial, and clinical settings, offers students an opportunity to become familiar with methods and analyses including in-vitro and in-vivo toxicity assessments and toxico-kinetic-toxicodynamic models and analyses. Includes mechanistic basis of toxicity, methods of toxicological analysis, and case studies pertinent to topics. Requires undergraduate physiology or biochemistry.

PHSC 5560. Nanotoxicity. 3 Hours.
Studies nanotoxicity, the adverse health effects of nanoparticles. Due to their small size, nanoparticles easily cross biological barriers, entering body fluids and cells. Nanoparticles toxicity may cause chronic and acute pathologies. Offers students an opportunity to develop and understand the principles of nanotoxicity. Focuses on mechanisms of cellular and organ damage by nanoparticles. Discusses ports of nanoparticle entry and detrimental effects upon blood, CNS, lungs, and GI system. Stresses mechanisms of intracellular degradation of nanoparticles and toxic effects of nanoparticles upon human cells and major organ systems. Reviews mechanisms of cellular and organ damage including oxidative stress, inflammation, and DNA, as well as toxic effects on nonmammalian cells.

PHSC 5619. Mass Spectrometry in Drug Development. 3 Hours.
Offers students an opportunity to obtain a fundamental understanding of modern mass spectrometers, to conceptually operate these instruments, and the ability to prepare biological samples. Undoubtedly the most popular analytical method in science, mass spectrometry is utilized in fields ranging from subatomic physics to biology. Focuses on the analysis of proteins, with applications including biomarker discovery, tissue characterization, detection of blood doping, drug discovery, and the characterization of protein-based therapeutics. By the end of the course, the student is expected to be able to solve a particular chemistry- or biology-related problem by choosing the appropriate sample preparation methods and mass spectrometer.

PHSC 5976. Directed Study. 1-4 Hours.
Offers independent work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated without limit.

PHSC 6210. Drug Design, Evaluation, and Development. 2 Hours.
Teaches students the concepts of using immunological, genomic, and proteomic techniques to find novel drug targets. Also introduces the concepts of drug targeting and dosage forms, in vivo/in vitro drug screening, and the importance of pharmacogenetics to explain variability in drug reactions.

PHSC 6212. Research Skills and Ethics. 1 Hour.
Teaches students the basics of laboratory safety, safekeeping laboratory data, and the process of writing a grant proposal. Also, case studies explore the concepts of data distortion or fabrication, conflicts of interest, confidentiality, ethical aspects of peer review, and the attribution of credit in science.

PHSC 6213. Ethical Problems in Health Sciences Research. 2 Hours.
Focuses on a series of cases that raise ethical and professional code of conduct concerns and engages with them collaboratively and carefully to develop essential skills for ethical analysis and evaluation. Scientific practice presents researchers and citizens with myriad ethical challenges. Engaging with those ethical challenges in ways that help yield the benefits of research while respecting ethical boundaries is furthered by not only understanding ethical frameworks but by carefully analyzing and evaluating ethical concerns in context.

PHSC 6214. Experimental Design and Biostatistics. 2 Hours.
Discusses fundamental principles of experimental design and statistical analysis, with emphasis on clinical research. Topics include descriptive statistics, hypothesis testing, analysis of variance, correlation, regression, chi-square test, and nonparametric methods.

PHSC 6216. Human Physiology and Pathophysiology. 2 Hours.
Introduces major topics in human physiology, emphasizing knowledge essential to health-related laboratory research. Topics include neurophysiology, immunology, cardiovascular, respiratory, renal, and gastrointestinal physiology and endocrinology.

PHSC 6218. Biomedical Chemical Analysis. 2 Hours.
Presents the modern reagents, techniques, and instrumentation used to analyze biological samples and purify their components (that is, drugs, metabolites, hormones, macromolecules, organelles, and cells) in health and disease. Emphasizes basic concepts and mechanisms at the chemical level, and applications to human samples.

PHSC 6222. The Chemistry and Biology of Drugs of Abuse. 2 Hours.
Provides an interdisciplinary introduction to substance abuse, including the medicinal chemistry and neurobiology of drugs that act through the opioid, dopamine, acetylcholine, and cannabinoid systems. Compares and contrasts neurochemical mechanisms that are common to many addictive agents and those that are specific to individual drug classes. Highlights the involvement of the brain dopamine system and differences and discusses similarities between the pharmacology of abused and therapeutic drugs, together with the development of medications for treating drug dependence. Includes lectures by experts on particular topics of their own recent research. Introduces students to key aspects of biological and chemical research as they pertain to drug abuse and its treatment.

PHSC 6224. Behavioral Pharmacology and Drug Discovery. 2 Hours.
Designed to prepare students to understand the advantages, shortcomings, and pitfalls of the use of live, behaving animals in drug discovery. Covers an in-depth analysis of ethical issues in animal research, as well as aspects of animal behavioral models, behavior and brain biochemistry, and methods of behavioral analysis. Specific topics include psychopharmacology; fear and anxiety; pain and stress; depression and reward; general arousal and tolerance; drug abuse and habitual behaviors. The ways in which animal behaviors can be described in a quantitative manner and the effects of medications and abused drugs quantified and related to human diseases and drug responses are an important component of the course.
PHSC 6235. Magnetic Resonance Imaging in Drug Discovery. 4 Hours.
Integrates physics, mathematics, and neuroscience, with the cutting-edge technology of magnetic resonance imaging (MRI), to address drug discovery in the treatment of neurodegenerative diseases. Involves a ‘virtual imaging lab’ and “classroom” encouraging critical thinking and interdisciplinary learning skills. Offers students an opportunity to design their own experiments guided by knowledge of the literature, as well as technical and statistical limitations. The Center for Translational Neuroimaging (CTNI) at Northeastern houses a state-of-the-art 7.0 Tesla MR animal scanner. Students in the classroom can ‘take over’ the console and run the experiment, setting parameters for anatomical and functional imaging protocols, and collect and analyze original imaging data for submission for publication in a peer-reviewed journal.

PHSC 6290. Biophysical Methods in Drug Discovery. 2 Hours.
Provides an interdisciplinary introduction to biophysical methods used in modern drug discovery, including hit generation and lead optimization. Emphasizes key experimental methods, including nuclear magnetic resonance (NMR) spectroscopy and X-ray crystallography, as well as computer modeling as applied to ligand- and structure-based drug design. Includes lectures by experts on related topics from their recent drug-discovery research. Presented under the auspices of the Center for Drug Discovery. Requires permission of instructor for students of junior or senior standing.

PHSC 6300. Pharmaceutical Science Seminar. 1 Hour.
Teaches students to evaluate critically the scientific literature in a journal club format. Several sections may be offered each semester to accommodate different specializations or interest groups. May be repeated without limit.

PHSC 6314. Special Topics of Pharmaceutical Science. 2 Hours.
Offers independent work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated without limit.

PHSC 6401. Pharmaceutical Science Internship. 1 Hour.
Offers an experiential component of the graduate curriculum that fosters professional development through internship in drug discovery, development, and/or regulatory affairs in a pharmaceutical or biotechnology company. Requires students to work in a company for a minimum of twenty hours per week. Offers students an opportunity to engage in pharmaceutical science research or to work in an environment outside the University but under the supervision of a faculty instructor. May be repeated up to three times.

PHSC 6760. Doctoral Pharmaceutical Science Research 1. 2 Hours.
Offers PhD research in preparation for thesis proposal.

PHSC 6761. Doctoral Pharmaceutical Science Research 2. 2 Hours.
Offers PhD research in preparation for thesis proposal.

PHSC 6810. Pharmaceutical Science Colloquium. 1 Hour.
Requires students to present one formal seminar on their research. This presentation is open to all those interested.

PHSC 6962. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHSC 6964. Co-op Work Experience. 0 Hours.
Provides eligible students with an opportunity for work experience. May be repeated without limit.

PHSC 6984. Pharmaceutical Science Research. 2 Hours.
Offers students laboratory research under the guidance of an adviser. May be repeated once for up to 4 total credits.

PHSC 6990. Thesis. 2 Hours.
Offers research/experimental work for master’s thesis. Students may register twice. May be repeated once.

PHSC 6996. Thesis Continuation. 0 Hours.
Offers continued registration while student completes master’s thesis or other research project to meet the research requirement in pharmaceutical science.

PHSC 7010. Pharmaceutical Sciences Laboratory. 4 Hours.
Offers hands-on graduate laboratory course that introduces students to the investigative approaches and laboratory methods used in contemporary pharmaceutical sciences research. Laboratory exercises have a practical relationship to essential techniques in modern drug discovery, drug targeting and delivery, and determining mechanisms of drug action. These exercises cover basic laboratory skills, the rationale for and application of standard laboratory methods, training in the use of equipment and techniques central to pharmaceutical sciences research, how to maintain a laboratory notebook, statistical analysis and interpretation of data, and how to present research results in technical laboratory reports.

PHSC 7020. Scientific Writing: Thesis Proposal. 2 Hours.
Presents the principles of writing a proposal based on the NIH R01 grant proposal template used by the department. Participants develop their own proposal in collaboration with their faculty advisor or the immediate project supervisor designated by their faculty advisor (the project principle investigator). Offers students an opportunity to meet with their own project principle investigators to develop content and map out the project aims and experimental design and to produce a revised draft of their thesis proposal. Each student must have initiated MS or PhD thesis research and have some preliminary data; PhD students must have passed their qualifying exam; MS students must petition the graduate committee in writing for permission to enroll.

PHSC 8940. Doctoral Training and Research. 1 Hour.
Intended to show full-time status for pharmaceutical science PhD students in the semester in which they are taking the comprehensive exam. In addition to successfully completing the comprehensive exam, students are expected to perform research in preparation for the doctoral proposal; the grade for this course documents successful performance.

PHSC 8986. Doctoral Full-Time Research. 0 Hours.
Expect student to conduct full-time research in an adviser’s laboratory. May be repeated without limit.

PHSC 9000. Comprehensive Exam. 0 Hours.
Indicates successful completion of the doctoral comprehensive exam.

PHSC 9681. Doctoral Proposal. 2 Hours.
Offers preparation of PhD dissertation proposal and proposal defense before dissertation committee. Requires passing of comprehensive exam. May be repeated without limit.

PHSC 9990. Dissertation Term 1. 1-3 Hours.
Offers research/experimental work for PhD thesis.

PHSC 9991. Dissertation Term 2. 1-3 Hours.
Offers dissertation supervision by members of the department.

PHSC 9996. Dissertation Continuation. 0 Hours.
Offers continuation of PhD dissertation research.

**Pharmaceutics Courses**

Search PMST Courses using FocusSearch (http://catalog.northeastern.edu/class-search/?subject=PMST)
PMST 6250. Advanced Physical Pharmacy. 2 Hours.
Covers the physical and chemical principles in drug formulation design, with emphasis on such topics as solutions of nonelectrolytes and electrolytes, ionic equilibria, drug complexation, reaction kinetics, mass transport, and interfacial phenomena.

PMST 6252. Pharmacokinetics and Drug Metabolism. 3 Hours.
Focuses on concepts of one- and two-compartment linear and nonlinear pharmacokinetics and compartmental modeling with plasma and/or urinary data. Discusses principles and methods of metabolic biotransformation and disposition of xenobiotics in biological system.

PMST 6254. Advanced Drug Delivery Systems. 3 Hours.
Examines in-depth the role of sustained, controlled, and site-specific delivery systems for drugs and genetic materials using polymeric systems, colloidal drug delivery systems, and vectors for gene therapy.

PMST 6258. Advanced Pharmacokinetics and Toxicology. 3 Hours.
Focuses on expanding prior basic pharmacokinetics to more advanced topics required for specialized work in research, clinical, and industrial settings. Using presentation and class participation, offers students an opportunity to become familiar with various analyses and modeling techniques, including compartmental/physiologic models, pharmacokinetic-pharmacodynamic analysis and modeling, and toxicokinetics/toxicodynamics. Requires prior completion of PMST 6252 or equivalent graduate pharmacokinetics course with calculus.

PMST 6962. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

Pharmacology Courses
Search PMCL Courses using FocusSearch (http://catalog.northeastern.edu/class-search/?subject=PMCL)

PMCL 6260. Pharmacology 1. 2 Hours.
Surveys the chemical and pharmacological basis of the major classes of drugs and their use in the treatment of disease. Characteristics of drugs studied include indications, adverse reactions, contraindications, structure-activity relationships, metabolism, mechanism of action, and clinically significant interactions.

PMCL 6261. Pharmacology 2. 2 Hours.
Continues PMCL 6260, although in a format that is not contingent that PMCL 6260 precedes this course.

PMCL 6262. Receptor Pharmacology. 2 Hours.
Reviews receptors for drug substances and for endogenous ligands in a format that combines lecture presentations and discussion. Focuses on the evaluation of current literature. Covers techniques available to study receptors, various models for receptor-ligand interactions, stereochemical aspects of receptor interactions, receptor-mediated coupling mechanisms, and evaluation of several specific receptor systems.

PMCL 6962. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

Toxicology Courses
Search TOXC Courses using FocusSearch (http://catalog.northeastern.edu/class-search/?subject=TOXC)

TOXC 6962. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.