The School of Pharmacy is dedicated to excellence in pharmacy-related education, research, and service, including the provision of patient care. The school prepares students with knowledge, skills, and values for careers in pharmacy practice and the pharmaceutical sciences. School of Pharmacy 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.

The school offers two programs for undergraduate students: the Pharmacy program, leading to the Doctor of Pharmacy degree, and the BS in Pharmaceutical Sciences program. These programs allow students interested in pharmacy practice or the pharmaceutical sciences to choose the pathway most suited to their professional goals. The Doctor of Pharmacy degree is the entry-level professional degree earned by pharmacists. The BS Pharmaceutical Sciences degree is designed for students interested in research in the area of drug design and delivery, pharmacology, pharmaceutics or interprofessional research collaborations. The BS Pharmaceutical Sciences degree does not qualify a graduate for the pharmacist licensure exam.

Programs

Bachelor of Science (BS)
- Pharmaceutical Sciences (http://catalog.northeastern.edu/undergraduate/health-sciences/pharmacy/pharmaceutical-sciences-bs/)
- Pharmacy Studies (http://catalog.northeastern.edu/undergraduate/health-sciences/pharmacy/pharmacy-studies-bs/)

Doctor of Pharmacy (PharmD)
- Pharmacy (http://catalog.northeastern.edu/undergraduate/health-sciences/pharmacy/pharmacy-pharmd/)

Accelerated Programs
See Accelerated Bachelor/Graduate Degree Programs (http://catalog.northeastern.edu/undergraduate/health-sciences/accelerated-bachelor-graduate-degree-programs/)

Courses

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

PHMD 1000. College: An Introduction. 1 Hour.
Introduces the University, college, and health professions to enhance students’ understanding of self and the decisions they make academically and socially as members of the University’s diverse, multicultural community. Offers students an opportunity to engage in group activities and individual assignments along with active participation in a learning community to help them adjust to life on an urban campus, develop a better understanding of the learning process, acquire essential academic skills, and make connections with the faculty and students in the college.

PHMD 1001. Introduction to the Profession of Pharmacy. 1 Hour.
Introduces the profession of pharmacy. Addresses professionalism, pharmacists’ responsibilities, and the education and training of pharmacists.

PHMD 1201. Introduction to Pharmacy Practice. 2.5 Hours.
Seeks to prepare pharmacy students for their first introductory pharmacy practice experience (IPPE)/co-op. Introduces students to the policies, procedures, and expectations of the Cooperative Education Program. Offers students an opportunity to develop the skills needed to be successful in the preparation, activity, and reflection components of the pharmacy co-op program; to prepare their first résumés; and to learn proper interviewing techniques. Exposes students to the various co-op opportunities available to them as well as potential career paths within the pharmacy profession. Covers workplace issues including diversity, sexual harassment, ethics, and confidence of information. Introduces students to the technical knowledge and skills required for their first pharmacy experiences in both community and institutional pharmacy practice and to drug information resources. Offers students an opportunity to develop basic communication skills to aid them in successful completion of their first IPPE.

PHMD 1202. Lab for PHMD 1201. 0.5 Hours.
Offers a laboratory course involving the learning of several skills needed for future patient-care experiences. Intended to supplement lecture content and provide practical reinforcement of concepts. Offers students an opportunity to apply knowledge learned in the classroom related to the appropriate and effective use of communication strategies and sterile techniques. Labs related to the learning of communication skills support a client-centered approach in assessing, adapting, and evaluating patient medication use needs. Specifically, students have an opportunity to learn and practice six core communication skills: (1) listening, (2) asking questions, (3) providing empathy, (4) understanding and managing confusion, (5) understanding and managing conflict, and (6) understanding and analyzing nonverbal behavior.

PHMD 1990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.
PHMD 2000. Professional Development Co-op. 1 Hour.
Introduces the Bouvé Cooperative Education Program. Offers students an opportunity to develop job-search and career-management skills. Students perform assessments of their workplace skills, interests, and values and discuss how they impact personal career decisions. Offers students an opportunity to prepare a professional-style résumé, learn proper interviewing techniques, and gain an understanding of the opportunities available to them for co-op. Introduces career paths, choices, and career decision making. Familiarizes students with workplace issues relative to their field of study and presents the MyNEU COOL database in the job-search and referral process. Presents and discusses co-op policies, procedures, and expectations of the Bouvé Cooperative Education Program and co-op employers.

PHMD 2310. Professional Communication in Pharmacy Practice. 2 Hours.
Offers pharmacy students an opportunity to learn the principles for understanding, applying, evaluating, and creating successful verbal and nonverbal communication interactions in a variety of pharmacist and interprofessional settings. Through a patient-centered approach, reviews and builds on core communication skills learned in the foundational introduction to pharmacy practice courses. Topics include using effective communication approaches to detect and intervene to improve adherence, facilitate behavioral change, collaborate with other professionals, and tailor communication to special and culturally diverse patient populations.

PHMD 2311. Lab for PHMD 2310. 0.5 Hours.
Supplements lecture content from PHMD 2310. Designed to provide pharmacy students with several skills needed for future patient-care experiences and provide practical reinforcement of concepts. Students apply knowledge learned in the classroom related to the appropriate and effective use of communication strategies. Labs related to the learning of communication skills support a client-centered approach in assessing, adapting, and evaluating patient medication use needs. Specifically offers students an opportunity to learn and practice six core communication skills: listening, asking questions, providing empathy, understanding and managing confusion, understanding and managing conflict, and understanding and analyzing nonverbal behavior.

PHMD 2350. Healthcare Systems. 3 Hours.
Examines the evolution of the American healthcare delivery system from the early forms of organized institutional healthcare through the dynamic, and increasingly integrated, delivery systems of the present. Explores the interactions of regulatory, economic, political, and social aspects of the healthcare system with particular emphasis on pharmacy practices. Compares current policies and proposals for health reform and pharmacy benefit coverage. Analyzes the impact and consequences of national and international actions in one era on the structure, function, and outcomes of healthcare and professional pharmacy practice in later years. Major emphases include factors affecting American population health, health disparities, and strategies, including pharmacy/pharmacists, to improve the nation’s health.

PHMD 2990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHMD 2991. Research in Pharmacy Practice. 1-4 Hours.
Offers an opportunity to conduct introductory-level research or creative endeavors under faculty supervision.

PHMD 3450. Research Methodology and Biostatistics. 3 Hours.
Offers an interactive course covering aspects of research designs used in experimental and observational studies, hypothesis testing, and an introduction to basic biostatistics. Offers students an opportunity to critically examine selected articles from the clinical literature, to analyze the framing of the research question and the methods used to insure the validity and generalizability of the study’s findings, and to assess for potential ethical issues in research design and conduct. Clinical trials, observational studies, and problem sets illustrate principles of research design, conduct, and data analysis.

PHMD 3600. Leadership and Advocacy in Health Professions. 2 Hours.
Designed to help facilitate successful careers of young healthcare professionals and expand students’ knowledge of their leadership potential. Consists primarily of topic discussions that include a variety of issues related to professional development, focusing on leadership, organizational and relational skills, and advocacy. Covers global issues in leadership and advocacy. Encourages students to recognize the need for leadership in health professions and the ability of practitioners to influence change regardless of whether they have a title or position of authority. Seeks to be valuable to students with interests in administrative positions in various settings, including in high-level clinical positions, and to students who plan to pursue postgraduate training.

PHMD 3990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHMD 4350. Exploring Academic Careers. 2 Hours.
Seeks to prepare pharmacy students to become more confident and effective as educators. Also seeks to increase the student’s awareness of academic careers and the roles and responsibilities that faculty play in the class, department, and school of pharmacy. The knowledge, skills, and attitudes discussed and explored in this course are applicable across the profession of pharmacy regardless of practice setting. Restricted to students with fifth-year standing.

PHMD 4581. Cancer Chemotherapy. 2 Hours.
Emphasizes the role of chemotherapy in the management of malignant disease. Reviews specific antineoplastic agents, specific malignancies, and related topics. Focuses throughout the course on supportive care for the cancer patient.

PHMD 4585. Research Methods in Health Systems. 4 Hours.
Exposes students to the research methods that health system pharmacists use most often when conducting research and builds on the content of PHMD 2350, PHMD 3450, and PHMD 4560. Incorporates a seminar discussion format led by healthcare system-based pharmacists actively involved in clinical research and helps prepare students for careers or postgraduate training programs (e.g., residencies) in health systems. Faculty use published studies, live patient databases, and descriptions of their current research projects to illustrate the topics in each session.
PHMD 4611. Comprehensive Disease Management 1. 6 Hours.
Covers foundational concepts of pharmacy practice, including patient evaluation; identification of drug-related problems; pathophysiology; and clinical management of diseases of the respiratory, cardiovascular, and endocrine systems. Specifically covers asthma and COPD, hypertension, hyperlipidemia, diabetes, fluids/electrolytes, and renal disorders. Reviews, system-by-system, the mechanisms of these diseases and their evidence-based prevention and treatment strategies. Offers students an opportunity to apply scientific knowledge and principles of medicinal chemistry, pharmacology, pharmacoeconomics, and pharmacokinetics to the design of rational, evidence-based therapeutic strategies to provide care to patients in inpatient, ambulatory, and community settings. Emphasizes pathophysiology, self-care, patient education, assessment, medication administration, management, monitoring, and preventative health and population-based health outcomes.

PHMD 4612. Comprehensive Disease Management 1 Seminar. 1 Hour.
Designed to provide students with opportunities to apply concepts from PHMD 4611 to patient cases, special projects, and other medication-related issues focusing on foundational aspects of pharmacy practice, identification of drug-related problems, and diseases of the respiratory, endocrine, cardiovascular, and renal systems. Accompanies PHMD 4611 and seeks to facilitate accomplishment of course objectives using an active learning format. While completing seminar work, students are expected to review, discuss, integrate, and apply information presented in comprehensive disease management lectures and readings as well as previous and concurrent course work.

PHMD 4621. Comprehensive Disease Management 2. 6 Hours.
Covers the pathophysiology and clinical management of diseases of the renal, cardiovascular, neurological, and gastrointestinal systems. Reinforces foundational concepts of pharmacy practice and diseases covered in PHMD 4611, while completing a system-by-system review of the mechanisms of renal, cardiovascular, neurological, and gastrointestinal disorders and their evidence-based prevention and treatment strategies. Offers students an opportunity to design rational therapeutic strategies to provide care to patients with these disease states in inpatient, ambulatory, and community settings. Emphasizes pathophysiology, self-care, patient education, assessment, medication administration, management, monitoring, and preventative health and population-based health outcomes.

PHMD 4622. Comprehensive Disease Management 2 Seminar. 1 Hour.
Designed to provide students with opportunities to apply concepts from PHMD 4621 to patient cases, special projects, and other medication-related issues focusing on foundational aspects of pharmacy practice, identification of drug-related problems; and diseases of the renal, cardiovascular, neurological, and gastrointestinal systems. Accompanies PHMD 4621 and seeks to facilitate accomplishment of course objectives using an active-learning format. While completing seminar work, students are expected to review, discuss, integrate, and apply information presented in comprehensive disease management lectures and readings as well as previous and concurrent course work. Activities in seminar are reinforced by laboratory skill-building exercises in PHMD 4623.

PHMD 4623. Comprehensive Disease Management 2 Skills Lab. 0.5 Hours.
Offers a self-paced, blended learning experience designed to provide the student with functional knowledge and skills in the area of physical assessment, patient education, and counseling in the ambulatory clinic and community pharmacy settings. Uses discussions, videos, podcasts, simulations, and hands-on learning activities in the lab. Offers students an opportunity to apply information gained in previous and concurrent courses to clinical situations. While completing laboratory work, students are expected to review, discuss, integrate, and apply information presented in the closely aligned PHMD 4621 and PHMD 4622 as well as previous and concurrent course work.

PHMD 4631. Comprehensive Disease Management 3. 6 Hours.
Covers the pathophysiology and clinical management of infectious diseases, solid organ transplant, dermatology, and otic/ophthalmic disorders. Reinforces foundational concepts of pharmacy practice and diseases covered in PHMD 4611 and PHMD 4612, while completing a system-by-system review of the mechanisms of infectious diseases and their evidence-based prevention and treatment strategies. Offers students an opportunity to design rational therapeutic strategies to provide care to patients with these disease states in inpatient, ambulatory, and community settings. Emphasizes pathophysiology, self-care, patient education, assessment, medication administration, management, monitoring, and preventative health and population-based health outcomes.

PHMD 4632. Comprehensive Disease Management 3 Seminar. 1 Hour.
Designed to provide students with opportunities to apply concepts from PHMD 4631 to patient cases, special projects, and other medication-related issues focusing on foundational aspects of pharmacy practice, identification of drug-related problems, and management of the infectious diseases and dermatologic and oral/otic disorders. Accompanies PHMD 4631 and seeks to facilitate accomplishment of course objectives using an active-learning format. While completing seminar work, students are expected to review, discuss, integrate, and apply information presented in comprehensive disease management lectures and readings as well as previous and concurrent course work. Activities in seminar are reinforced by laboratory skill-building exercises in PHMD 4633.

PHMD 4633. Comprehensive Disease Management 3 Skills Lab. 0.5 Hours.
Teaches and assesses various skills, including interpretation, processing, and verification of medication orders; detection and resolution of drug-related problems; use of current pharmacy software programs; and patient education and counseling in the community pharmacy setting. Uses discussions, videos, podcasts, simulations, and hands-on learning activities in the lab. While completing laboratory work, students are expected to review, discuss, integrate, and apply information presented in the closely aligned PHMD 4631 and PHMD 4632 as well as previous and concurrent course work.

PHMD 4641. Comprehensive Disease Management 4. 6 Hours.
Covers the pathophysiology and clinical management of men’s and women’s health issues and neurological, psychiatric, and oncologic disorders. Reinforces foundational concepts of pharmacy practice and diseases covered in PHMD 4611, PHMD 4612, and PHMD 4613, while completing a system-by-system review of the mechanisms of infectious diseases and their evidence-based prevention and treatment strategies. Offers students an opportunity to design rational therapeutic strategies to provide care to patients with these disease states in inpatient, ambulatory, and community settings. Emphasizes pathophysiology, self-care, patient education, assessment, medication administration, management, monitoring, and preventative health and population-based health outcomes.
PHMD 4642. Comprehensive Disease Management 4 Seminar. 1 Hour.
Designed to provide students with opportunities to apply concepts from PHMD 4641 to patient cases, special projects, and other medication-related issues focusing on foundational aspects of pharmacy practice, identification of drug-related problems, and management of women's and men's disease, psychological disorders, and cancers. Accompanies PHMD 4641 and seeks to facilitate accomplishment of course objectives using an active-learning format. While completing seminar work, students are expected to review, discuss, integrate, and apply information presented in comprehensive disease management lectures and readings as well as previous and concurrent course work. Activities in seminar are reinforced by laboratory skill-building exercises in PHMD 4643.

PHMD 4643. Comprehensive Disease Management 4 Skills Lab. 0.5 Hours.
Teaches and assesses various skills, including interpretation, processing, and verification of medication orders; detection and resolution of drug-related problems; use of current pharmacy software programs; medication reconciliation; presentation of hospitalized patients; and management of sterile compounding systems in the hospital pharmacy setting. Uses discussions, videos, podcasts, simulations, and hands-on learning activities in the lab. While completing laboratory work, students are expected to review, discuss, integrate, and apply information presented in the closely aligned PHMD 4641 and PHMD 4642 as well as previous and concurrent course work.

PHMD 4700. Principles in General Medicine. 2 Hours.
Offers students an opportunity to apply concepts learned in comprehensive-disease-management modules to patient cases, special projects, and other medication-related problems in an active-learning environment. Creates an environment similar to that of acute care advanced pharmacy practice experiences (APPEs) to enable students to gain familiarity and confidence in disease-state management, oral communication skills, and professional behavior and interactions. Focuses on oral presentations and communication skills, which is similar to how students are evaluated on clinically based rotations; students are also evaluated by quizzes and exams to measure mastery of content-specific objectives.

PHMD 4880. Special Topics. 2 Hours.
Explores topics germane to the use of medication as established by the course coordinator in various section offerings. May be repeated up to two times.

PHMD 4890. Contemporary Issues in Geriatric Pharmacy. 2 Hours.
Focuses on physiological and practical aspects of medication use in the elderly, the pharmacist's role in geriatric care, and the management of disease states and syndromes that predominantly occur in the elderly. Pharmacists must assess and assure safe and effective use of medication in the geriatric population to prevent adverse events that increase morbidity and mortality and reduce quality of life. Utilizes problem-based learning by promoting critical thinking, effective use of resources in research, and application of concepts to real-world situations.

PHMD 4970. Junior/Senior Honors Project 1. 4 Hours.
Focuses on in-depth project in which a student conducts research or produces a product related to the student's major field. Combined with Junior/Senior Project 2 or college-defined equivalent for 8-credit honors project. May be repeated without limit.

PHMD 4971. Junior/Senior Honors Project 2. 4 Hours.
Focuses on second semester of in-depth project in which a student conducts research or produces a product related to the student's major field. May be repeated without limit.

PHMD 4990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHMD 4991. Research. 4 Hours.
Extends current knowledge or offers novel insights through faculty-directed and supervised individual undergraduate research or creative projects. The project must be designed in concert with and obtain formal prior approval from relevant faculty and program director. May be repeated without limit.

PHMD 4992. 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.

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 advanced 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 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.

PHSC 1990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHSC 2000. Professional Development for Pharmaceutical Sciences Co-op. 1 Hour.
Introduces students to the pharmaceutical sciences cooperative education program and professionalism in the field. Students assess their workplace skills, interests, and values and discuss how these impact personal career decisions. Offers students an opportunity to develop effective job search and career management skills, prepare a professional resume, learn proper interviewing techniques, develop a strong online professional profile, and learn how to use the Northeastern job database and referral process.

PHSC 2100. Lab Research Rotation. 4 Hours.
Offers students an opportunity to conduct laboratory research under the direct supervision of a laboratory mentor, generally a faculty member or laboratory director, gain experience in research techniques, and develop good laboratory practices as they learn about research topics under investigation in the laboratory of their choice. Students attend seminars, departmental events, and other activities relevant to the mentor's laboratory. The time commitment is at least eight hours a week. Mentor expectations and grading criteria are decided upon between the student and the mentor prior to the start of the rotation and must be approved by the course director. Students prepare a presentation that encompasses the research performed by the student that includes description, experimental design, data generated, data interpretation, and discussion of their research project.

PHSC 2301. Human Physiology 1. 3 Hours.
Provides students with an understanding of the principles of physiology. Discusses physiological information mostly related to cardiovascular, respiratory, digestive, urinary, and endocrine systems. Focuses on the physiological mechanisms of the major organ systems. Physiological information is related to the specific areas of pharmacology.

PHSC 2302. Human Anatomy Lab. 1 Hour.
Accompanies PHSC 2301. Focuses on the anatomy of the major organ systems. Interactive CD-ROMs allow each student to study in-depth the structure of each organ system.

PHSC 2303. Human Physiology 2. 3 Hours.
Continues PHSC 2301. Provides students with an understanding of the principles of physiology. Discusses physiological information mostly related to cell physiology, muscle physiology, and physiology of the nervous system. Focuses on the physiological mechanisms of the major organ systems. Physiological information is related to the specific areas of pharmacology.
PHSC 2304. Human Physiology Lab. 1 Hour.
Accompanies PHSC 2303. Covers topics from the course through various experiments.

PHSC 2320. Biochemistry. 4 Hours.
Introduces the structures, functions, and metabolism of amino acids, proteins, carbohydrates, lipids, and nucleic acids. Discusses the mechanisms of enzyme reactions, enzyme kinetics, vitamins, biological oxidation-reduction reactions, and bioenergetics, as well as various inborn errors of metabolism.

PHSC 2330. Immunology. 3 Hours.
Provides students with an understanding of the principles, mechanisms, organs, cells, and molecules of the innate and adaptive immunity. Monoclonal antibodies, organ transplant immunity, hypersensitivity, tolerance, tumor immunity, autoimmune, and immunodeficiencies are discussed in light of potential therapeutic interventions. Weekly journal club-style presentation of related assigned topic is required.

PHSC 2400. Research Ethics for Beginning Health Scientists. 4 Hours.
Explores various dimensions of ethical research. Introduces ethical foundations and controversies that are central to understanding and developing appropriate ethical frameworks for engaging in research. Requires students to work collaboratively to carefully develop essential skills for ethical analysis and evaluation of professional code of conduct concerns.

PHSC 2650. Introduction to Health Science Research. 4 Hours.
Surveys research methods and topics relevant to health science research with the goal of engaging undergraduate students to commit to research training throughout at least one semester and possibly continuing throughout their undergraduate program. Exposes students to lectures addressing the benefits of a research experience and readings of original literature. Health science faculty from across the university present their lines of research focusing on projects that would be available to students. Seeks to familiarize students with use of the scientific method in addressing unsolved problems and to prepare them to select the most appropriate research laboratory to engage in research.

PHSC 2990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHSC 2991. Research in Pharmaceutical Science. 1-4 Hours.
Offers an opportunity to conduct introductory-level research or creative endeavors under faculty supervision.

PHSC 3411. Pharmaceutics 1. 4 Hours.
Develops an understanding of pharmaceutical dosage forms, with emphasis on solids, liquids, semisolids, parenterals, inhalation, and novel drug delivery systems. Combines the discussion of pharmaceutical products developed in industry and those compounded in local pharmacies. Focuses on application of mathematical principles and problem-solving skills in pharmaceutical compounding.

PHSC 3412. Pharmaceutics 2. 4 Hours.
Continues PHSC 3411. Examines the physical and chemical properties of the drug as it relates to pharmaceutical product development. Covers concepts of thermodynamics, colligative properties, ionic equilibriums and buffers, solubility, complexation and protein binding, reaction kinetics, mass transport, interfacial phenomena and dispersion, and rheology.

PHSC 3419. Pharmaceutics Laboratory. 1 Hour.
Formulates pharmaceutical dosage forms such as powders, capsules, solutions, suspensions, emulsions, ointments, gels, creams, lotions, and suppositories, and tests the quality of the products in the lab using approved methods of analysis. Also provides an understanding of the physical and chemical properties of drugs as they relate to formulation development through experimental observation of dissolution, stability, and effects of pH and co-solvent on solubility of drugs.

PHSC 3430. Pharmacokinetics and Biopharmaceutics. 3 Hours.
Focuses on the basic principles and methods of biopharmaceutics and pharmacokinetics. Covers the kinetics of drug absorption, distribution, metabolism, and excretion; linear and nonlinear pharmacokinetics; general concept of one- and two-compartment models with instantaneous (i.v. bolus), zero order (i.v. infusion), or first order (oral administration or i.m. injection) input; evaluation of bioavailability and investigation of the factors affecting drug availability; influence of the route of administration, dosage form, and regimen on bioavailability of drugs; bioequivalence study; multiple dosing kinetics; general approaches to dosage adjustment in renal disease; noncompartmental analysis; and pharmacokinetic-pharmacodynamic modeling.

PHSC 3990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHSC 4340. Pharmacology for the Health Professions. 4 Hours.
Provides the fundamentals of pharmacology to students entering the health professions. Topics include the general principles of drug action, drug distribution, and drug elimination, with attention to the development of reasoning skills necessary to identify, avoid, and solve practical drug-related problems. Drugs are presented according to therapeutic or functional classification.

PHSC 4501. Pharmacology/Medical Chemistry 1. 5 Hours.
Introduces the principles and basic concepts of pharmacology and the general mechanisms of drug action including drug receptor interactions. Discusses the major drug classes affecting the peripheral autonomic and central nervous systems including anxiolytics, sedative-hypnotics, anesthetics, anticonvulsants, neuroleptics, antidepressants, and antimalarial agents. Considers therapeutic uses, mechanisms of drug action, and undesirable actions including side effects and adverse reactions.

PHSC 4502. Pharmacology/Medical Chemistry 2. 5 Hours.
Continues PHSC 4501. Covers the mechanisms of action, structure-activity relationships, therapeutic uses, and adverse effects of drugs including cardiovascular agents, hormones, anticancer drugs, antibiotics, and antiinflammatory agents.

PHSC 4600. Pharmacy Capstone. 4 Hours.
Acts as a final integrator of the major, general education, and experiential aspects of the student's education. Expect 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.
PHSC 4850. Capstone for BS in Pharmaceutical Sciences. 4 Hours.
Designed to facilitate integration of major, general education, and experiential aspects of the individual student's program of study with a focused scientific research experience under the mentorship of a faculty member. Offers students an opportunity to develop a research question, perform data collection and analysis, and satisfactorily complete a quality research report (detailing background; methods; results; discussion, including relevance to their pharmaceutical science career development; and references), followed by participation in a seminar on their work presented to the Northeastern community. In addition, students are strongly encouraged to present their findings at local, regional, national, and international professional meetings. Requires approval of director of pharmaceutical sciences BS program.

PHSC 4970. Junior/Senior Honors Project 1. 4 Hours.
Focuses on in-depth project in which a student conducts research or produces a product related to the student's major field. Combined with Junior/Senior Project 2 or college-defined equivalent for 8-credit honors project. May be repeated without limit.

PHSC 4971. Junior/Senior Honors Project 2. 4 Hours.
Focuses on second semester of in-depth project in which a student conducts research or produces a product related to the student's major field. May be repeated without limit.

PHSC 4990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHSC 4991. Research. 4 Hours.
Extends current knowledge or offers novel insights through faculty-directed and supervised individual undergraduate research or creative projects. The project must be designed in concert with and obtain formal prior approval from relevant faculty and program director. May be repeated without limit.

PHSC 4992. 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 4997. Senior Thesis. 4 Hours.
Offers students an opportunity to prepare an undergraduate thesis under faculty supervision.

PHSC 4998. Senior Thesis Continuation. 4 Hours.
Offers students an opportunity to execute a project as described in PHSC 4997, which involves laboratory work; skill development; and the ability to generate, analyze, and report valid and reproducible data with the highest level of honesty and integrity. Students write and defend a thesis project to a public audience that describes the scientific background and context of the research, the hypothesis tested, methods utilized, and experimental results obtained. The thesis also includes interpretation of data, its contribution to the field, and future directions for the research. Students are expected to demonstrate motivation and initiative and to develop skills necessary to work cooperatively with a faculty mentor and other lab personnel.

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 resume; 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, pharmacokinetics, 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 toxicokinetic-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 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.

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

TOXC 4990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.