The School of Pharmacy is dedicated to excellence in pharmacy-related education, research, and service, including the provision of patient care. We 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.

The six-year (two years of preprofessional and four years of professional courses) program at Northeastern University leading to the professional Doctor of Pharmacy degree (PharmD) fully integrates campus-based learning with experiential learning, including the university's signature cooperative education (co-op) program, to provide students with the knowledge, skills, and abilities necessary to succeed in the pharmacy profession. Our students promote and ensure the safe and effective use of drugs and provide medication therapy management services. In addition to preparing and dispensing prescribed medications, our students provide information to patients about medications and their uses; advise physicians, other prescribers, and other healthcare practitioners on medication selection, dosages, interactions, and adverse effects; and monitor patient responses to drug therapy.

Our students are well equipped to provide patient care services in a variety of settings. Most of our graduates work in community pharmacies or in healthcare facilities such as hospitals and ambulatory clinics. Additional practice opportunities exist in health maintenance organizations, private practice groups, long-term-care facilities, home healthcare, the Public Health Service, the armed services, and law enforcement agencies such as the Federal Drug Administration (FDA) or Drug Enforcement Administration (DEA). Graduates may also find employment in drug development, marketing and research within the pharmaceutical industry, colleges of pharmacy, and professional association management. In addition, many of our graduates go on to pharmacy practice residencies, fellowships, and leading graduate programs.

Pharmacy students are admitted with the expectation that by working with faculty, staff, and each other, they will develop the knowledge, skills, and attitudes necessary for academic and professional success. Students follow academic progression plans for their respective years of graduation. Any deviation from the prescribed curriculum will require faculty/staff permission and an approved plan of study from the school's Academic Standing Committee.

The pharmacy curriculum includes introductory (cooperative education) and advanced pharmacy practice experiences (IPPEs and APPEs). These pharmacy practice experiences are provided primarily under the direct supervision of qualified pharmacist preceptors and occasionally with other qualified healthcare professionals. The school is affiliated with many world-class practice sites throughout the United States, providing students with access to experienced clinicians and scholars. Although every effort is made to accommodate individual circumstances and requests, students should be prepared to travel outside the Boston area to complete some of their pharmacy practice experiences. Availability of a car may be required, as some sites are not accessible by public transportation. All expenses associated with pharmacy practice experiences, including travel and housing, are the responsibility of the student.

IPPEs are competitive placements that are based on job availability in a geographic region. The placements are facilitated by the school's cooperative education coordinators. Students are required to earn a satisfactory (S) grade on one IPPE in a community setting and on one IPPE in an institutional/hospital practice setting.

APPE placements are provided based on site/preceptor availability and the final approval of the school's Office of Experiential Education. Students may be able to petition for out-of-system APPEs; however, availability for such requests is limited.

To be eligible for a Doctor of Pharmacy degree (PharmD), a student must successfully complete all courses in the curriculum including the IPPEs (co-op) and APPEs; meet the academic progression standards of the program; meet the technical standards of the program; and satisfy all other requirements as stated in the Bouvé College of Health Sciences Undergraduate Student Information Manual. The pharmacy program, which is fully accredited by the Accreditation Council for Pharmacy Education (ACPE), subscribes and adheres to the standards established by ACPE.

Students enrolled in the PharmD program will be awarded a Bachelor of Science in Pharmacy Studies after successful completion of all didactic and laboratory courses in semesters 1 through 10 of the pharmacy curriculum. The Bachelor of Science in Pharmacy Studies does not allow for individuals to pursue licensure for direct patient care in the practice of pharmacy. To earn the PharmD degree, students must complete an additional 36 semester hours of APPEs (see "Requirements for the Doctor of Pharmacy Advanced Pharmacy Practice Experiences" below) with an overall GPA of 3.000 or greater in the Bouvé College of Health Sciences graduate program.

Pharmacy graduates must meet specific requirements to qualify for professional licensure in the state where they plan to practice as a registered pharmacist. These requirements include graduating from an accredited school of pharmacy, passing national and state board examinations, and completing internship hours. The internship is a period of practical experience conducted under the supervision of a registered pharmacist. Massachusetts requires 1,500 internship hours, all of which are satisfied through IPPEs (co-op) and APPEs.

The Bachelor of Science in Pharmaceutical Sciences is geared toward highly motivated students who are strongly focused on careers in biomedical/pharmaceutical research, biomedicine, and/or the pharmaceutical/biotech industries. The educational approach is an innovative paradigm that immerses students into undergraduate research at the earliest possible time and promotes graduate-style mentorship and experiential learning in the context of an intensive scientific curriculum with specialized educational opportunities. Pharmaceutical sciences are by nature highly interdisciplinary: they include pharmacology, physiology, structural biology, medicinal chemistry, pharmaceutics, and the allied fields of toxicology, chemical biology, nanomedicine, and a spectrum of
emerging health science disciplines that span classical life sciences, engineering, and biotechnology. All students take courses in basic chemistry, basic biology, organic chemistry, physiology, pharmacology, medicinal chemistry, and pharmaceutical sciences and can then further specialize their education with elective courses in areas of their interest and their developing career trajectory. Entering students are expected to initiate a self-directed search for opportunities to participate in laboratory research. In the first year, students take Introduction to Health Science Research, a course that introduces students to the scientific literature, hypothesis generation, and use of the scientific method to investigate unsolved problems. To facilitate student identification and research, this course also introduces students to faculty researchers from within and outside of the university with the goal of matching students with faculty research mentors. Graduates of the Bachelor of Science in Pharmaceutical Sciences program will have a solid foundation in the science of drug discovery, delivery, evaluation, and development, as well as specialized training at the undergraduate level in research labs. The program prepares students to pursue graduate studies, professional programs, or to enter the biopharmaceutical industry. The BS degree requires a minimum of four years of study and provides for at least one co-op period.

Professional and/or legal exigencies arise from time to time that may necessitate changes in a pharmacy course, progression, and/or graduation requirements. Students should review their status with academic advisors on a timely basis and refer to current publications for updated information.

Requirements for the PharmD Pharmacy Practice Experiences (PPEs)
Requirements for the successful completion of the PharmD PPEs include:

1. Evidence of health clearance from University Health and Counseling Services before placements at any PPE site.
2. Satisfactory completion of any additional site-specific requirements including, but not limited to, criminal record information (CORI), urine drug screens, and verification of immunization status. All fees associated with these requirements are the responsibility of the student.

If the student learns the urine screen (aka test #1) is positive, the student will notify the OEE (pharmacyoee@northeastern.edu) and immediately complete a second urine screen (aka test #2). A professional concern form will be completed based on test #1 results.

- If that urine screen (test #2) is negative (-), the student will be allowed to continue the PPEs. However, the student will be asked to complete a random urine screen (aka test #3) at a time determined by the OEE. If this urine screen (test #3) is positive (+), the student will be administratively removed from the active PPEs and graduation may be delayed. A second professional concern form will be completed, based on test #3 results. The return to PPEs will occur once a repeat urine test is negative. That repeat negative test will be followed up by a random urine screen at a time determined by the OEE.
- If the urine screen (test #2) is positive (+), the student will be administratively removed from the PPEs and graduation may be delayed. The return to PPEs will occur once a repeat urine screen is negative. That negative screen will be followed up by a random urine screen at a time determined by the OEE. A second professional concern form will be completed based on a positive test #3 result.

3. Adherence to the school’s code of professional conduct and university’s code of conduct policies while off-campus.
4. Maintenance of an active, pharmacy intern license in every state where the student completes an experience.
5. Compliance with site-specific requirements (via site descriptions) and completion of site requests within specified deadlines. Failure to complete these requirements as directed will likely result in delay of graduation.
6. Maintenance of a portfolio throughout the professional years and completion of all portfolio submission requirements within specified deadlines.
7. Students are expected to adhere to the policies and standards of their program major as stated to progress through their curriculum as planned. Students seeking any exceptions to the program policies and standards specified for their program major must present a petition before the School of Pharmacy Academic Standing Committee.

Given programmatic requirements, coupled with concerns over the loss of therapeutic knowledge, requests for a general leave of absence:

- Must comply with all stated Northeastern University general policies, regardless of the academic year.
- May be made at any time period during the freshman through P2 years.
- During the P3 academic year, any request for a general leave must be made no later than February 1 of the given academic year. Requests after this date for students in the P3 year will not be permitted.
- During the P4 academic year, requests for a general leave cannot be made at any time.

Technical Standards for the Doctor of Pharmacy Program
The PharmD program at Northeastern University is a rigorous and challenging academic program that requires students to possess specific characteristics and abilities within the cognitive, affective, and psychomotor domains, referred to here as technical standards. To successfully progress in and ultimately complete the didactic, laboratory, and experiential components of the PharmD program, students must meet the standards described below.

INTELLECTUAL ABILITIES
Students must have well-developed problem-solving and critical-thinking skills. Cognitive function must be appropriate to integrate, evaluate, and apply information gained through measurement, analysis, calculation, and reasoning. Students must have the capacity to learn efficiently in classroom, laboratory, small group and experiential settings, and through independent study. Students are required to demonstrate the ability to integrate course content knowledge with clinical practice applications to optimize medication therapy management.

COMMUNICATION SKILLS
Students must be able to communicate effectively with colleagues, professors, patients, families, and healthcare providers. This includes efficiently comprehending, speaking, reading, and writing in English. Students must be able to process and use appropriate nonverbal cues and be proficient in the use of electronic communication media.
BEHAVIORAL AND SOCIAL ATTRIBUTES
Students must demonstrate professionalism, maturity, integrity, honesty, compassion, and respect when relating to others. Students must have sufficient mental and emotional health to complete work and responsibilities using good judgment. Students must be able to tolerate and adapt to stressful workloads and situations and modify behavior based on constructive criticism. Students must be able to function in accordance with the legal, ethical, and professional standards of practice.

OBSERVATION AND MOTOR SKILLS
Students must have functional use of visual, auditory, and tactile senses. Students must be able to observe and perform experiments, physical assessments, patient interviews, and medication order processing. Students must be able to distinguish physical characteristics of medications by inspection. Students must have coordination of gross and fine muscular movements sufficient to perform pharmacy-related tasks including compounding and dispensing medications, administering medications, and using computers and other technology necessary for learning and professional practice.

Programs
Bachelor of Science (BS)
• Pharmaceutical Sciences ([http://catalog.northeastern.edu/undergraduate/health-sciences/pharmacy/pharmaceutical-sciences-bs](http://catalog.northeastern.edu/undergraduate/health-sciences/pharmacy/pharmaceutical-sciences-bs))
• Pharmacy Studies ([http://catalog.northeastern.edu/undergraduate/health-sciences/pharmacy/pharmacy-studies-bs](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](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](http://catalog.northeastern.edu/undergraduate/health-sciences/accelerated-bachelor-graduate-degree-programs))

Courses
Pharmacy Practice Courses
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 2310. Educational and Behavioral Interventions in Pharmacy Practice. 2 Hours.
Seeks to provide pharmacy students with theoretical frameworks and principles for understanding communication processes and practical tools to engage in effective interpersonal communication when providing medication therapy management to diverse patient populations. Uses a patient-centered approach to assess, adapt, and evaluate various types of communications within a variety of pharmacy settings. Reviews core communication skills, including listening, asking questions, providing empathy, understanding/managing confusion, understanding/managing conflict, and understanding/analyzing nonverbal behavior. Additional skills covered include detecting/intervening to improve adherence, facilitating behavioral change, communicating with special populations, leading/facilitating group communication, collaborating with other professionals, analyzing organizational communication in pharmacies, and understanding/analyzing health promotion campaigns. Offers students an opportunity to become aware of communication issues facing pharmacy practice at interpersonal, interprofessional, and organizational levels.
PHMD 2311. Lab for PHMD 2310. 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 2350. Healthcare Systems. 3 Hours.
Examines the evolution of the healthcare system in the United States, from the early forms of organized institutional care to the dynamic, increasingly integrated, and managed-care system of present healthcare delivery. Examines the interaction of regulatory, economic, political, social, and ethical aspects of the healthcare system, with emphasis on issues related to pharmacy practice. Current proposals for healthcare and drug-related reform and regulation are considered. Considers the impact and consequences of action in one era on the structure and function of healthcare in later years.

PHMD 2390. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

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, pharmaceutics, 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 (APPPEs) 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. Fulfills the geriatric pharmacy requirement for pharmacists practicing in a long-term care setting. Studies the principles of evidenced-based medicine and how to apply them 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 4970. Junior/Senior Honors Project 1. 4 Hours. Fulfills a portion of the advanced pharmacy practice experiences (APPEs) requirement. Designed to provide new knowledge (e.g., from didactic courses) to offer a smooth transition from the didactic courses to APPEs.

PHMD 4971. Junior/Senior Honors Project 2. 4 Hours. Fulfills a portion of the advanced pharmacy practice experiences (APPEs) requirement. Designed to provide new knowledge (e.g., from didactic courses) to offer a smooth transition from the didactic courses to APPEs.

PHMD 4972. Seminar 1. 0.5 Hours. Requires students to research a pharmacy case decided by a court and give an oral presentation. Centers on the individuals who operate a pharmacy: pharmacists, pharmacy technicians, and pharmacy interns; their workplaces: pharmacy, pharmacy department, hospital, restricted pharmacy, managed care, nuclear pharmacy, and wholesale businesses; and duties performed by pharmacy personnel: dispensing medication and counseling patients.

PHMD 4973. Seminar 2. 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).

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. Covers all federal and state laws and regulations that affect the practice of pharmacy. Discusses sources of law including the U.S. Constitution, statutes, administrative regulations, and case law. Introduces federal and state administrative agencies that regulate pharmacy, including the Drug Enforcement Administration (DEA), Food and Drug Administration (FDA), Consumer Products Safety Commission (CPSC), Massachusetts Board of Registration in Pharmacy, and Massachusetts Department of Public Health. Requires students to research a pharmacy case decided by a court and give an oral presentation. Centers on the individuals who operate a pharmacy: pharmacists, pharmacy technicians, and pharmacy interns; their workplaces: pharmacy, pharmacy department, hospital, restricted pharmacy, managed care, nuclear pharmacy, and wholesale businesses; and duties performed by pharmacy personnel: dispensing medication and counseling patients.

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).

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. Provides 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 liaison, 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. Expected for 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. Requires students to be enrolled in the third professional year of the pharmacy curriculum and to apply and be approved by the course coordinators through an application process. Criteria to be considered include, but are not limited to, grades of B or better in PHMD 4611, PHMD 4612, PHMD 4621, and PHMD 4622.
PHMD 5880. Special Topics. 1-3 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.

Pharmaceutical Science Courses
PHSC 1990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.
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, autoimmunity, 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 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 3490. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

PHSC 3434. 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 antimanic 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. 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.

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 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 continue preparing an undergraduate thesis under faculty supervision.

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.
Prepares students for the internship with an in-depth discussion of the principles of pharmacology, pharmaceutics, and drug discovery and development. Integration of advanced topics in pharmacology, pharmacokinetics, and drug discovery and development. Topics include the fundamentals of pharmacology, pharmacokinetics, and drug discovery and development. Offers students an opportunity to work on course-related team applications and include graded peer evaluations.

PHSC 5300. Pharmaceutical Biochemistry. 2 Hours.
Covers the structure and physiology of the cell, including energy production, signal transduction, synapses, and physiological processes in the cytosol. Relates physiological information to the specific areas of pharmacology, pharmaceutics, and drug discovery and 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 and 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-toxidynamic models and analyses. Includes mechanistic basis of toxicity, methods of toxicological analysis, and case studies pertinent to topics. Requires undergraduate physiology or biochemistry.

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