



PHARMACEUTICS? PHARMACEUTICS!

Pharmaceutical sciences focus on the physiology and chemistry controlling drug therapeutic action in modern medicine. Often confused with pharmacy practice, pharmaceuticals is distinct in its research and development emphasis, contributing important technologies and scientific bases for drug delivery to patients. Over half of newly discovered drug candidates cannot be commercialized without further drug delivery and formulation assistance. Researchers trained in pharmaceuticals integrate a broad working knowledge of diverse scientific disciplines: from fundamental studies of drug physiochemical properties and bioactive molecules to mechanisms of various physiological processes that impact drug delivery to specific biological sites of action and, therefore, their therapeutic effectiveness. Increasing awareness of the complexity of the drug delivery process in living systems means that researchers in pharmaceuticals today must maintain breadth and depth in physical chemistry, physical organic chemistry, mathematics, bioengineering, nanotechnology and the life sciences in order to solve research problems that require integration of basic science concepts from multiple disciplines with medical applications.

The University of Utah *pharmaceuticals graduate program* emphasizes training in physical chemistry, physical organic

chemistry, mathematical modeling, bioengineering and molecular biotechnology. Graduate students learn to apply their understanding of basic concepts in these areas to specialized areas of modern drug delivery research including:

- Gene medicine: novel therapeutic gene delivery and targeting methods.
- Improving biomaterials performance in medical applications, including implantable devices and diagnostics.
- Design and characterization of novel drug delivery systems using new biomaterials (polymers, peptides, nanosystems) and new drug forms (e.g., transgenes, proteins, peptides) to build and control system design, drug release and stability.
- Innovative drug delivery systems that combine new targeting, imaging, and triggered release features to improve therapy.
- Cell-based therapies for metabolic disease.
- Basic research in the kinetics and mechanisms of drug metabolism in the body.
- Studies of drug transport mechanisms into and through biological membranes (e.g., skin, GI tract, mouth/nose, lung or cell membranes and cell organelles) and synthetic polymer delivery devices.
- Analysis of drug physical and chemical properties and the influence of bioactive molecule chemistry on those properties.

The University of Utah encourages opportunities for collaboration with researchers in other University departments (e.g., bioengineering, oncology, internal medicine and surgical specialties), as well as opportunities for joint work with scientists at other universities and in industry, both in the United States and internationally.

PHARMACEUTICS CAREERS



The increasing importance of drug delivery in the overall drug discovery and development process is widely appreciated by pharmaceutical industry: delivery methods improve drug efficacy and safety, and provide new markets and extend drug patent lifetimes. Current therapeutic value emphasizes improving targeting of bio-active chemical species to specific sites of action. While easily stated, this is quite difficult to do experimentally, requiring multi-disciplinary teams of scientists strongly grounded in basic and applied sciences, engineering and medicine. Consequently, our Ph.D. graduates with diverse scientific training and research skills are highly recruited.

Many graduates choosing industrial positions become involved in product development research, and apply their skills to solutions of commercial, practical, yet challenging problems across the pharmaceutical and biomedical device industry. Others select positions oriented more toward fundamental research with less emphasis on short-term product-oriented goals.

Numbers of basic research positions in pharmaceuticals are expanding rapidly as the pharmaceutical industry in the United States

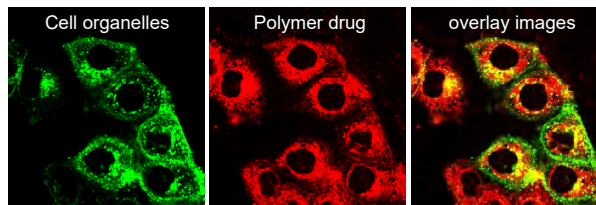
recognizes advantages of long-range research to compete effectively in a global scientific and economic environment. Entry-level positions are found as often in smaller, rapidly moving biotechnology and biopharmaceutical companies as they are in traditional industrial giants like Johnson&Johnson, Pfizer, 3M, Amgen and Genentech.



Many pharmaceuticals graduates begin their industrial career ladder in research; some then choose to transfer to administrative, business management, legal, regulatory and investment career tracks. The increasing dimensionality of the international pharmaceutical business requires more sophistication and versatility, providing diverse career opportunities to those capable of remaining up-to-date. Researchers with strong scientific backgrounds, management talent and ambition become more and more sought for important corporate management positions. Increasing numbers of pharmaceuticals-trained individuals now entering upper management impact the direction of health-related research programs in the future. The demand for outstanding researchers in pharmaceuticals will, therefore, continue to grow and their job opportunities will expand into many dimensions of this business.

Graduates interested in providing training and guidance for future researchers while directing their own research programs may opt for careers in academia as faculty or staff researchers. This career offers mentoring, teaching, and research components spanning basic science, professional pharmacy training, and clinical medicine collaborations.

Internationally, pharmaceuticals academic programs are expanding, continuously seeking capable teaching and research faculty. The Ph.D. degree provides direct access to these academic careers.



Microscopy: Cell targeting with polymer drugs
PREPARING FOR CAREERS IN PHARMACEUTICS

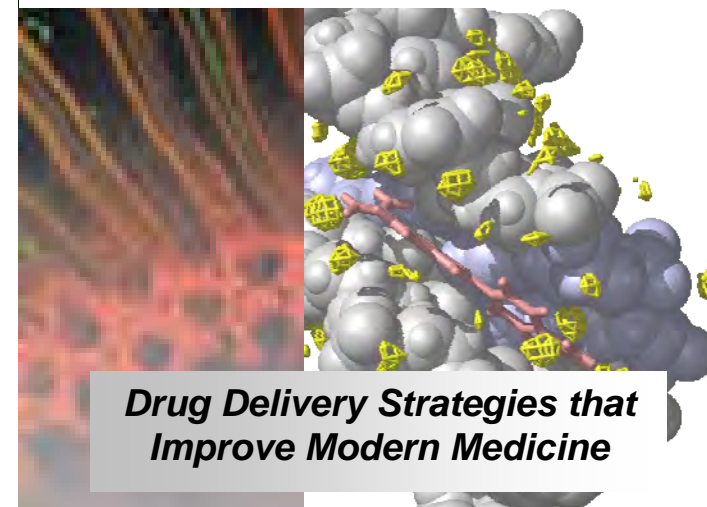
The University of Utah's Ph.D. program in pharmaceuticals comprises intensive coursework to cover essential topics in basic science, and most importantly as a research degree, in-depth research experience. Most students entering with a bachelor's degree in a related discipline fulfill their Ph.D. degree requirements within 4-5 years. *Highly motivated students with bachelor's degrees in chemistry, engineering, biochemistry, microbiology, biology, biomedical science, mathematics or pharmacy are best prepared to enter the pharmaceuticals graduate program.* The difficulty to fully prepare for this rigorous graduate program with an undergraduate degree is recognized: skills that are lacking are made up during the first year of pharmaceuticals graduate studies. Undergraduates are advised to complete the entire undergraduate calculus sequence to qualify to begin the physical chemistry sequence (a pre-requisite for most advanced graduate-level courses) immediately upon entry. This avoids significant delays in completing the pharmaceuticals graduate curriculum.



COLLEGE OF
PHARMACY
UNIVERSITY OF UTAH

L. S. SKAGGS PHARMACY INSTITUTE

Graduate Training and Research program in Pharmaceuticals and Drug Delivery



Drug Delivery Strategies that Improve Modern Medicine

Contact: Department of Pharmaceutics and Pharmaceutical Chemistry, University of Utah, Salt Lake City, UT 84112

<https://pharmacy.utah.edu/pharmaceutics/>

Department Chair:
Hamid Ghandehari, Ph.D.
hamid.ghandehari@utah.edu
Tel: 801 581 4532

