

BMED/CHEM/CHBE 4765 Drug Design, Development and Delivery

Credit: 3-0-3

Prerequisite(s): CHEM 3511 or 4511

Catalog Description

Introduction to the pharmaceutical development process, including design of new drugs, synthesis and manufacturing issues, and methods for delivery into the body. Includes student presentations.

Text

None

Objectives

The course introduces the student to drug design, development, and delivery in the context of the process of generating pharmaceutical therapies. The curriculum is designed to include an interdisciplinary mix of ideas that emphasize the intersection of engineering and chemistry/biochemistry applied to pharmaceuticals.

After an introduction to the critical issues in drug design, development, and delivery, the course focuses on a series of case studies of actual drug products involving written and oral student reports. Students are expected to participate heavily in class discussions and project preparation/presentation. Class attendance and familiarity with the assigned readings are required.

Outcomes

After completing this course, students should be able to:

- appreciate critical issues, perform analysis, and make quantitative calculations related to drug design
- appreciate critical issues, perform analysis, and make quantitative calculations related to drug development
- appreciate critical issues, perform analysis, and make quantitative calculations related to drug delivery
- integrate concepts from drug design, development and delivery and appreciate their interdependence
- understand the different phases of the pharmaceutical process
- appreciate the role of alternative methods and broader implications of the pharmaceutical process
- communicate with professionals in the pharmaceutical community.

Topical Outline

Introduction

Challenges of drug design, development and delivery
Current practice of developing new drugs
Successful examples of drug design and development
Tutorial on transport phenomena

Tutorial on transport phenomena
Tutorial on bioorganic chemistry

Drug Design

Drug characteristics; Sources of drugs
Structure-based drug design
High throughput screening
The story of four enzymes

Drug Development

Chirality; Chemo- and biocatalysis; Pharma process development (Tamiflu)
Hydrolyses & condensation reactions; Thermodynamic & kinetic control; Peptides
Redox reactions; Oxidoreductases; Phenylalkanol drugs; Steroids
Additions; Development of a protein therapeutic
Development of vaccines (influenza vaccine)

Drug Delivery

Conventional delivery methods; Pharmacokinetic models
Polymeric controlled release systems
Transdermal delivery
Ocular and other routes of delivery
Future directions in drug delivery
Pharmaceutical marketing
Introduction to testosterone patch

Case Study I: Testosterone Patch

Chemical synthesis of testosterone
Microbial synthesis of testosterone synthesis
Transdermal patch delivery of testosterone
Other methods of testosterone delivery
Broader implications: steroid abuse
Introduction to ocular dorzolamide

Case Study II: Ocular Dorzolamide

Dorzolamide synthesis by conventional chemoenzymatic synthesis
Dorzolamide synthesis by novel chemoenzymatic routes
Topical dorzolamide delivery to the eye
Structure-permeability relationships for ocular delivery
Broader implications: race-based health disparities
Introduction to leuprolide implant

Case Study III: Leuprolide Implant

Solid-state synthesis of leuprolide
Enzymatic synthesis of leuprolide
Polymeric controlled release of leuprolide
Protein stability in controlled release systems
Chemical vs. enzymatic synthesis of nifedipine
Broader implications: FDA approval process