

# Drug Design, Development and Delivery Syllabus

Date	Topic	Speaker	Reading
Jan 10	Challenges of drug design, development and delivery	<u>Bommarius, Prausnitz</u>	<u>Reading</u>
Jan 12	Current practice of developing new drugs	<u>Bommarius, Prausnitz</u>	<u>Reading</u>
Jan 17	Successful examples of drug design and development	<u>Bommarius</u>	<u>Reading</u>
Jan 19	Successful examples of drug delivery	<u>Prausnitz</u>	<u>Reading</u>
Jan 24	Tutorial on transport phenomena	<u>Prausnitz</u>	<u>Reading</u>
	Tutorial on bioorganic chemistry	<u>Bommarius</u>	<u>Reading</u>

## DRUG DESIGN

Jan 26	Drug characteristics; Sources of drugs	Powers	
	QUIZ and <u>HOMEWORK</u> due at beginning of class		
Jan 31	Structure-based drug design	Powers	<u>Reading</u>
Feb 2	High throughput screening	Powers	<u>Reading</u>
Feb 7	The story of four enzymes	Powers	<u>Reading</u>

## DRUG DEVELOPMENT

Feb 9	Chirality; Chemo- and biocatalysis; Pharma process development (Tamiflu)	<u>Bommarius</u>	<u>Reading</u>
	QUIZ and <u>HOMEWORK</u> due at beginning of class		
Feb 14	Hydrolyses & condensation reactions; Thermodynamic & kinetic control; Peptides	<u>Bommarius</u>	<u>Reading</u>
Feb 16	Redox reactions; Oxidoreductases; Phenylalkanol drugs; Steroids	<u>Bommarius</u>	<u>Reading</u>
Feb 21	Additions; Development of a protein therapeutic	<u>Bommarius</u>	Reading.
Feb 23	Development of vaccines (influenza vaccine)	<u>Bommarius</u>	Reading.
	<u>HOMEWORK</u> due at beginning of class; <u>SOLUTIONS</u>		

## DRUG DELIVERY

Feb 28	Conventional delivery methods; Pharmacokinetic models	<u>Prausnitz</u>	<u>Reading</u>
	QUIZ at beginning of class; <u>SOLUTIONS</u>		
Mar 2	Polymeric controlled release systems	Prausnitz	<u>Reading</u>
Mar 7	Transdermal delivery	<u>Prausnitz</u>	<u>Reading</u>
Mar 9	Ocular and other routes of delivery	Prausnitz,	<u>Reading</u>
Mar 14	Future directions in drug delivery	<u>Prausnitz</u>	Reading
	<u>HOMEWORK</u> due at beginning of class; <u>SOLUTIONS</u>		

Mar 16	Pharmaceutical marketing	<u>Thompson, Marketrx</u>	Reading
	Introduction to testosterone patch	Bommarius, Prausnitz	<u>Reading</u>
	QUIZ at beginning of class		

## CASE STUDY I: TESTOSTERONE PATCH

Mar 28	Chemical synthesis of testosterone	Team 1	<u>Reading</u>
	Microbial synthesis of testosterone synthesis	Team 2	<u>Reading</u>
Mar 30	Transdermal patch delivery of testosterone	Team 3	<u>Reading</u>
	Other methods of testosterone delivery	Team 4	<u>Reading</u>
Apr 4	Broader implications: steroid abuse	Bommarius, Prausnitz	<u>Reading</u>
	Introduction to ocular dorzolamide	Bommarius, Prausnitz	<u>Reading</u>

## CASE STUDY II: OCULAR DORZOLAMIDE

Apr 6	Dorzolamide synthesis by conventional chemoenzymatic synthesis	Team 5	<u>Reading</u>
	Dorzolamide synthesis by novel chemoenzymatic routes	Team 6	<u>Reading</u>
Apr 11	Topical dorzolamide delivery to the eye	Team 7	<u>Reading</u>
	Structure-permeability relationships for ocular delivery	Team 8	<u>Reading</u>
Apr 13	Broader implications: race-based health disparities	Bommarius, Prausnitz	<u>Reading</u>

Introduction to leuprolide implant

Bommarius,  
Prausnitz

Reading

### CASE STUDY III: LEUPROLIDE IMPLANT

Apr 18	Solid-state synthesis of leuprolide	Team 9	<u>Reading</u>
	Enzymatic synthesis of leuprolide	Team 10	<u>Reading</u>
Apr 20	Polymeric controlled release of leuprolide	Team 11	<u>Reading</u>
	Protein stability in controlled release systems	Team 12	<u>Reading</u>
Apr 25	Chemical vs. enzymatic synthesis of nifedipine	Team 13	<u>Reading</u>
	Broader implications: FDA approval process	Bommarius, Prausnitz	<u>Reading</u>
Apr 27	Wrap-up of case studies and course review	Bommarius, Prausnitz	
May 3	Final Exam 8:00 - 10:50 am		

# **Drug Design, Development and Delivery Course Administration**

## **Class Meetings**

TTh 9:30 - 11:00

ES&T Building, Room L1105

## **Office Hours**

By appointment

## **Prerequisites**

Biochemistry (CHEM 3511 or CHEM 4511)

## **Philosophy**

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.

## **Objectives**

After this class, students should be able to:

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

## **Class Attendance and Participation**

Although attendance will not be taken, you are expected to come to class, participate in class discussions, and be responsible for all material presented there. If you miss class, you must find out what was presented and obtain any handouts or other materials you may have missed. Written and oral assignments directly reflect the material discussed in class. Your grade is based in part on class participation.

## **Assignments**

There will be three types of classwork assignments: homework assignments, written reports, and oral reports. The latter types of assignments will involve group efforts.

- homework
- written report

- oral report

There will also be quizzes after each module and a final exam; they will be in-class, short-answer or essay type, and closed book/closed notes.

Homework and written report assignments are due at the beginning of class. Oral reports are presented during regular class meeting times. Although no credit is given for late work, it may be critiqued at the instructor's discretion. Discussion of homework assignments with classmates is encouraged, but all submitted assignments must be your own. Plagiarism and other Honor Code violations are taken very seriously and reported to the Dean of Students.

All homework and written report assignments should be on single-sided, 8.5" x 11" paper that has been stapled together. Written reports and lengthy text other than calculations in homework assignments should be typed with 12-point font and 1.5 line spacing (hand-written text will not be accepted). Written reports must also be submitted electronically.

### **Deadline Conflicts**

Late homework assignments are not accepted unless special arrangements have been made with the instructor in advance. If a medical emergency prevents you from turning in an assignment, a letter from the health center is required. Other cases may be referred to the Dean of Students. As soon as you know that you will miss or have missed an assignment due date, you are requested to notify one of the instructors (a telephone or email message is fine).

### **Grading**

Class Participation: 15%

Homework assignments: 10%

Written reports: 15%

Oral reports: 15%

Quizzes: 15%

Final Exam: 30%

### Note on cross-listing

This course draws material from chemical engineering, biomedical engineering, and chemistry, as well as other disciplines. It is a highly interdisciplinary course. During the previous offerings of the course, there have been students from ChBE, BMED, and CHEM enrolled. For these reasons, we believe it is appropriate to cross-list the course in these three Schools.

### Note on offering separate undergraduate and graduate courses

This class has content suitable for both undergraduate and graduate students. Lectures for the undergraduate and graduate courses are concurrent, but assignments and grading are different. For example, graduate students receive additional questions on their homework; these questions are open-ended and involve significant independent literature research. Graduate students are also held to higher standards and expectations during their in-class project presentations, post-presentation questioning, and written reports. Grading of undergraduate and graduate students is done separately, with each class having its own grading curve. This is how the class has been taught previously and it worked well.