

UNIVERSITY OF PENNSYLVANIA
Department of Chemical and Biomolecular Engineering

CBE/PHRM 564

Drug Delivery Systems

Instructors: Dr. Vladimir Muzykantov
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Course The course will be divided into four sections.

Description: I. Drug distribution and delivery in the body and drug interactions with the body: challenges and specific aspects of biotherapeutics
II. Drug delivery systems and nanocarriers
III. Targeted and smart drug delivery systems, cellular delivery
IV. Translational aspects drug delivery systems

Course Goals: Explain the need for new drug delivery systems
Explain the advantages and applications of biotherapeutic drugs
Explain the means of drug transport in the body
Explain the benefits of nanocarriers as a drug delivery system
Describe several means used to target drugs to specific areas in the body
Explain current drug delivery systems in research
Explain the design and application of controlled drug delivery systems
Explain the problems involved with developing new drug delivery systems
Explain the translational aspects of developing a disease treatment with a drug delivery system
Read current journal articles on drug delivery topics and formulate a proposal for a new research topic

Text: References from current journals on major topics will be provided.

Grading:	Group Project	30%
	Midterm Exam on Sections I and II	35%
	Final Exam on Sections III and IV	35%

Group Project: A proposal will be written by groups of students for a research project on a new or improved drug delivery system. Three papers and an oral presentation will be required.

Journal Club: Current journal articles will be presented by two groups of students on several days during the semester.

CT3N Seminars: Students are encouraged to attend seminars sponsored by the Center for Targeted Therapeutics and Translational Nanomedicine (CT3N). Announcements will be made for the seminars during class and on the Canvas site.

Academic Integrity: All students are expected to be familiar with and follow the Penn guidelines for academic integrity. Any student suspected violating academic integrity will be penalized. The web link for the Penn graduate academic integrity code is <http://www.seas.upenn.edu/graduate/handbook/student-ethics.php>.

#	Section and Lecture Title
	I. Drug distribution and delivery in the body and drug interactions with the body: challenges and specific aspects of biotherapeutics
1	Introduction to the course outline and training aspects: lectures by invited lecturers, journal articles, independent projects, and exams
2	Routes of administration, pharmacokinetics, AUC, mechanisms of drug clearance and inactivation
3	General macromolecule transport phenomena: diffusion, convection, membrane transfer
4	Diffusion, pore permeation, transport in tissues
5	Biotherapeutics, proteins, enzymes: need for precise location, examples of side effects, immune system and response, complement system and innate immunity
6	Vaccines and immunotherapy
7	Cellular therapies and transfusion delivery
8	Delivery of genetic materials, gene therapies, siRNA
9	Literature review session
	II. Drug delivery systems and nanocarriers
10	Carrier circulation and tissue uptake, EPR, PEG-coating, stealth carriers
11	Liposomes and nanogels
12	Polymeric carriers, di-block and tri-block copolymers, polymersomes, bioconjugation to polymers
13	Role of carrier geometry in drug delivery, polymeric filomicelles, elasticity
14	Control of carrier degradation and drug release
15	Stents and implants
16	Literature review session
17	Discussion of independent projects progress/Written proposal due
18	Mid-term review
19	Mid-term exam
	III. Targeted and smart DDS, cellular delivery
20	Affinity targeting, target determinants, carriers, ligands
21	Dynamic interactions of carrier with targets
22	Recombinant fusion proteins
23	Phage display and other high throughput systems
24	Multifunctional carriers and theranostics
25	Environment (pH)-sensitive and smart nanocarriers
26	Cellular barriers, intracellular delivery I
27	Vesicular traffic and cytosolic release
28	Literature review session, second paper due
29	Peer Review
	IV. Translational aspects
30	Cardiovascular targeting
31	Blood-brain barrier and the CNS
32	Hematological malignancies and immunotoxins
33	Targeting tumors and tumor vasculature
34	Featured Keynote Speaker
35	Translation: IP and commercialization
36	Industrial development and benefit/cost ratio, clinical
37	Nanotoxicology: biocompatibility of drug carriers
38	Literature review session
39	Presentation of independent projects I
40	Presentation of independent projects II
41	Presentation of independent projects III
42	Presentation of independent projects IV
	Course Review
	Final exam