

Course Syllabus: Biotechnology and Drug Development, BME 155/255

Course Description:

This course is for students interested in careers in the biopharmaceutical industry. The course focuses on recombinant DNA technology and the drug development process, including: discovery research, preclinical testing, clinical trials, and regulatory review, as well as manufacturing and production considerations. The course will be open to upper division and graduate students who have a background in basic molecular genetics and cell biology, and is intended for both science majors and non-science majors interested in health care, discovery research, and applied clinical research.

Prerequisites:

Biology 20A (Cell and Molecular Biology) and Biology 100 (Biochemistry) or Biochemistry and Molecular Biology 100A (Biochemistry)

Objective/Mission:

To provide an overview of recombinant DNA technology, the biopharmaceutical industry, the FDA and the drug development pathway.

Although the course is appropriate for students interested in M.D. and Ph.D. programs, it is also appropriate for students interested in biotechnology careers involving non-doctoral professional disciplines such as Engineering, Public Health (MPH), Biostatistics, Law and the Social Sciences

At the end of the course the students will be able to identify and describe:

- Basics of recombinant DNA technology
- Structure and organization of biopharmaceutical companies
- Major professional disciplines common to all drug development organizations
- Structure and organization of the FDA
- Key documents required for clinical testing and regulatory approval of new drugs
- Case histories in the development of vaccines and therapeutics for infectious diseases, autoimmune diseases, and cancer

Instructor Research Interests:

- Development of vaccines to prevent STDs: HIV/AIDS
- Humanized antibodies and chimeric receptors to treat autoimmune disease, traumatic shock, burns
- Engineering of cell substrates (bacterial and mammalian) for commercial production of recombinant proteins

Biotechnology and Drug Development Lecture Schedule

Updated 05-30-07; subject to change

Week	Lecture	Date	Topic
1	1	4/3/07	Course Overview, Introduction to the Biotechnology Industry, Organization and Characteristics of the Drug Development Enterprises
	2	4/05/07	Comparison of Biotech Drugs with Conventional Drugs
2	3	4/10/07	Basics of Recombinant DNA Technology Restriction Endonucleases, Plasmid Cloning Vectors, etc.
	4	4/12/07	Gene Libraries, Sequencing, Synthetic DNA, and PCR
3	5	4/17/07	Expression of Recombinant Proteins in Prokaryotic Cells; Expression and Selection Systems
	6	4/19/07	Gene Expression in Mammalian Cells; Production Cell Lines; Expression and Selection Systems
4	7	4/24/07	Outside Speaker (Dr. Robert Coffman) Discovery Research
	8	4/26/07	Case Histories of Early Biotech Products: Insulin, Hepatitis B Vaccine, etc
5	9	5/01/07	The FDA: Organization, Major Regulatory Documents, Advisory Boards (Web video assignment)
	10	5/03/07	Midterm Exam
6	11	5/08/07	Clinical Trials: Clinical Protocols, Informed Consent, IRBs, DSMB, Ethical Considerations
	12	5/10/07	Outside speaker (Dr. Tim Gregory) Manufacturing: Facilities and Downstream Processing, Future Directions
7	13	5/15/07	Recombinant Vaccines: Hepatitis B, Herpes Simplex Virus Vaccine
	14	5/17/07	Case study HIV Vaccine
8	15	5/22/07	Outside Speaker (Dr. Don Francis) Vaccine Development and Emerging Infections
	16	5/24/07	Antibodies as Therapeutics: Humanization, Intellectual Property, Antibody Engineering, Rituxan
9	17	5/29/07	Immunoadhesins and TNFR-IgG to Treat Rheumatoid Arthritis
	18	5/31/07	Antibodies to Integrins for Treatment of Autoimmune Diseases (psoriasis, multiple sclerosis), Trauma
10	19	6/04/07	Antibodies as drugs to treat cancer. Herceptin
	20	6/07/07	Antibodies to treat cancer: VEGF
		6/14/07	Final Exam: 8am to 11am in Baskin 165

Reading

Textbook: B.R. Glick and JJ Pasternak (2003) Molecular Biotechnology, ASM Press.

Reader Assignments: Reader for BME155/255, available from Bay Tree Bookshop

(Schedule of reading assignments provided below.)

Students may also be given sets of reading assignments from different online sources. These will include journal articles and patents that can be downloaded from the UCSC library. These assignments will be made available on the course webpage.

URLs of Interest

www.biospace.com

Biospace industry and research news, careers

www.ich.org

ICH (International Conference on Harmonisation), worldwide regulatory oversight

www.fda.gov

FDA (Food and Drug Administration), USA's national regulatory oversight

www.cdc.gov

CDC (Centers for Disease Control and Prevention)

www.who.int

WHO (World Health Organization)

Exams, Homework, Projects

Exams will include questions drawn from weekly reading assignments and review questions.

Options for Papers or Class Projects will be selected based on surveys of students' course background, and specific interests in Biotechnology and Drug Development.

Grading

The final grade will be based on performance on weekly homework assignments, two exams (a midterm and a final) and a research paper critically evaluating the development process of a new drug for which a BLA was submitted. The weighting of each component in the grade is shown below.

BME155

	#	points each	total points	% of grade
Exams	2	50	100	50
Homework	5	10	50	25
Paper/Project	1	50	50	25
Total:			200	100

BME255

	#	points each	total points	% of grade
Exams	2	50	100	30
Homework	5	10	50	20
Paper	1	50	50	20
Project	1	50	50	30
Total:			250	100

Office Hours

Friday mornings 9-11am, or by appointment (call Ann Durbin at 459-3016 to schedule). Additional office hours will be scheduled prior to midterm & final exams.

Biotechnology & Drug Development, BME 155 / BME 255
Course Reading Assignments

Spring 2007

Week	Content / Title	Pages*	Notes
		T = textbook, R = reader	
1	The Molecular Biotechnology Revolution	T 1-13	
	Molecular Biotechnology Biological Systems	T 14-22	
	DNA, RNA, and Protein Synthesis	T 23-46	(review)
	Construction of Biologically Functional Bacterial Plasmids <i>In Vitro</i>	R 107-112	Optional
2	Recombinant DNA Technology	T 47-90	
	Chemical Synthesis, Sequencing, and Amplification of DNA	T 91-120	
	Chemical DNA Synthesis and Recombinant DNA Studies	R 115-120	
	Primer-Directed Enzymatic Amplification of DNA with a Thermostable DNA Polymerase	R 123-128	Optional
3	Manipulation of Gene Expression in Prokaryotes	T 121-161	
	Heterologous Protein Production in Eukaryotic Cells	T 163-189	
	Transformation of Mammalian Cells with Genes from Prokaryotes and Eucaryotes	R 131-139	Optional
	Isolation of Chinese Hamster Cell Mutants Deficient in Dihydrofolate Reductase Activity	R 143-148	Optional
4	Directed Mutagenesis and Protein Engineering	T 190-223	
5	Economic Considerations in Medical Biotechnology	R 1-6	
	Product Development & New Drug Approval	R 9-18	
	Pharmacokinetics and Pharmacodynamics of Peptide and Protein Drugs	R 21-44	Optional
6	Large-Scale Production of Proteins from Recombinant Microorganisms	T 481-509	
	Production and Downstream Processing of Biotech Compounds	R 47-62	
	Challenges and Issues in the Development of Formulations of Protein Pharmaceuticals	R 65-79	
	Good Manufacturing Practices: Regulatory Requirements	R 83-94	Optional
	Manufacture of Large Molecule APIs (Recombinant DNA Methods)	R 97-103	Optional

Course Reading Assignments, *continued*

Week	Content / Title	Pages*	Notes
7	Vaccines	T 309-338	
	Molecular Diagnostics	T 227-232	
	Protection of Mice from Lethal <i>Herpes simplex</i> Virus Infection by Vaccination with a Secreted Form of Cloned Glycoprotein D	R 151-156	
	Glycoprotein-D-Adjuvant Vaccine to Prevent Genital Herpes	R 159-168	
8	Therapeutic Agents	T 256-307	
	Continuous Culture of Fused Cells Secreting Antibody of Predefined Specificity	R 177-179	
	Reshaping Human Antibodies for Therapy	R 191-196	
	Treatment of Patients With Low-Grade Lymphoma With the Combination of Chimeric Anti-CD20 Monoclonal Antibody and CHOP Chemotherapy	R 233-241	
	Generation of Antibody Activity from Immunoglobulin Polypeptide Chains Produced in <i>Escherichia coli</i>	R 183-188	Optional
9	Soluble Tumor Necrosis Factor (TNF) Receptors Are Effective Therapeutic Agents in Lethal Endotoxemia and Function Simultaneously as Both TNF Carriers and TNF Agonists	R 207-220	
	Treatment of Rheumatoid Arthritis With a Recombinant Human Tumor Necrosis Factor Receptor (p75)-Fc Fusion Protein	R 223-229	
	Humanization of an Anti-p185HER2 Antibody for Human Cancer Therapy	R 283-288	
	Humanization of an Anti-Lymphocyte Function-Associated Antigen (LFA)-1 Monoclonal Antibody and Reengineering of the Humanized Antibody for Binding to Rhesus LFA-1	R 245-254	
	Efalizumab: An Overview	R 269-280	
	Biological Properties of a CD4 Immunoaderhin	R 171-174	Optional
	Protection Against Endotoxic Shock by a Tumor Necrosis Factor Receptor Immunoaderhin	R 199-204	Optional

Course Reading Assignments, *continued*

Week	Content / Title	Pages*	Notes
10	Use of Chemotherapy Plus a Monoclonal Antibody Against HER2 for Metastatic Breast Cancer That Overexpresses HER2	R 291-300	
	From the Molecule to the Clinic – Inhibiting HER2 to Treat Breast Cancer	R 303-304	
	Inhibition of Vascular Endothelial Growth Factor-Induced Angiogenesis Suppresses Tumour Growth <i>In Vivo</i>	R 307-310	
	A Randomized Trial of Bevacizumab, an Anti-Vascular Endothelial Growth Factor Antibody, for Metastatic Renal Cancer	R 323-330	
	Humanization of an Anti-Vascular Endothelial Growth Factor Monoclonal Antibody for the Therapy of Solid Tumors and Other Disorders	R 313-319	Optional