

Genes, Drugs, and Diseases

Instructor: Dr. Gordon Rule. rule@andrew.cmu.edu 2195



Course Description: The central goals of this course are to explain the molecular basis of action for various drugs used to treat diseases and to explore the genetic basis of diseases. The first part of the course provides the student with sufficient background to understand the biological basis of drug action with emphasis on retroviral inhibitors. The usefulness of genetic engineering in the production of proteins for drug discovery is then explored. This is followed by an overview of DNA replication, transcription, and protein synthesis, with an emphasis on the inhibitory action of antibiotics on prokaryotic processes. Modern techniques for sequencing of DNA are also discussed. The fundamental properties of carbohydrates, lipids, and membranes are discussed at a level necessary to develop an understanding of penicillin and the treatment of elevated cholesterol levels. Signaling processes in eukaryotic cells is discussed with reference to cancer treatment. The treatment of disease using antibody is also discussed. The course ends with a discussion of inheritance and genetic deficiencies that give rise to disease and how these diseases can be treated.

Prerequisite or co-requisite: Some exposure to biology and chemistry in high school. Online resources are provided for background information.

Course Text: Molecular & Cell Biology for Dummies

Grading: A >90, B 80-90, C 65-79, D 55-65, E <55.

[50%] Three in-class hour exams

[25%] Final Exam

[5 %] Graded quizzes on blackboard

[10%] Problem sets

[10%] In-class presentations

Exams: Three exams will be given during the semester. One-half of the grade from the lowest in-class hour exam will be dropped. The two best in-class exams will each contribute 20% of your final grade while the worst in-class exam will contribute only 10% towards your final grade. The final exam can be used to replace the poorest grade on an in-class exam. For example, if you get a C on an in-class exam and an A on the final, the C is converted to an A when the final grade is calculated.

Blackboard Assessment Quizzes are provided to help you assess your understanding of topics in the course. A total of 10 quizzes will be assigned during the course. The lowest two quiz grades can be dropped.

Problem Sets will constitute 10% of the final grade. Problem sets will be nominally assigned on a weekly basis, with the exception of weeks where exams fall on the due date. Of the ~10 problem sets in the course, the three with the lowest score will be dropped in calculating the final grade.

In class presentations: Groups of 1-2, students will present the most important aspects of a topic related to a drug or genetic disease that has not been discussed in the course. The presentations should be approximately 7 minutes long with an additional 3 minutes for questions. Students are encouraged to build appropriate visual aids/computer animations/etc. to enhance their presentation.

Tentative Schedule:

Lecture	Date	Topic	Readings
1	Aug 23(S)	Structure and Properties of Cells and Viruses	Chapter 1-3
2	Aug 25(T)	Properties of Atoms and Molecules	Chapter 4
3	Aug 27(R)	Chemistry and Chiral Drugs	Chapter 4
4	Aug 30(S)	Water and pH & hydrogen bonding	Chapter 4
5	Sep 1(T)	Amino acids & Primary Structure	Chapter 6
6	Sep 3(R)	Proteins - Secondary & Tertiary Structure	Chapter 6
7	Sep 6(S)	Proteins - Quaternary Structure	Chapter 6
8	Sep 8(T)	Immunology - Production of Antibodies - Vaccines	Lecture Notes
9	Sep 10(R)	Enzymes	Chapter 6
10	Sep 13(S)	Enzyme Inhibitors	Chapter 6
	Sep 15(T)	Exam I (Lectures 1-9)	
11	Sep 17(R)	Viruses and Retroviruses	Chapter 3
		EID	
12	Sep 27(S)	HIV Protease Inhibitors/Drugs and Clinical trials	Lecture Notes
13	Sep 29(T)	Nucleic Acids	Chapter 7
14	Oct 1(R)	Nucleic Acids & Polymerases	Chapter 17
15	Oct 4(S)	DNA Sequencing & Bioinformatics	Chapter 20
16	Oct 6(T)	PCR - cloning and forensics	Chapter 20
17	Oct 8(R)	DNA Replication	Chapter 17
18	Oct 11(S)	Recombinant Protein Production	Chapter 20
19	Oct 13(R)	DNA Transcription/Bacterial Operon	Chapter 18/19
20	Oct 15(S)	Protein Synthesis/Ribosomal antibiotics	Chapter 18
	Oct 18(T)	Exam II (Lectures 10-17)	
21	Oct 20(T)	RNA Modifications/splicing	Chapter 18
22	Oct 22(R)	Carbohydrates and Bacterial Cell Walls	Chapter 5
23	Oct 25(S)	Mechanism of Penicillin/Intro to Lipids	Chapter 8
24	Oct 27(T)	Membranes, channels, and osmotic effects	Chapter 9
25	Oct 29(R)	Protein Export/Cholesterol metabolism	Chapter 9
26	Nov 1(S)	Cell Signaling	Chapter 9
27	Nov 3(T)	Introduction to Metabolism	Chapter 10
28	Nov 5(R)	Glycolysis and TCA cycle	Chapter 11
29	Nov 8(S)	Electron transport & ATP synthesis	Chapter 11
30	Nov 10(T)	Chromosomal Structure	Lecture Notes
	Nov 12(R)	Exam III (Lectures 18-28)	
31	Nov 15(S)	Mitosis, Meiosis	Chapter 13/14
32	Nov 17(T)	Mendelian Genetics	Chapter 15
33	Nov 19(R)	Human Inheritance	Chapter 16
34	Nov 22(S)	Human Inheritance	Chapter 16
35	Nov 24(T)	Genetic diseases of Metabolism	Lecture Notes
36	Nov 26(R)	Gene therapy	Lecture Notes
37	Nov 29(S)	In-class presentations	
38	Dec 1(T)	In-class presentations	
39	Dec 3(R)	In-class presentations	
		Final Exam (Comprehensive)	