NEW YORK UNIVERSITY
DEPARTMENT OF BIOLOGY

MOLECULAR AND CELL BIOLOGY I
(BIOL-UA 21)

Course Syllabus

Time: Two 75-minute lectures plus one 75-minute recitation per week


Instructors:

Professor Sevinc Ercan
Professor Mark Siegal (Course Coordinator)
Professor Stephen Small
Professor Eric Brenner (Recitation Coordinator)

Welcome to Molecular and Cell Biology! Our objective is to give you a firm and rigorous foundation in the principles of modern molecular and cellular biology. These concepts form almost all the basis for the great advances now being made in biology and the medical sciences. During the first semester, we will discuss biomolecular structure and function, fundamental molecular biology of the cell, and recombinant DNA technology and genetic analysis. Genomics and bioinformatics will also be introduced and play an important role in recitation and group-learning activities.

This document presents the course policies and schedule. Any updates will be posted to Blackboard. Questions should be addressed to Dr. Siegal <mark.siegel@nyu.edu>.
COURSEWORK AND POLICIES

Exams
There will be two midterm examinations and a final examination. Midterm 1 covers material through Meeting 9. Midterm 2 covers material through Meeting 17; it primarily covers material after Meeting 9 but is cumulative in the sense that you are expected not to forget fundamentals learned in the first part of the course. The final exam is truly cumulative; questions cover the entire course, with a slight emphasis on material after Meeting 17.

No notes, books or other materials will be allowed during the testing periods unless stated otherwise. **ALL EXAMS ARE MANDATORY.** If you have a schedule conflict involving other courses, religious observance, or personal matters, you MUST see Dr. Siegal at least **ONE WEEK PRIOR TO THE EXAM.** Any missed exam will result in a grade of 0 for that exam, unless there are serious extenuating personal circumstances that are immediately brought to the attention of Dr. Siegal. Illness will be accepted as a justification for absence from a scheduled test if a doctor’s excuse is presented. The excuse must be dated on or immediately prior to the exam date, **AND** you MUST contact Dr. Siegal prior to the exam in order to be excused. If either of these conditions is not met, you will be given a grade of 0. If you miss a midterm exam and present a legitimate excuse, then, at the discretion of the instructors, either a make-up test will be made available to you or the final exam will count more toward your grade.

A grade of “Incomplete” (I) will not be given unless it is warranted by circumstances like those described above. If you miss the final exam and present a legitimate excuse then a grade of I will be given and a make-up exam will be scheduled for the following semester. **NO ALTERNATIVE DATES** for the final exam will be offered, so avoid making travel plans to leave NYU before the date of the final exam.

Academic Integrity
The instructors of this course will not tolerate cheating or plagiarism. When academic dishonesty is suspected, it will be dealt with seriously in adherence to the official guidelines of New York University. The College of Arts & Science guidelines, which all students should read, are available online at http://cas.nyu.edu/page/academicintegrity

Prerequisites
This course is required for the biology major for all students enrolled in the College of Arts & Science at NYU. You must have taken Principles of Biology I and II (BIOL-UA 11, 13 or 9011 AND BIOL-UA 12, 14 or 9012) to register for this class. If you have not taken Principles of Biology I and II because you have sought advanced placement, you must have had an Advanced Placement Biology Course in high school **AND** received a four or a five as a score on the National Advanced Placement Examination. If you have taken the equivalent of Principles of Biology I and II at another college or university, be certain that you have received the approval of the Director of Undergraduate Studies for the Department of Biology, and that the credits transfer properly. General Chemistry I and II (CHEM-UA 125 and 126, or their equivalent) are also prerequisites. If you think you have a conflict, see Dr. Siegal as soon as possible.

Calculation of Final Grades
The final course grades will be calculated as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Midterm Exam I</td>
<td>25%</td>
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<tr>
<td>Midterm Exam II</td>
<td>25%</td>
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<tr>
<td>Final Exam</td>
<td>30%</td>
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<tr>
<td>Recitation Participation</td>
<td>5%</td>
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<tr>
<td>Recitation Portfolio</td>
<td>10%</td>
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<tr>
<td>Recitation Presentations</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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Letter Grades

After each midterm exam, the full distribution of scores for the entire class will be posted on Blackboard. An indication will also be given of what score ranges would correspond to what letter grades, if that exam were representative of the student’s performance in the whole course. When the final course grade is calculated, it is the numerical scores (not the letter grades) that get combined and ultimately converted into a single letter grade for the entire course. Based on past history with this course, it is expected that approximately 2/3 of the students will receive a course grade of B– or higher.

Office Hours

Office hours are to be used to ask questions about course material. Each instructor will explain office hour policies during his or her first lecture. As a general rule, office visits should be no longer than 15 minutes, which will allow other students to have access to the instructor. You should prepare for the meeting by making a list of specific questions. Those questions should be about the scientific content of the course, and not about what material will appear on an exam.

If you need additional help, you will need to make an appointment with the instructor outside of office hours or to obtain a tutor. Tutoring is available through the University Learning Center: http://learning.cas.nyu.edu/

Recitations

Contrary to the popular image of the lonely scientist toiling away in isolation, science is a collective activity that depends on the sharing of ideas. During recitation, you will discuss concepts learned in lecture, work in groups and solve problems. You will receive a grade for recitation based on participation and ability. Material from recitation may also appear on exams. **DO NOT** change your recitation section unless you do so officially in Albert. If you must attend another class for some personal reason, you **MUST** clear it with your section leader.

Reading Assignments

The schedule of class meetings and associated readings are on the following pages. Reading assignments should be completed prior to each meeting. Readings not from the text will be linked on Blackboard. Any changes to the readings or lecture schedule will be on Blackboard as well. **It is important to understand that meetings often present subject matter that is not introduced in the text. It therefore behooves you to attend class.**
Module 1 | Biomolecules: Information and Function

Meeting 1 (Siegal)

Introduction: Biomolecules and Cells

Chapter 1: “Molecules, Cells, and Evolution”
1.0 Introduction, p. 1–4
1.1 The Molecules of Life, p. 4–10
1.2 Genomes, Cell Architecture, and Cell Function, p. 10–16
1.3 Cells into Tissues: Unicellular and Metazoan Organisms Used for Molecular Cell Biology Investigations, p. 16–22

Module 1 | Biomolecules: Information and Function

Meeting 2 (Siegal)

The Central Dogma I: DNA as Chemical and Genetic Material

Chapter 2: “Chemical Foundations”
2.0 Introduction, p. 23–24
2.1 Covalent Bonds and Noncovalent Interactions, p. 24–33
2.2 Chemical Building Blocks of Cells*, p. 33, 36–43
*not Amino Acids Differing Only in Their Side Chains Compose Proteins
2.3 Chemical Reactions and Chemical Equilibrium*, p. 43–44
*not Dissociation Constants of Binding Reactions Reflect the Affinity of Interacting Molecules

Chapter 4: “Basic Molecular Genetic Mechanisms”
4.0 Introduction, p. 115–116
4.1 Structure of Nucleic Acids*, p. 117–121
*not Torsional Stress in DNA is Relieved by Enzymes

Meeting 3 (Siegal)

The Central Dogma II: RNA Synthesis and Properties

Chapter 4: “Basic Molecular Genetic Mechanisms”
4.1 Structure of Nucleic Acids, p. 122–124
4.2 Transcription of Protein-Coding Genes and Formation of Functional mRNA, p. 124–131
4.3 The Decoding of mRNA by tRNAs*, p. 131
*not Messenger RNA Carries Information from DNA in a Three-Letter Genetic Code

Meeting 4 (Siegal)

The Central Dogma III: Protein Synthesis and Properties

Chapter 2: “Chemical Foundations”
2.2 Chemical Building Blocks of Cells, p. 33–36

Chapter 3: “Protein Structure and Function”
3.0 Introduction, p. 59–60
3.1 Hierarchical Structure of Proteins, p. 61–70
3.2 Protein Folding, p. 70–77

Chapter 4: “Basic Molecular Genetic Mechanisms”
4.3 The Decoding of mRNA by tRNAs, p. 131–136
4.4 Stepwise Synthesis of Proteins on Ribosomes, p. 136–145
Meeting 5 (Siegal)

*Biomolecule Structure and Function*

Chapter 2: “Chemical Foundations”
2.3 Chemical Reactions and Chemical Equilibrium, p. 44–48

Chapter 3: “Protein Structure and Function”
3.3 Protein Binding and Enzyme Catalysis, p. 77–85
3.5 Purifying, Detecting, and Characterizing Proteins, p. 93–106

Chapter 10: “Biomembrane Structure”
10.2 Membrane Proteins: Structure and Basic Functions, p. 455–464

MODULE 2 | DNA and Chromosomes

Meeting 6 (Ercan)

*Chromosomes I: DNA Packaging in Cells*

Chapter 6: “Genes, Genomics, and Chromosomes”
6.0 Introduction, p. 223–225
6.6 Structural Organization of Eukaryotic Chromosomes, p. 256–265
6.7 Morphology and Functional Elements of Eukaryotic Chromosomes, p. 266–275

Meeting 7 (Ercan)

*Chromosomes II: The Microanatomy of Eukaryotic DNA*

Chapter 6: “Genes, Genomics, and Chromosomes”
6.1 Eukaryotic Gene Structure, p. 225–230
6.2 Chromosomal Organization of Genes and Noncoding DNA, p. 231–233
6.3 Transposable (Mobile) DNA Elements, p. 234–243
6.4 Organelle DNAs, p. 245–251

Meeting 8 (Ercan)

*DNA Replication and Repair*

Chapter 4: “Basic Molecular Genetic Mechanisms”
4.5 DNA Replication, p. 145–149
4.6 DNA Repair and Recombination*, p. 151–155
*not Two Systems Utilize Recombination to Repair Double-Strand Breaks in DNA

Chapter 24: “Cancer”
24.5 Carcinogens and Caretaker Genes in Cancer, p. 1144–1149

Meeting 9 (Ercan)

*DNA Recombination*

Chapter 4: “Basic Molecular Genetic Mechanisms”
4.6 DNA Repair and Recombination, p. 155–159

Chapter 19: “The Eukaryotic Cell Cycle”
20.8 Meiosis: A Special Type of Cell Division, p. 913–918

Chapter 23: “Immunology”
23.2 Immunoglobulins: Structure and Function, p. 1068–1072
23.3 Generation of Antibody Diversity and B-Cell Development, p. 1073–1081
MODULE 3 | Recombinant DNA

Meeting 10 (Siegal)
Recombinant DNA I: Restriction Enzymes, Cloning and Libraries
Chapter 5: “Molecular Genetic Techniques”
5.0 Introduction, p. 171–172
5.2 DNA Cloning and Characterization, p. 182–191

Meeting 11 (Siegal)
Recombinant DNA II: Sequencing DNA and Polymerase Chain Reaction
Chapter 5: “Molecular Genetic Techniques”
5.2 DNA Cloning and Characterization, p. 192–198

Midterm Examination I (covers material through Meeting 9)

Meeting 12 (Siegal)
Recombinant DNA III: Molecular Analysis Using Cloned Sequences
Chapter 5: “Molecular Genetic Techniques”
5.3 Using Cloned DNA Fragments to Study Gene Expression, p. 198–206

MODULE 4 | Transcriptional Regulation

Meeting 13 (Ercan)
Transcription I: RNA Polymerases, Transcription in Prokaryotes
Chapter 7: “Transcriptional Control of Gene Expression”
7.0 Introduction, p. 279–282
7.1 Control of Gene Expression in Bacteria, p. 282–288
7.2 Overview of Eukaryotic Gene Control and RNA Polymerases, p. 288–295

Meeting 14 (Ercan)
Transcription II: Transcription Initiation, Elongation, and Termination
Chapter 7: “Transcriptional Control of Gene Expression”
7.3 RNA Polymerase II Promoters and General Transcription Factors, p. 295–302
7.8 Other Eukaryotic Transcription Systems, p. 336–338

Meeting 15 (Ercan)
Transcription III: Regulation of Transcription
Chapter 7: “Transcriptional Control of Gene Expression”
7.5 Molecular Mechanisms of Transcription Repression and Activation, p. 315–323
7.6 Regulation of Transcription-Factor Activity, p. 323–327
7.7 Epigenetic Regulation of Transcription, p. 327–335

Meeting 16 (Ercan)
Gene Expression on the Genome Scale
Chapter 24: “Transcriptional Control of Gene Expression”
24.1 Tumor Cells and Onset of Cancer
“DNA Microarray Analysis of Expression Patterns Can Reveal Subtle Differences Between Tumor Cells”, p. 1123–1124
Meeting 17 (Small)

*Enhancers and Combinatorial Gene Regulation*

Chapter 7: “Transcriptional Control of Gene Expression”

7.4 Regulatory Sequences in Protein-Coding Genes and the Proteins Through Which They Function, p. 302–314

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**MODULE 5 | Molecular Genetic Analysis**

Meeting 18 (Small)

*Molecular Genetic Analysis I: Mutation Analysis*

Chapter 5: “Molecular Genetic Techniques”

5.1 Genetic Analysis of Mutations to Identify and Study Genes, p. 172–182

Midterm Examination II (covers material through Meeting 17)

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Meeting 19 (Small)

*Molecular Genetic Analysis II: Transgenics*

Chapter 5: “Molecular Genetic Techniques”

5.5 Inactivating the Function of Specific Genes in Eukaryotes, p. 217 only Figure 5-43

Meeting 20 (Siegal)

*Molecular Genetic Analysis III: Cloning a Human Gene*

Chapter 5: “Molecular Genetic Techniques”

5.4 Locating and Identifying Human Disease Genes, p. 206–211

Meeting 21 (Siegal)

*Molecular Genetic Analysis IV: Reverse Genetics*

Chapter 5: “Molecular Genetic Techniques”

5.5 Inactivating the Function of Specific Genes in Eukaryotes, p. 212–219

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**MODULE 6 | Layers of Gene Regulation**

Meeting 22 (Siegal)

*Post-transcriptional Control*

Chapter 8: “Post-Transcriptional Gene Control”

8.0 Introduction, p. 345–348

8.1 Processing of Eukaryotic Pre-mRNA, p. 348–360

8.2 Regulation of Pre-mRNA Processing, p. 360–365

8.3 Transport of mRNA Across the Nuclear Envelope, p. 365–370

Meeting 23 (Siegal)

*Transcription and Nuclear Organization*


Meeting 24 (Siegal)

*Translational and Post-translational Control*

Chapter 3: “Protein Structure and Function”
3.4 Regulating Protein Function, p. 85–92

Chapter 8: “Post-Transcriptional Gene Control”
8.4 Cytoplasmic Mechanisms of Post-transcriptional Control, p. 370–384

**MODULE 7 | Genomics and Systems Biology**

Meeting 25 (Ercan)

*Sequencing and Annotating an Entire Genome*


Meeting 26 (Ercan)

*Comparative, Functional, and Personal Genomics*

Chapter 6: “Genes, Genomics, and Chromosomes”
6.5 Genomics: Genome-wide Analysis of Gene Structure and Expression, p. 252–255

Meeting 27 (Ercan)

*Proteomics, Metabolomics, Microbiomics and Systems Biology*

Chapter 3: “Protein Structure and Function”
3.6 Proteomics, p. 106–108

Meeting 28 (Siegal)

*Conclusion: The Future of Molecular Biology*


**Final Examination**