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Course Description
The structure and functions of cell components are covered. Emphasis will be placed on the molecular composition of cells and the molecular mechanisms a cell uses to grow and divide. Experiments and computer exercises are designed around fundamental questions in eukaryotic cell biology with an emphasis on biochemical and molecular biological techniques.

Prerequisites: Bio 1400 and Chm 1100

Student Learning Outcomes
1. Increase student understanding of the biological complexity of the cell through the study of the molecular and cellular mechanisms which underlie life.
2. Identify the principal molecules of the cell (DNA, RNA, protein), their interaction with one another, with other cellular components and with other cells.
3. Develop a more in depth knowledge of the molecular and cellular basis of homeostasis and cell division.
4. Learn and practice basic techniques used in biotechnology in a laboratory setting.
5. Analyze data in order to determine genetic relatedness among fish by constructing a cladogram.

Course Requirements and Policies

Laboratory: There is no laboratory manual. You are required to bring a 3-ring binder with you to the first lab where you will be given laboratory handouts.

Grading: Lecture and lab are 50% each of your final grade. Point distribution is as follows:

<table>
<thead>
<tr>
<th>Course requirements</th>
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<tbody>
<tr>
<td><strong>Laboratory</strong></td>
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<tr>
<td>Quizzes</td>
<td>20%</td>
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<tr>
<td>Lab Notebook</td>
<td>10%</td>
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<td>Lab Techniques</td>
<td>5%</td>
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<tr>
<td>Research Project</td>
<td>15%</td>
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<tr>
<td><strong>Lecture</strong></td>
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<tr>
<td>Lecture Exams</td>
<td>30%</td>
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<tr>
<td>Final Exam</td>
<td>20%</td>
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<td><strong>Course total</strong></td>
<td>100%</td>
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**Attendance and Required Materials**

- It is expected that students will attend every lecture and lab. Since all lectures and labs have an activity or assignment worth points, it is imperative that you attend class on time.
- If you miss 13 hours (15%) of class in any combination of lecture and laboratory hours, and for any combination of reasons (valid or invalid), your grade is a WU (unofficial withdrawal).
- It is distracting and disrespectful to both the professor as well as your classmates to come in late, especially for lab sessions where experiments are done in a timely manner. Be on time!
- If you miss a lecture/lab session, you should ask your classmates what you have missed and borrow their notes.
- Work that is to be turned in must be turned in within the first 15 minutes of class.
- Assignments turned in late will receive a 0. There are no make-up exams. If one lecture exam or lab quiz is missed the lowest grade you received on another exam or quiz will substitute it. Missing a second exam or quiz will be counted as a 0.
- Knee length laboratory coats, goggles and nitrile gloves are required for EVERY lab. You are not permitted in the lab without them and you will be marked as absent. Since nothing can be stored in the lab you need to be sure you have your materials with you on the day of lab.
- Please have functional No. 2 pencils, erasers, and a calculator (not your cell phone) ready for any exams and quizzes.
- There are no negotiations for grades. Your grade is the sum of the components listed. There are no extra credit, make-up or “pity” points. It is expected that you give 100% effort in all your endeavors including this course. Therefore there are no extra points for “working hard”.
- All cell phones and other electronic devices should be off within the classroom or laboratory. There is no talking or texting with your phone, or you'll be asked to leave.

**Access-Ability Services (AAS)** serves as a liaison and resource to the KCC community regarding disability issues, promotes equal access to all KCC programs and activities, and makes every reasonable effort to provide appropriate accommodations and assistance to students with disabilities. Please contact this office if you require such accommodations and assistance. Your instructor will be glad to make the accommodations you need, but you must have documentation from the Access-Ability office for any accommodations.

**How to succeed in Molecular and Cellular Biology:**

- Complete all assignments and turn them in on time. Late assignments are not accepted.
- Attend all lectures and labs
- Read the text and laboratory handouts BEFORE class
- Review your class notes as soon as possible after lecture and immediately before lecture.
- Participate in a study group on a weekly basis.
- Know the vocabulary! The study of MCB is like learning a new language. You need to know the vocabulary in order to understand the concepts.
- Get a good night’s sleep before the exam.

**Required laboratory equipment/items**

- Knee-length lab coat
- Goggles
- Nitrile gloves
- Marble notebook

Safety is a priority for the laboratory portion of this course. You must pay attention to and STRICTLY FOLLOW the instructor’s directions in performing experiments at all times!

**Academic Integrity Policy**

Academic dishonesty is prohibited in The City University of New York and is punishable by penalties, including failing grades, suspension, and expulsion. Examples of academic dishonesty include cheating, plagiarism, internet plagiarism, obtaining unfair advantage, and falsification of records. A full definition of each form of academic dishonesty, as well as procedures for imposition of sanctions for violations of the CUNY Policy on Academic Integrity, may be accessed at www.kingsborough.edu.
Lecture Outline

Week 1 Lecture: Introduction to the Cell
  a. Cells and genomes
  b. Biochemistry of the cell
  c. Proteins
  Reading Assignment: Chapters 1 (pgs 1-25), 2 (pgs 39-63) and 4

Week 2 Lecture: DNA
  a. DNA and Chromosomes
  b. DNA Replication
  c. DNA Repair and Recombination
  Reading Assignment: Chapters 5 and 6

Week 3 Lecture: From DNA to Protein I
  a. Transcription
  b. Regulation of Gene Expression
  c. Comparison of gene expression and regulation of gene expression between Prokaryotes and Eukaryotes.
  Reading Assignment: Chapter 7

Week 4 Lecture: From DNA to Protein II
  a. The Mechanics of Translation in Prokaryotes and Eukaryotes
  b. Regulation of Translation in Eukaryotes
  Reading Assignment: Chapter 8

Week 5 Lecture: Membranes
  a. Membrane structure
  b. Membrane synthesis
  c. Electrical properties of membranes
  d. Transport Across Membranes
  Reading Assignment: Chapter 11

Week 6 Lecture: The Compartmentalization of Cells
  a. Intracellular Compartments
  b. Transport of Proteins between the Nucleus and Cytoplasm
  c. Transport of Proteins into Mitochondria
  d. Transport of proteins into the Endoplasmic Reticulum
  Reading Assignment: Chapter 15 (pgs 498-511)

Week 7: Intracellular Vesicular Traffic
  a. Transport Through the Endomembrane System
  b. Transport from the trans Golgi Network to Lysosomes
  c. Endocytosis
  d. Exocytosis
  Reading Assignment: (pgs 512-529)

Week 8: The Cytoskeleton
  a. The Dynamic Structure of Cytoskeletal Filaments
  b. Molecular Motors
  c. Regulation of Cytoskeletal Components
  Reading Assignment: Chapter 17
Week 9: The Cell Cycle I
a. Overview of the Cell Cycle
b. Molecular Components of the Cell Cycle
c. Regulation of the Cell Cycle
*Reading Assignment: Chapter 18 (pgs 612-624)*

Week 10: The Cell Cycle II
a. Overview of Mitosis and Cytokinesis
b. Regulation of Mitosis and Cytokinesis
c. Apoptosis
d. Cancer
*Reading Assignment: Chapter 18 (pgs 624-634) and Chapter 19*

Week 11: Cell Communication
a. General Mechanisms of Extracellular Signaling through Cell Receptors
b. G-Protein-Linked Cell-Surface Receptors
c. Tyrosine Kinase Receptors
*Reading Assignment: Chapter 16*

Week 12: Development of Multicellular Organisms: *Drosophila*
a. General Mechanisms of All Animal Development
b. HOX Genes
c. Positional Signals
*Reading Assignment: Chapter 21*

**Laboratory Outline**

**Week 1 Lab: Introduction**
1. Laboratory Safety and policies
2. Aseptic Technique
   a. Streaking for colony isolation
   b. Cell spreading
3. Measurements and Quantitation
   - Appropriate use of micropipettes
   - Basic laboratory calculations I: How to make stock solutions
4. The laboratory notebook

**Week 2: Restriction Digestion and Analysis of Lambda DNA**
1. Cutting DNA with restriction endonucleases
   - EcoRI
   - BamHI
   - HindIII
2. Aseptic Technique Results
3. Basic laboratory calculations II: How to make buffer from stock solutions

**Week 3: Bacterial transformation**
1. Agarose Gel Electrophoresis
2. Determining sizes of DNA fragments
   - Constructing a standard curve
   - Determining sizes of unknowns
3. Transforming *E. coli* with pGLO plasmid DNA
Week 4: Isolating Plasmid DNA from Transformed E. coli
1. Preparing 2 ml cultures of transformed E. coli
   - adding lysozyme for Wk 5 Chromatography
2. Mini prep of pGLO plasmid DNA
3. Spectrophotometry of DNA Prep product
4. Restriction enzyme digestion of plasmid DNA

Week 5: Chromatography
1. Agarose gel electrophoresis of DNA Prep-cut (from Wk4)
2. Protein prep of E. coli containing GFP
3. Size exclusion chromatography

Week 6: PCR
1. Using mock crime scene evidence, identify the Criminal through amplification of DNA via PCR

Week 7: ELISA Immunodetection
1. Gel Electrophoresis of Crime Scene PCR results (from Wk6)
2. Modeling Ag/Ab complexes
3. ELISA assay
4. Analysis of data acquired by ELISA

Week 8/9: Comparative Proteomics with Western Blotting
1. Protein Extract of fish samples
2. PAGE: fish samples & GFP (from Wk5)
3. Transfer of proteins to nitrocellulose
4. Western blotting

Week 10/11: Genetically Modified Organisms
1. DNA extraction of plant samples
2. Identification of GMOs through PCR
3. Analysis of results of PCR

Week 12: Research Paper Presentation