

CMPB 5003: Cellular and Molecular Biology

Semester: Fall 2022

Course Director: Nicholas Brady, PhD njb2003@med.cornell.edu (preferred)

Times: Two 90-minute classes per week; August 22 to December 7
Mondays and Wednesdays @ 2:00pm – 3:30pm

Location: 1300 York Avenue, 2nd Floor, Rooms G/H (B-215/B-217)

No Class: Labor Day (September 5), Day before Thanksgiving (November 23)

Prerequisites: Admission to WCGS MS-CB Program or permission from the Course Director

Credits: 3.5

Course Description:

This course presents a review of essential cellular and molecular processes with a focus on experimental techniques and data quantification. Topics include cellular structure and function, genetics and genomics, transcriptomics, proteins and proteomics, post-translational regulation, and cell signaling. Methodologies and quantification include: microscopy, PCR, blots, antibodies, immunoprecipitation, fluorescence, mass spectroscopy, flow cytometry, genome-wide sequencing approaches, and single cell-based strategies. We will also cover the latest genetic engineering techniques and showcase visualization of 3D protein structures.

Learning Objectives:

1. Students will acquire a basic understanding of cellular and molecular processes.
2. Students will learn large-scale genomics and proteomics required for further systems biology studies.
3. Students will be able to describe modern experimental techniques and understand abilities and limitations of these techniques for generating quantitative data.
4. Students will feel comfortable reading primary literature, critically analyzing the conclusions, presenting summaries of scientific figures, and proposing testable hypotheses for further research.

Course Format:

The course will consist of twice-weekly lectures within 7 subject modules; 7 exams, one for each module; and short student presentations on instructor-assigned subjects, one within each module (based on on-line resources, textbook chapters, scientific reviews, and original articles).

Texts:

Molecular Biology of the Cell, B. Alberts et al., 6th Edition; reviews, articles and on-line resources as directed by instructor.

Lecture Schedule:

<u>Date:</u>	<u>Activity:</u>	<u>Topic and Assigned Reading:</u>
8/22/2022	Lecture 1	Introduction to cellular organization (Ch. 1, 2)
8/24/2022	Lecture 2	Biomembrane structure and function. Transport of ions and proteins (Ch. 10, 11)
8/29/2022	Lecture 3	Cell energetics (Ch. 14)
8/31/2022	Lecture 4	Immunity, specific immunity, and antibodies (Ch. 24)
9/5/2022	Labor Day	
9/7/2022	Lecture 5	Protein structure, function, immunolabeling, detection, visualization (Ch. 3, 8)
9/12/2022	Journal Club #1 and Exam #1 Due	
9/14/2022	Lecture 6	Nucleic acids, chromatin structure, DNA replication, DNA repair (Ch. 4, 5)
9/19/2022	Lecture 7	Prokaryotic and eukaryotic gene structure, transcription (Ch. 6)
9/21/2022	Lecture 8	Post-transcriptional control (splicing, mRNAs, mRNA export) (Ch. 6)
9/26/2022	Journal Club #2 and Exam #2 Due	
9/28/2022	Lecture 9	Transcriptional control of gene expression (Ch. 7)
10/3/2022	Lecture 10	Translation, protein synthesis (Ch. 6)
10/5/2022	Lecture 11	Cell division, mitosis, meiosis (Ch. 17)
10/10/2022	Journal Club #3 and Exam #3 Due	
10/12/2022	Lecture 12	Molecular genetic techniques I (mutations, cloning, qPCR, microarrays) (Ch. 8)
10/17/2022	Lecture 13	Molecular genetic techniques II (sequencing, ChIP, CRISPR) (Ch. 8)
10/19/2022	Lecture 14	Modern genomics techniques (genome analysis, GWAS) (Ch. 8)
10/24/2022	Journal Club #4 and Exam #4 Due	
10/26/2022	Lecture 15	Post-translational modifications and proteomics (Ch. 3)
10/31/2022	Lecture 16	Signal transduction and G-protein coupled receptors (Ch. 15)
11/2/2022	Lecture 17	Signaling pathways that control gene expression (Ch. 7, 15)
11/7/2022	Journal Club #5 and Exam #5 Due	
11/9/2022	Lecture 18	Cell cycle checkpoints, programmed cell death (Ch. 17, 18)
11/14/2022	Lecture 19	Development of multicellular organisms (Ch. 21)
11/16/2022	Lecture 20	Stem cells (ESCs, iPSCs), regeneration (Ch. 22)
11/21/2022	Journal Club #6 and Exam #6 Due	
11/23/2022	Thanksgiving	
11/28/2022	Lecture 21	Cancer cells and oncogenesis (Ch. 20)
11/30/2022	Lecture 22	Tumor microenvironment (Supplemental reading TBA)
12/5/2022	Journal Club #7 and Exam #7 Due	
12/7/2022	Lecture 23	Translational cancer research, animal models (Supplemental reading TBA)

Assignments, Exams and Grading:

Grading of the Course will be based on 7 Exams (70% of grade) and completion of 7 in-class Journal Club presentations on designated subjects from the course material (30% of grade). All students will receive a letter grade (A-F) for the course. Letter grades will be determined using a standard percentage point evaluation as outlined below:

A+:	97 - 100
A:	93 - 96.9
A-:	90 - 92.9
B+:	87 - 89.9
B:	83 - 86.9
B-:	80 - 82.9
C+:	77 - 79.9
C:	70 - 76.9
D:	60 - 69.9
F:	Below 60

Exams:

The exams will be given in a “take-home” format, consisting of short questions about the topics for a given module. The exams will be distributed via email on the last lecture day of each module. You must complete your work **independently** and return the exam via email **BEFORE** 2:00pm Eastern Time on the specified due dates. Please do not wait until the last moment to submit your exam in case any unexpected technical difficulties arise. It is imperative that you submit your answers before class, as we may discuss answers to exam questions during Journal Club. Please submit your exams to njb2003@med.cornell.edu with “CMPB 5003 Exam #X” in the subject line.

Late Submission Policy:

In fairness to other students in the class who submitted their work on time, any exams that are returned after 2:00pm Eastern Time on the due date will be subject to an automatic point deduction based on the time the work is submitted.

<i>Late Submission Time</i>	<i>Deduction</i>
Submitted after 2:00pm on Monday but before 5:00pm on Monday	-5 points
Submitted after 5:00pm on Monday but before 5:00pm on Tuesday	-10 points
Submitted after 5:00pm on Tuesday but before 5:00pm on Wednesday	-15 points
Submitted after 5:00pm on Wednesday but before 5:00pm on Thursday	-20 points
Submitted after 5:00pm on Thursday	-25 points [no credit]

Journal Club:

At the conclusion of each module, a research article will be assigned for all students to read. During the in-person sessions, we will hold a Journal Club to discuss the reading. Each student will be randomly assigned to present one or more figures from the assigned reading. Students will be expected to discuss: hypothesis/rationale, experimental approach, results, conclusions, etc. More details will be discussed in class.

Students with Disabilities: Your access in this course is important to me. If you have, or think you may have a disability, please contact the Assistant Dean of Student Affairs in Student Disability Services for a confidential discussion: Judith Cukor, PhD: juc2010@med.cornell.edu, (212)746-4492. If applicable, please request your accommodation letter early in the semester so that we have adequate time (at least 2 weeks prior) to arrange your approved academic accommodations.

For more information, visit: <https://studentservices.weill.cornell.edu/student-life/student-disability-services>.

Student Responsibilities/Honor Code:

The following policy statements regarding student responsibilities are from the Code of Legislation of the Weill Cornell Graduate School of Medical Sciences of Cornell University (revised June 16, 2020):

It shall be the responsibility of the students and faculty of the Graduate School to uphold the integrity and ethical standards of the community to the fullest extent possible. The standards of conduct listed below set forth general responsibilities of students and faculty in a teacher learner environment. The full range of responsible conduct cannot be set forth in any policy document. Accordingly, students and faculty should view these enumerated responsibilities as an illustration and should strive to comply with both the letter and the spirit of these standards of conduct.

In order for students to be permitted to continue their studies at the Graduate School, students must demonstrate a range of skills and abilities, such as good judgment, a sense of responsibility and morality, the ability to synthesize and apply knowledge, and evidence that they are capable of becoming effective scientists. Students must also assume responsibility for the integrity of the content of the academic work performed and submitted, including papers, examinations and reports.

The following are examples of conduct that are not suitable for students at the Graduate School:

- *knowingly or carelessly representing the work of others as one's own;*
- *using or giving unauthorized assistance in any academic work;*
- *restricting the use of material used to study in a manner prejudicial to the interest of other students;*
- *purposely misleading or give false information;*
- *cheating otherwise committing a breach of academic and/or professional integrity;*
- *repetitively or egregiously failing to fulfill the professional requirements and responsibilities;*
- *committing an act of physical abuse or violence of any kind;*
- *sexual or other prohibited forms of harassment;*
- *sharing confidential or inappropriate information (including but not limited to, photos, images, text or video) on the internet or any form of electronic media*
- *being repeatedly absent, unexcused, from a required course, or laboratory activities; or*
- *failing to respond in a timely way to communications (phone calls, emails or other correspondence) from the administration, faculty, course leadership or their representatives.*

A student, or group of students, knowing of any situation in which a violation of any of the standards of conduct set forth above may have occurred is responsible for providing any such information in writing to the Dean of the Graduate School. Faculty are similarly required to report a violation to the Dean of the Graduate School. Each student shall be bound by standards of conduct described above and shall be presumed to be familiar with the above provisions.