**Syllabus for Applied Cell and Molecular Biology (03-709)**

Fall 2024

*“Critique is not some peripheral feature of science, but rather is core to its practice, and without [it], the construction of reliable knowledge would be impossible.”*

- Jonathan Osborne, 2010

**Section A:** TR 2:00 – 3:20 pm US Eastern Time (New York time), Mellon 348

**Instructors: DJ Brasier**, [dbrasier@cmu.edu](mailto:dbrasier@cmu.edu)

**Stephanie Wong-Noonan**, [sawong@andrew.cmu.edu](mailto:sawong@andrew.cmu.edu)

(see Canvas for office hours or e-mail to schedule)

**TAs: Arunaa Ganesan** [arunaan@andrew.cmu.edu](mailto:arunaan@andrew.cmu.edu)

**Tianyi Liu** [tliu4@andrew.cmu.edu](mailto:tliu4@andrew.cmu.edu)

**Course Description**:

This course will introduce and review key cellular and molecular phenomena in biology with a strong emphasis on the latest experimental techniques used in applications including, but not limited to, disease diagnosis & therapeutics and large-scale genomic & proteomic analysis. This course will employ “active learning” teaching methodologies, thus making the classroom an interactive place. Additionally, students will cultivate sustained excitement about molecular and cellular aspects of biology and will be adept at applying this knowledge for problem solving.

**Learning Objectives:**

Upon successful completion of this course students should be able to:

1) Describe molecular mechanisms and regulation of key cell biology processes including cell signaling, central dogma, cell cycle and DNA replication, intracellular trafficking, and energetics.

2) Explain the significance of individual molecules and cellular pathways in relationship to the following: cell survival, cell division, cell growth, tissue growth, and organismal development.

3) Describe the uses of key cutting-edge techniques including: western blots, 2D proteomic gels, PCR, Sanger sequencing, sequencing by synthesis, genomic screening, CRISPR/Cas9, genomic reconstruction, and *in situ* labeling tools for RNA & protein.

4) Design experiments to study the molecular basis of cellular function. These experiments will apply the methods described in objective 3, above.

5) Read an original research article and describe the conclusions and the results that support the conclusions.

6) Evaluate the technical and theoretical limitations on interpretation of results given particular methods from original research articles.

7) Design intervention strategies using all of the above (objectives 1-6). Plan the use of these strategies in application-based research for translating basic science into treatment of human diseases.

The textbook is "Molecular Biology" by Clark & Pazdernik (2nd edition). If students log in with their Andrew ID, they should be able to get a free electronic version through the CMU library here:

<http://CM.eblib.com/patron/FullRecord.aspx?p=861227>

**Additional optional reference texts:** *Biological Science*, Freeman, 6th Edition.

*Molecular Biology of the Cell*, by Alberts.

(Both available on e-reserve)

***Responsibilities***

*The choice to take this course is entirely up to you. If you do choose to take the course, please do your best to be a good course citizen. This means you should make every effort to attend all classes on time and to be prepared to participate in class discussions and activities.*

*In turn, we will make every effort to build a valuable learning experience for every student. If there is ever any way we can improve your learning, or if any topic doesn’t capture your interest, we welcome feedback (either in class, outside of class, or anonymously).*

*Finally, it is everyone’s responsibility to be respectful of others during class.*

**Background material:**

Because this course moves so quickly and assumes some knowledge of background biology material, students are strongly advised to use the textbook, the additional text, and CMU online learning tools at: <http://oli.cmu.edu/learn-with-oli/see-our-free-open-courses/> (under “Modern Biology”).

**Philosophy on lifelong learning:**

"*The test will measure whether you are an informed, engaged, and productive citizen of the world, and it will take place in schools and bars and hospitals and dorm rooms and in places of worship. You will be tested on first dates, in job interviews, while watching football, and while scrolling through your Twitter feed. The test will judge your ability to think about things other than celebrity marriages, whether you’ll be easily persuaded by empty political rhetoric, and whether you’ll be able to place your life and your community in a broader context. The test will last your entire life, and it will be comprised of the millions of decisions that, when taken together, will make your life yours. And everything, everything, will be on it!*"

- John Green (Vlogbrothers, Crash Course)

*“[I do not] carry such information in my mind since it is readily available in books... The value of a college education is not the learning of many facts but the training of the mind to think.”*

- Albert Einstein, 1921

*“The real reason I care so much about the scientist’s brain being an important storage device for experiments done, papers read and courses studied is that it is impossible to think creatively into the future without a sense of what is known… we would all be better scientists if we remembered to remember more of what we learn about science. It is impossible to reason with the forgotten, and every time we give ourselves permission to forget, we are forgoing the opportunity to make new and interesting connections between what has been discovered in the past in seemingly disparate domains of enquiry. Biology will inevitably, in time, degrade all of our memories, but I suspect that most truly creative scientists take full advantage of the memories they have stored in their brains as they make new discoveries.”*

-- Eve Marder, “The Importance of Remembering”, E-Life, 2017.

**Faculty aspirations**:

* Teach you about science – being skeptical, pursuing questions, formulating hypotheses, designing experiments, carrying them out, and making sense of them. Sometimes good ideas are wrong and sometimes (really, always) trying to answer interesting questions only leads to more questions.
* Excite you about biology and about science in general.
* Prepare you to be critical scientific thinkers.

**How to succeed in 03-709**:

* **Read the assigned readings** *before* **class.** The most important way to make sure you get valuable use out of class time is to walk in the door with some background and basis for understanding the material. You only get to have the lecture once, and the worst thing you can do is have that be your first exposure to the material.
* **Be prepared to discuss assigned scientific literature readings in class.** Think about the major points of the paper and do your best to complete the assignments. *Don’t worry if you don’t get it all the first time; that is what class time will be for.*
* **Come with questions about the readings.** It is vitally important to everyone’s success in the class that we spend as much of the lecture time going over the most interesting and challenging concepts. If we spend most of the class discussing things that everyone understood from the reading and then only a small amount of time quickly covering the parts that made no sense, then you will struggle on those issues at the exams; worse, you may never learn them.
* **Ask questions in class.** Whether these are for clarification, repetition, or because you’re interested and want to know more, student questions make for a better learning environment for all.
* **Attend class and be attentive in class.** Attending class is the most important thing that you can do to be successful in this class. Take notes during class. Discuss class with each other and with the instructor.
* ***Speak up in class!*** Share your thoughts or questions about the material. We are all here to learn from each other.
* **Review/think about/talk about what was covered in class.** In addition to simply showing up for class, spend time between lectures looking over your notes and thinking about what was discussed. This daily review of material is an immensely helpful way of preparing for the next lecture, having questions answered in a timely fashion and learning the material. You can do this alone or in groups with other students in the class. You should expect to spend on average 6 hours/week outside class preparing for lectures & exams and doing assignments (9 units means 3 hours/week in class plus 6 hours/week out of class).
* **Read (about biology).** Lots of stuff gets written about biology. You can go to the library, look on‐line, read the newspaper/magazines. Talk to me or the TAs to find other stuff that people have written about biology. All of this will make you a more sophisticated student and will help you to integrate the topics covered in the course.
* **Contact the instructors.** Send an e-mail or post on Piazza any time. Come talk after class or make an appointment for help with any aspect of the course.
* **Success in this course is about more than your grade.** We want you to learn to think scientifically. This will serve you well long after you stop caring about your transcript.

**Evaluation**:20% Midterm exam

30% Final exam

15% Homework

15% Online modules

10% In-class activities

10% Written project

*Grade cutoffs:*

A+ = 97% and above

A = 94% to 96.999%

A- = 90% to 93.999%

B+ = 87% to 89.999%

B = 84% to 86.999%

B- = 80% to 83.999%

C+ = 77 % to 79.999%

C = 74% to 76.999%

C- = 70% to 73.999%

D+ = 66% to 69.999%

D = 60% to 65.999%

R = 0% to 59.999%

* **Homework & online modules.** There will be homework assignments every week (usually Tuesdays, sometimes other days). Additionally, some weeks there will be online modules to complete related to the course topics.
* **In class activities.** There will be some in class discussion questions and in-class written assignments that will be collected at the end of class.
* **Exams.** There will be one midterm exam. Exam policies will be reviewed closer to the exam date.
* **Make up Exams.** If a student cannot complete an exam on the designated day, we require documentation explaining the need before a make-up exam can be rescheduled. Please let us know as early as possible. See course policies below.
* **Final exam.** The final exam is cumulative and covers all the material from the course. It will be during finals week.
* **Other assignments.** More details about all assignments will be posted each week on Canvas.

***NOTE on relationship between assignments, lectures, and exams***

This is an intense course with long homeworks. We will not lecture about everything from the homework. You will be expected to learn the material from the lectures ***and*** the material from the homeworks. Exams will “cover” material from the lectures that was not on homework, some material from the homework that was not “covered” in class, and some material that overlaps. If the majority of the class demonstrates knowledge of material in homework assignments, then I will NOT repeat that material in lectures. You are responsible for coming to office hours for help on material that was on homeworks but not discussed in lectures or any other material that is unclear.

**Course policies**

**Attendance & in-class discussion work policy:**

* Please make every effort to come to class.
* If you know in advance you will be missing a class, please let us know as early as possible. Most reasonable absences are excused if you tell us before and you will receive full credit for missed in class work.
* If a medical situation or emergency causes you to miss class unexpectedly, please let us know when you are able: most extenuating circumstances can be excused even in retrospect.
* Unexcused absences will cause you to miss points on in-class assignments and participation grades.
* Excused absences will earn full credit for participation in in-class discussions/work.

**Late work policy:**

Unless stated otherwise, homework assignments are turned in via file upload to Canvas. Please be attentive not just to the due date, but the time due for every assignment on Canvas. Assignments that are late will receive a 10% penalty for being late by anywhere between 1 second and 24 hours. Assignments that are 24 hours to 1 week late will earn half credit. Longer than 1 week requires students to inform their academic advisor or student affairs. No work will be accepted for credit after an answer key has been posted.

**Missed exams:**

If you will be unable to attend a scheduled exam, please contact us at least 1 week in advance to discuss if it is possible to schedule an alternative time.

If a situation prevents you from attending the assessment that arises less than 1 week before (including situations the day of the assessment), documentation from Student Affairs (<https://www.cmu.edu/student-affairs/>). Any medical documentation will need to be provided to student Affairs NOT to us.

Make-up exams may have alternative questions but will be similar to the main exam format.

**Students with Disabilities:**

If you wish to request an accommodation due to a documented disability, please inform your instructor and contact Disability Resources as soon as possible. They can be reached at [*access@andrew.cmu.edu*](mailto:access@andrew.cmu.edu)or 412-268-2013.

Students who have accommodations related to in-class assessments (including extra time or distraction-reduced environments) will take assessments with Disability Resources proctoring the assessment.

**Technology Policy**

No cell phones in class. Other technology can be used for **note taking purposes only**.

Research has shown that divided attention is detrimental to learning, so I encourage you to close any windows not directly related to what we are doing while you are in class so you can fully engage with the material, each other, and me. Even if you can follow along while doing other things you may be distracting those around you. Staying focused on this course will create a better learning environment for everyone.

***Respect for Diversity***

*It is our intent that students from all diverse backgrounds and perspectives be well served by this course, that students’ learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: national origin, gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.*

**University-Wide Commitment to Diversity, Equity, and Inclusion**

**We must treat every individual with respect.** We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus. We, at CMU, will work to promote diversity, equity and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment.

Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment on the basis of identity to speak out for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

* **Center for Student Diversity and Inclusion:** [csdi@andrew.cmu.edu](mailto:csdi@andrew.cmu.edu), (412) 268-2150
* **Confidential reporting of discrimination or other concerns about diversity and inclusion including racial discrimination, gender discrimination, or other concerns or incidents:**
  + <https://www.cmu.edu/title-ix/how-to-report-+-options-for-resolution/confidential-reporting.html>

All reports will be documented and deliberated to determine if there should be any following actions. Regardless of incident type, the university will use all shared experiences to transform our campus climate to be more equitable and just.

**Academic Integrity**

* **Cheating.** Cheating of any sort will not be tolerated. For example, if quiz or assessment answers are copied from another student, both students will receive zeros; if graded assessments or quizzes are altered and resubmitted for a higher score, the revised score will be zero. Other forms of cheating may result in reduction of final grade in the course, including course failure, depending on the severity of the violation. In addition, these and other forms of cheating will also be referred to the Academic Review Board for more severe penalties. This warning has two purposes: 1) to dissuade a small number of students from even thinking about cheating; and 2) to persuade the large majority that they will get a fair grade based on their individual performance.
* **Plagiarism.** Cheating includes plagiarism. In this course, this is defined as using another person’s work as your own, especially on homework assignments and written assignments. You may consult sources if you cite them, but you should demonstrate your understanding by writing the assignments in your own words. See additional plagiarism guidelines.
* **Exams.** All exams are closed notes, closed books, with no talking or other sharing of information. Students will be allowed to bring 1 piece of 8.5 inch x 11 paper with anything you want on it (front and back) for the midterm and 2 pieces of paper (front and back) for the final exam.
* **Homework.** For the homework you are welcome (encouraged, actually) to discuss the questions with others.
  + However, you are required to **write the answers** **entirely on your own** unless explicitly given the option to submit a joint assignment.
* **In-class activities.** We will give you instructions for each activity about working together, most are designed to be collaborative.

*Student Success Center. The Student Success Center is a great resource for you to use. Many students in the past have found them to be incredibly valuable to support the transition into CMU and graduate school.*

[*https://www.cmu.edu/student-success/*](https://www.cmu.edu/student-success/)

**Commitment to Health and Interpersonal Support**

**Take care of yourself.**

Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

*There are a lot of ongoing uncertainties and physically and/or emotionally isolating experiences that many of us are having this semester. I am happy to support you in any way I can (*[*dbrasier@cmu.edu*](mailto:dbrasier@cmu.edu)*).*

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic or personal stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at <http://www.cmu.edu/counseling/>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

**ALSO**

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

**CaPS: 412-268-2922**

**Re:solve Crisis Network: 888-796-8226**

**If the situation is life threatening, call the police:**

**On campus: CMU Police: 412-268-2323**

**Off campus: 911**

**Approximate Schedule:**

Week 1: Biology Foundations – Molecules, Energy, Central Dogma

Week 2: Central Dogma cont. and genetics (including PCR)

Week 3-4: DNA methods and genomics

Week 5: Protein folding (including western blot)

Week 6: Protein trafficking (including immunohistochemistry)

Week 7: Proteomics

***10/10: Midterm exam***

Week 8: Protein tools & immune system

Week 9: Microarrays for protein and nucleic acids

Week 10: Cell signaling and imaging

Week 11: Mitosis and cell cycle regulation

Week 12: Cell environment and cell culture

Week 13: Immune System and immunotherapies

Week 14: Genome Editing Technologies

*Please pay attention to Canvas for any updates.*