BIOS 4012A / BIOL 8803CHE: Protein Biology

Tentative Updated Syllabus

3 credit class

TR 3:30 – 4:45 PM; Spring, 2022; Clough 129

**Instructor Information**

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| Instructor | Email | Office Hours & Location |
| Prof. Yury O. Chernoff | [yury.chernoff@biology.gatech.edu](mailto:yury.chernoff@biology.gatech.edu) | Thu 2-3 PM, Krone EBB 5016  (prior Email appointment is required) |

**General Information**

**Description**

This course will cover and integrate genetic, cell biological, biochemical and proteomic approaches to studying proteins, and will explain protein functions and protein-based pathologies within the broad biological framework. Proteins are major building blocks and catalytic machineries of life. Understanding biological roles of proteins requires integration of the genetic, cell biological, biochemical and computational approaches. Protein assembly disorders, caused by misfolded protein (amyloids and prions), represent one of the major challenges for humankind. As these disorders are usually age-dependent, their importance is going to increase with the increase in human life span. Protein-based heritable systems control epigenetic phenomena in microorganisms and possibly in higher eukaryotes. Directed protein evolution techniques have been applied to engineering new proteins for technological and medical purposes. Understanding of the biological control and roles of proteins is crucial for modern specialists dealing with various aspects of science, medicine and technology.

This course covers protein “life span” from “birth” (biosynthesis) to “death” (degradation), including genetic control of these processes, with implications for cell functioning and evolution, and special emphasis on protein assembly disorders, amyloids, prions, and protein-based heritable and epigenetic phenomena. This course includes traditional and interactive lectures, selected paper presentations on the course topics, and discussions of the presented materials. The undergraduate class BIOS 4012A is co-taught with the graduate class BIOL 8803CHE (paper presentations are typically given by graduate students, but attended and discussed by all students). To broaden the student perspective, the course will occasionally incorporate guest lectures, given by experts in the specific fields covered in the class (including those from departments other than School of Biological Sciences).

## Prerequisites

## BIOL1510 or 1511 or equivalent, or consent of the School.

**Course Materials**

*Textbook* - Buxbaum, E. (2015) Fundamentals of Protein Structure and Function. Springer ISBN 978-3-319-19919-1 (eBook ISBN 978-3-319-19920-3) (Recommended.)

## *Outside Materials:* Journal articles, website links of interest/discussion, etc.

## *Additional Sources:*

Lesk (2016) *Introduction to Protein Science: Architecture, Function, and Genomics.* 3rd Edition (Oxford University Press.)

Lodish et al. *Molecular Cell Biology*, 7th or later Edition (W. H. Freeman & Co)

Plopper, Sharp and Sikorski, eds. *Lewin’s Cells*. 3rd or later Edition (Jones & Bartlett Learning).

Krebs, Goldstein and Kilpatrick. *Lewin’s Genes XI* (Jones & Bartlett Learning).

*Course Website and Other Classroom Management Tools*: Powerpoint (or PDF) presentations of all lectures, as well as outside materials (OMs) will be posted on the course site. Lectures are typically posted after the class, except for interactive lectures and paper presentations, that will be posted before the class. It is highly recommended that students take detailed notes in class to supplement their understanding of lecture and OMs.

**Course Mode**

In Spring 2022, the course is expected to be taught in person (face-to-face format). Live attendance is critical, as some lectures are interactive and may include in-class assignments that are not to be announced previously. However, the mode could change depending upon health status of individuals in classroom. In case if there are any changes in the mode of teaching during semester, students will be informed. Any changes would be communicated through Canvas; please follow the announcement closely. **Please refer to Georgia Tech safety guidelines.** (See also **COVID-19 Expectations** below.)

## Course Objectives

## Upon completion of this course, students will be able to:

1. Describe the processes involved in protein biosynthesis, processing, folding and degradation.
2. Become familiar with theoretical foundations of the major technical approaches involved in protein analysis.
3. Understand molecular and cellular foundations of the protein assembly disorders and their impact on human health.
4. Get exposure to the integrative interdisciplinary approaches to major biological problems,
5. Develop skills that are necessary for scientific discussion and for the analysis of current scientific literature.

**Grading Criteria**

BIOS 4012A: Exams (two in class exams and final exam) – 75%; in class activity, quizzes and assignments – 25%.

BIOL 8803CHE: Exams (two in class exams and final exam) – 60%; in class activity, quizzes and assignments – 20%; paper presentations – 20%.

Extra credit will be assigned for exceptional performance in the class (including answering questions from Professor to the class during lectures and exceptional level of participation in the in-class activities).

*Grading Scale:* A - 90-100%; B - 80-89%; C- 70-79%; D - 60-69%; F - 0-59%.

**Course Schedule**

*NOTE: This schedule is subject to change!*

Week 1: 01/11 Lecture 1: Genes and Proteins

01/13 Lecture 2: Ribosome (Guest Lecture – Dr. Loren Williams)

Week 2: 01/18 Lecture 3: Genetic Code and Translation

01/20 Lecture 4: Translation Initiation I

Week 3: 01/25 Lecture 5: Translation Initiation II / Elongation and Termination I

01/27 Lecture 6: Translation Elongation and Termination II

Week 4: 02/01 Lecture 7: mRNA Degradation and Translation Inhibitors

02/03 Lecture 8: PTMs and Translocation

Week 5: 02/08 Lecture 9: Protein Analysis

02/10 Lecture 10: Discussion Session / Proteomics and Interactomics I

Week 6: 02/15 **EXAM I** (Covers Lectures 1-10)

02/17 Lecture 11: Proteomics and Interactomics II / Analysis of Protein Structure I

Week 7: 02/22Lecture 12: Analysis of Protein Structure II

02/24 Lecture 13: Protein Folding I

Week 8: 03/01 Lecture 14: Protein Folding II

03/03 Lecture 15: Chaperones

Week 9: 03/08 Lecture 16: Protein Quality Control

03/10 Lecture 17: Mammalian Prions I

Week 10: 03/15 Lecture 18: Mammalian Prions II Alzheimer Disease I

03/17 Lecture 19: Alzheimer Disease II Parkinson Disease

Week 11: 03/22, 24 SPRING BREAK

Week 12: 03/29 Lecture 20: Diversity of Amyloids

03/31 **EXAM II** (Covers Lectures 11-20)

Week 13: 04/05 Lecture 21: Protein-based Memory and Inheritance I

04/07 Lecture 22: Protein-based Memory and Inheritance II

Week 14: 04/12 Paper Presentations I, II

04/14 Paper Presentations III, IV

Week 15: 04/19 Paper Presentations V, VI

04/21 Paper Presentations VII, VIII

Week 16: 04/26 Lecture 23: Protein-based Memory and Inheritance III

and Concluding Remarks

Finals: 05/03 (Tue), 2:40-5:30 PM **FINAL EXAM**

**Course Expectations & Guidelines**

## Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on the Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or <http://www.catalog.gatech.edu/rules/18/>

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations. Please note that all quizzes must be taken in the classroom. Attempts to take the quizzes outside of the classroom, or facilitating other students taking the quizzes outside of the classroom, will be considered cheating.

**COVID-19 Related Expectations**

This is an unprecedented time. Georgia Tech recommendation is that everyone who is eligible should be vaccinated. Vaccination significantly reduces likelihood of severe disease. As virus can still be spread by vaccinated individuals, it is recommended that everyone who is able should wear a mask, correctly covering mouth and nose, when indoors. Both of these recommendations are based on current CDC guidance. As that guidance is updated, we will communicate any new expectations. Weekly asymptomatic surveillance testing is also recommended, regardless of vaccination status. Details are here: <https://health.gatech.edu/coronavirus/testing>.

## Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404) 894-2563 or <http://disabilityservices.gatech.edu/>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

## Attendance and/or Participation

Class time will be used for lectures, quizzes, discussions, and exams. If you miss lecture, *you* are responsible for obtaining all notes, announcements, and assignments. Written confirmation of a legitimate excuse, such as a severe illness, will be required if any assessment is missed. The institute’s excused absence policy will be enforced in this course (http://www.catalog.gatech.edu/rules/4/). *No exceptions!*

## Collaboration & Group Work

This class will require active participation in the in-class group activities and discussions.

## Extensions, Late Assignments, & Re-Scheduled/Missed Exams

There will be either point subtractions (if specified in the assignment rules) or no credit given (if not specified) for any assignments turned in after the deadline. For students that miss any assignments/exams for approved Institute activities and religious observances, separate arrangements will be made if proper documentation is provided. See <http://www.catalog.gatech.edu/rules/4/> for more information.

## Student-Faculty Expectations Agreement

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

**Student Use of Mobile Devices in the Classroom**

Lecture is a time when we all work together, so be courteous to your fellow students and do not disrupt class by entering and leaving the room, reading, talking, allowing cell phones to ring, etc. ***In addition, while in class, do not use your electronic devices (laptops, tablets, smartphones, etc.) for activities unrelated to class.***

**Campus Resources for Students**

In your time at Georgia Tech, you may find yourself in need of support. Below you will find some resources to support you both as a student and as a person.

**Academic Support**

Center for Academic Success <http://success.gatech.edu>

* + 1-to-1 tutoring <http://success.gatech.edu/1-1-tutoring>
  + Peer-Led Undergraduate Study (PLUS) <http://success.gatech.edu/tutoring/plus>
  + Academic coaching http://success.gatech.edu/coaching
* Residence Life's Learning Assistance Program

<https://housing.gatech.edu/learning-assistance-program>

* + Drop-in tutoring for many 1000 level courses
* OMED: Educational Services (<http://omed.gatech.edu/programs/academic-support>)
  + Group study sessions and tutoring programs
* Communication Center (<http://www.communicationcenter.gatech.edu>)
  + Individualized help with writing and multimedia projects
* Academic advisors for your major: <http://advising.gatech.edu/>

**Personal Support**

Georgia Tech Resources

* The Office of the Dean of Students: <http://studentlife.gatech.edu/content/services>; **404-894-6367**; Smithgall Student Services Building 2nd floor (you also may request assistance at <https://gatech-advocate.symplicity.com/care_report/index.php/pid383662?>
* Counseling Center: <http://counseling.gatech.edu>; 404-894-2575; Smithgall Student Services Building 2nd floor
  + Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention. Their website also includes links to state and national resources.
  + *Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at 404-894-2204.*
  + Students’ Temporary Assistance and Resources (STAR): <http://studentlife.gatech.edu/content/need-help> (can assist with interview clothing, food, and housing needs).
* Stamps Health Services: <https://health.gatech.edu>; 404-894-1420
  + Primary care, pharmacy, women’s health, psychiatry, immunization and allergy, health promotion, and nutrition
* OMED: Educational Services: <http://www.omed.gatech.edu>
* Women’s Resource Center:  <http://www.womenscenter.gatech.edu>; 404-385-0230
* LGBTQIA Resource Center:  <http://lgbtqia.gatech.edu/>; 404-385-2679
* Veteran’s Resource Center:  <http://veterans.gatech.edu/>; 404-385-2067
* Georgia Tech Police: 404-894-2500

**Statement of Intent for Inclusivity**

As members of the Georgia Tech community, we are committed to creating a learning environment in which all of my students feel safe and included. Because we are individuals with varying needs, we are reliant on your feedback to achieve this goal. To that end, I invite you to enter into dialogue with us about the things we can stop, start, and continue doing to make my classroom an environment in which every student feels valued and can engage actively in our learning community.