BIOS 4012: Protein Biology

Syllabus

3 credit class

TR 3:00 – 4:15 PM; Spring, 2018; Cherry Emerson 204

**Instructor Information**

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| Instructor | Email | Office Hours & Location |
| Prof. Yury Chernoff | [yury.chernoff@biology.gatech.edu](mailto:yury.chernoff@biology.gatech.edu) | Wed 1-2 PM, Krone EBB 5016 |

**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 course is co-taught with BIOL 8803CHE graduate class (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

## BIOS 1107 AND (BIOS 1107L OR BIOS 1207L) OR BIOL 1510 OR BIOL 1511, 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 (2010 or 2016) *Introduction to Protein Science: Architecture, Function, and Genomics.* 2d or 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 will typically 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 Objectives

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

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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**

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

NOTE: Final exam will be given in two formats (cumulative and non-cumulative), depending on the standings in the class. Details will be discussed closer to date.

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**

*This schedule is subject to change!*

Week 1: 01/09, 11 Genes and Proteins I, II

Week 2: 01/16 Translation Initiation I

01/18 Translation Initiation II / Translation Elongation and Termination I

Week 3: 01/23 Translation Elongation and Termination II

01/25 Ribosome Evolution (Guest Lecture – Prof. L. Williams)

Week 4: 01/30 Translation Elongation and Termination III

02/01 PTMs, Processing and Translocation

Week 5: 02/06 Protein Analysis

02/08 Proteomics and Interactomics

Week 6: 02/13 Discussion Session / Analysis of Protein Structure I

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

Week 7: 02/20 Analysis of Protein Structure II

02/22 Discussion Session / Protein Folding I

Week 8: 02/27 Protein Folding II

03/01 Chaperones and Degradation I

Week 9: 03/06 Chaperones and Degradation II

03/08 Mammalian Prions I

Week 10: 03/13 Mammalian Prions II / Amyloids I

03/15 Mass-Spectrometry Analysis of Proteins

(Guest Lecture – Prof. R. Wu)

Week 11: 03/20, 22 SPRING BREAK

Week 12: 03/27 When Destroying a Protein is a Good Thing

(Guest Lecture – Prof. K. Wilkinson)

03/29 **EXAM II** (Covers Lectures 11-19)

Week 13: 04/03 Amyloids II

04/05 Amyloids III

Week 14: 04/10 Amyloids IV

04/12 Protein-based Inheritance I

Week 15: 04/17 Phase Separation (Research Paper Discussion)

04/19 Paper Presentations

Week 16: 04/24 Protein-based Inheritance II / Concluding Remarks

Finals Week: Thu, 04/26, 2:50-5:40 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 Georgia Tech's 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.

## 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 no credit given for any assignments turned in after the deadline. Students that miss any assignments/exams for approved Institute activities and religious observances will be excused for any missed credit. 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.