Chem 601, Fall 2019

Protein Structure and Function

Mondays and Wednesdays, **2:00 - 3:15 pm**, Chem **170**

Instructor: Dr. Nicholas Silvaggi

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Office hours: By appointment

Prerequisites: Jr. status, grade of C or better in Chem 345 and 501, as well as Chem 560 or 562

Required Textbook: Textbook of Structural Biology ISBN: 978-9813142466
A. Liljas, L. Liljas, M.-R. Ash, G. Lindblom, P. Nissen, and M. Kjeldgaard

Optional Textbook: Lehninger, Principles of Biochemistry ISBN: 0-71677-108-X
6th ed; D. Nelson and M. Cox

Course Policies

University Policies located online at http://www.uwm.edu/Dept/SecU/SyllabusLinks.pdf
Lectures and other resources will be made available via the **D2L** system (https://uwm.courses.wisconsin.edu/)

Grading

Undergraduate: Two in-class exams*, each 45%
Class participation/written assignments, 10%

Graduate: Two in-class exams*, each 35%
One term paper, 30%, due Dec 12th (*no extensions will be given* – get started early!)

*Make-up exams will only be allowed under very limited circumstances (*e.g.* death of a close family member or illness requiring medical treatment). You must contact me first to make arrangements and suitable written proof must be provided. **DO NOT miss a test and expect to arrange a make-up afterward!** Small in-class and take-home assignments will be given periodically. Though they will not be graded, it is important to complete them because they are designed to help you (1) identify points you do not understand and (2) help you assimilate the information. I reserve the right to modify the grading scheme (*i.e.* these small assignments may be graded) if necessary. A new version of this syllabus will be distributed on the course web site in that event.

Attendance

It is expected that students will attend all lectures, observe basic courtesy, participate in discussions, and complete all assignments given.

Course Goals

By the end of this course you should know (1) how proteins are put together (*e.g.* building blocks, structural elements, forces involved in maintaining structure), (2) the different roles proteins play in living cells, (3) how these activities are regulated, (4) how we study protein structure and function (*i.e.* tools and techniques available).

Tentative lecture schedule

Basics of Protein Structure | Sep 4, 9, 11
Liljas, et al. Ch. 2, p. 11-35

- Introduction, PyMol, and the Protein Data Bank
- Properties of amino acids and the peptide bond
- Forces involved in protein folding
- Secondary structure (helices, sheets, and turns)

Folding, Folds, and Functions of Proteins | Sep 16, 18, 23, 25, 30
Liljas, et al. Ch. 3, p. 37-65

- Protein folding
- Tertiary structure
- Quaternary structure
- Amyloids

Membrane Proteins | Oct 2, 7, 9, 14
Liljas, et al. Ch. 4, p. 69-102

- Structure of helical membrane proteins
- Insertion of helical proteins into membranes
- Structure of β-Barrel membrane proteins
- β-Barrel insertion into membranes

Exam 1 | October 16

Enzymes | Oct 21, 23, 28, 30, Nov 4, 6
Liljas, et al. Ch. 8, p. 227-265

- Catalysis in carbonic anhydrase
- Transition state theory
- Ribonucleotide reductase and regulation
- Motor proteins and molecular switches
- Fatty acid synthase
- Methods for studying enzyme kinetics
- Enzyme inhibitors
- Non-Michaelis-Menton enzymes

Protein Folding and Degradation | Nov 11, 13, 18, 20
Liljas, et al. Ch. 12, p. 385-421

- Spontaneous vs assisted folding
- Molecular Chaperones
- Protein degradation

Transmembrane Transport | Nov 27, Dec 2
***No class on Monday 11/25**
Liljas, et al. Ch. 13, p. 425-449

- Membrane channels
- Primary active transporters: ABD transporters
- Secondary active transporters: antiporters and efflux pumps
- Symmporters

Signal Transduction | Dec 4, 9
Liljas, et al. Ch. 14, p. 451-479

- Signaling by cytokines
- The importance of protein-binding domains
- GPCR pathways
- Bacterial 2-component systems

Term Paper Due (GS) | December 11

(see next page for details)

Exam 2 | December 11

Graduate student research papers

Some possible topics for the research paper are listed below. You are by no means limited to these ideas, but it should not be *directly* related to your thesis project. Papers should be about 3,000 words (5-6 single-spaced pages), and should include figures (that *you make* using PyMol or a similar molecular graphics program; I do not want to see screen grabs from some pdf file!) and a proper bibliography (I do not have a preference for a particular format, as long as the citations are complete). **The focus should be how a protein's structure influences its function**. An outline of the paper will be due ~4 weeks into the course. Five weeks after that, a rough draft is due. The final draft of the paper is due on the last day of class.

Important dates:

September 18 — You must have chosen and confirmed your topic with me **VIA EMAIL** by the start of lecture.

October 2 — Complete outline due by the beginning of lecture; **WORD or PDF format submitted by EMAIL**.

November 6 — First draft due by the beginning of lecture; **WORD or PDF format submitted by EMAIL**.

December 11 — Final draft due by the beginning of Exam 2; **WORD or PDF format submitted by EMAIL**.

- **Do not miss these deadlines! You will lose 10 points off your term paper grade for each deadline you miss. No excuses will be accepted—you have plenty of time to plan!**

- Enzymes that use S-adenosyl methionine
- Methionine synthase
- Leprosy infection
- Penicillin-binding proteins
- Orotidine-5-monophosphate decarboxylase
- Prostaglandin synthase
- The alpha-keto acid dependent oxygenases
- Aldolases
- Virulence factors
- Novel receptor types
- Molecular machines (e.g. F1-ATPase)
- Glutathione-S-transferase type enzymes
- Analgesics and the COX enzymes
- The biosynthesis of thiamine
- The enzymes of tryptophan catabolism
- P450 hydroxylases
- Extradiol dioxygenases
- Other topics are welcome, but run them by me first.

Topics I need a break from: HIV protease, ricin, P-glycoprotein, ribonucleotide reductase, treatments for alcoholism, snake venom, DNA photolyase.