BB 481/581 Macromolecular Structure Fall 2015

Professor: Dr. Andrew Karplus, 2101B ALS (karplusp@science.oregonstate.edu)

Required Text: Selected *Karplus Chapters* and other assigned readings

Recommended Text: *Principles of Physical Biochemistry, Ed 2* by van Holde, Johnson, & Ho

Course Hours: M,W,F 1:00 - 1:50 p.m. in ALS 2018

Office Hours: By appointment

Course summary: This course provides an introduction to structural biology, the discipline focused on understanding the structural properties of biological macromolecules – especially proteins and nucleic acids – and relating them to their function. The course introduces students to the vocabulary and tools of this discipline, covering both the fundamental physico-chemical principles governing the structure and function of biological macromolecules and a selected set of widely used experimental and theoretical approaches to their characterization. This is done through lectures, and textbook and literature readings. Graduate students receive additional experience in scientific reading, writing and presentation through a literature-based term project.

Targeted learning outcomes: Through taking this course, successful students will:

1. Understand the breadth of the discipline of structural biology and the importance of knowing molecular structure for understanding mechanism in biology.
2. Acquire the technical language for techniques used in structural biology and be able to recall key elements of these techniques, including the concepts behind the experiments and the types of results obtained.
3. Understand the fundamental thermodynamic principles governing protein and nucleic acid folding and stability as well as molecular recognition
4. Be able to apply the above concepts with the principles of logic to solve realistic, specific problems in structural biology and to understand and critically evaluation research papers in this field.

Grading:

BB481:
33 % Exam 1 (Mon Oct 26)
33 % Exam 2 (Mon Nov 23)
33 % Final exam (Take home due Wed Dec 9 by noon)

BB581:
25% Exam 1 (Mon Oct 26)
25% Exam 2 (Mon Nov 23)
25% Term project
25% Final exam (Take home due Wed Dec 9 by noon)

Grades will be assigned according to the following absolute scale:
A: 80 - 100 ; B: 65 - 80 ; C: 50 - 65 ; D: 35 - 50 ; F: <35
with +/- given for the top or bottom two percentage points in each range.
The cutoffs may be lowered but will not be raised.

Course Outline:

I. Basic Concepts of Macromolecular Structure (PPB Ch. 1; Karplus Ch $2A_{1\text{-}3,5}$; $D_{0\text{-}1,3ab}$)
II. Structure Determination by X-ray Crystallography (PPB Ch. 6; Karplus Ch. 3)
III. Structure Determination by NMR Spectroscopy (PPB Ch. 12; Karplus Ch. 3)
IV. Molecular Thermodynamics (PPB Ch. 2, 3, 4.1; Karplus Ch. 5, 2, $6_{9\text{-}11}$)
V. Protein Energy Landscapes and Hydrogen Exchange (PPB pp 684-90; Karplus Ch. $6_{A,D,E}$)
VI. Mass Spectrometry (PPB Ch. 15)
VIII. Spectroscopy (PPB Ch. 9, 10, 11)
IX. Single Molecule Methods (PPB Ch. 16)

GENERAL OSU AND DEPARTMENTAL POLICIES

Please note: "Students with documented disabilities who may need accommodations, who have any emergency medical information the instructor should know, or who need special arrangements in the event of evacuation, should make an appointment with the instructor as early as possible, no later that the first week of the term. In order to arrange alternative testing, the student should make the request at least one week in advance of the test. Students seeking accommodations must be registered with the Office of Services for Students with Disabilities."

Oregon State University strives to respect all religious practices. If you have religious holidays that are in conflict with any of the requirements of this class, please see me immediately so that we can make alternative arrangements.

The Department of Biochemistry/Biophysics follows the university policies on student conduct. These can be found at **http://oregonstate.edu/admin/stucon/regs.htm**.

Cheating or plagiarism by students is subject to the disciplinary process outlined in the Student Conduct Regulations. Students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in one of the following areas:

* cheating- use or attempted use of unauthorized materials, information or study aids
* fabrication- falsification or invention of any information
* assisting- helping another commit an act of academic dishonesty
* tampering- altering or interfering with evaluation instruments and documents
* plagiarism- representing the words or ideas of another person as one's own

Behaviors disruptive to the learning environment will not be tolerated and will be referred to the Office of Student Conduct for disciplinary action.

The goal of Oregon State University is to provide students with the knowledge, skill and wisdom they need to contribute to society. Our rules are formulated to guarantee each student's freedom to learn and to protect the fundamental rights of others. People must treat each other with dignity and respect in order for scholarship to thrive. Behaviors that are disruptive to teaching and learning will not be tolerated, and will be referred to the Student Conduct Program for disciplinary action. Behaviors that create a hostile, offensive or intimidating environment based on gender, race, ethnicity, color, religion, age, disability, marital status or sexual orientation will be referred to the Affirmative Action Office.

BB-581 Term Project (Fall 2015)

Each student must choose and have approved an original scientific publication that will be the subject of their term project. *The publication must be a primary report published within the last five years of a theoretical or experimental biophysical study of a protein or nucleic acid molecule using one or more of the methods covered in this course.* The article chosen must have an explicit and informative methods section (either in the article or as supplementary material that is available). The project will result in a short written report due during week 10 of classes.

The written report must be in your own words and be <3 pages single-spaced explicitly organized as follows:

1) *Introduction* (1 paragraph) - Includes what questions the researchers were hoping to answer in this study, why is that of interest, and a briefly what strategies were used to obtain the answers.
2) *Key methods (1-5 paragraphs)* - This section includes a description of each key method used, the principles behind it, what is assumptions are and what it can deliver. This section IS NOT a summary of what experiments were done or how they were done; rather, it is an explanation in your own words of the principles behind the approaches used and what information they deliver. Focus on the molecular biophysics approaches only; cloning, protein expression and protein purification, etc experiments should be skipped.
3) *Key results (1 paragraph)* - This section is a brief fairly technical description of the basic results reported by the authors (not their interpretation or your interpretation!)
4) *Interpretation and Conclusions (1 paragraph)* - This section is a brief summary of the substantive conclusions reported by the authors (not the results and not your opinions!)
5) *Critique (3 paragraphs)*- This is your opinion of the work in terms of strengths and weaknesses and value. Focus the first paragraph on strengths and things you agree with, the second on weaknesses and the third on your opinion about the work.
6) *References* (not counted in page limits) - References should be kept to a minimum, but references from which specific information was used must be referred to in the text and included in a single spaced bibliography. References used to help you understand methods do not need to be cited. In the text, references should be inserted in the form of numbers in square brackets [#], with references numbered in the order of appearance. The following simple format for scientific journals articles should be used (Authors (year) "article title" *Stndrd. J. Abbrev.* **Volume**, first-last pages.:
    1. Pearson, M.A., Schaller, R.A., Michel, L.O., Karplus, P.A. & Hausinger, R.P. (1998) "Chemical rescue of *Klebsiella aerogenes* urease variants lacking the carbamylated lysine nickel ligand" *Biochemistry* **37**, 6214-6220.
7) *Figures* - One optional page with drawn or photocopied/scanned (give citation) figures you refer to in your text that are not in the original article. This page does not count toward the page limits.

Deadlines and Details:

1. The written report **must** be ≤3 pages single-spaced and typed in 12 point Times, Times New Roman, or in 11 point Arial font.
2. By *Friday Oct.* 30th *@ 3 p.m.* an **approved** paper must be chosen and a paper copy given to me.
3. The written report is due by *Wednesday December 2nd @ 4:30 p.m.* The completed paper may be submitted to me or to the BB receptionist. Late papers will lose 15 points per day.

Grading: The project will be worth 100 points assigned as follows:

- 5 for meeting *Nov.* 1st deadline for paper selection (all or none);
- 95 for the written report 10, 30, 15, 15, and 15 for sections 1-5 above respectively and 10 for overall grammar and style.