BB481 / 581 Molecular Biophysics I: Macromolecular Structure Fall 2016

Instructor	Dr. Victor Hsu 2143 Ag. Life Sci. Bldg. (ALS) (541) 737–4398 ; hsuv@onid.orst.edu
Day, Time and Location	Mondays, Wednesdays & Fridays 1:00 – 1:50 pm, LInC 268 Office Hours: Tuesdays & Thursdays 1:00 – 1:50 pm, ALS 2143 (office)
Course Objectives	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 physicochemical 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.
Learning Resources	Assigned readings and articles from the literature. Recommended Text and Readings: *"Principles of Physical Biochemistry, 2nd Ed."* by van Holde, Johnson, and Ho *"Envisioning Information"*, "*The Visual Display of Quantitative Information"*, "*Visual Explanations: Images and Quantities, Evidence and Narrative"*, "*The Cognitive Style of PowerPoint"*, *"Beautiful Evidence"* by Edward Tufte "*Entropy and Art"*, *"Visual Thinking"* by Rudolf Arnheim *"The Elements of Graphing Data"*, *"Visualizing Data"* by William Cleveland *"Data Points"*, *"Visualize This"* by Nathan Yau BB Departmental and CGRB Seminars, alternate Wednesday, 3:30 – 4:30pm, ALS 4001
Course Policies	Prerequisites: BB 450 / 550 or BB 490 / 590 Incompletes: Take this course only if you plan to finish it in a timely manner (during this term). An "Incomplete" will only be given when there is a strong and compelling case for doing so (e.g., health reasons, military commitment).

Learner Outcomes	When confronted with a biochemical phenomenon, students should be able to rationalize how to examine, model, and analyze the system and effectively communicate the results. 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. (BB 481/581) 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. (BB 481/581) 3) Understand the fundamental thermodynamic principles governing protein and nucleic acid folding and stability as well as molecular recognition. (BB 481/581) 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 evaluate research papers in this field. (BB 481/581) 5) Intelligently analyze, interpret and appraise the soundness of the findings obtained (which involves being able to make basic order-of-magnitude estimates). (BB 581) 6) Demonstrate the ability to produce quality critical analysis. (BB 581) *N.B.* Actually, everyone should be able to examine, model, analyze and effectively communicate all their observations and experiences!
Learner Expectations	First and foremost, I expect everyone to respect one another. Among other things, this means that only one person speaks at a time, no cell phone usage in class, and that each of you put forth an honest effort in class. Arrive to class on time every day, prepared and with all necessary materials, ready to discuss the topic for the day. I hope that this class will be very active and expect each of you to participate as much as possible. Don't be afraid to ask questions or make mistakes – both are key in helping you understand the subject material. This course will require you to spend time each week reading the assigned material and participating in classroom discussions.

Course Evaluation	Fulfillment of the student learning outcomes will be assessed through three exams, and in the case of BB 581 an additional written assignment, as follows:

	BB 481	BB 581
Exam #1 (Friday, October 14th)	33 %	25 %
Exam #2 (Wednesday, November 9th)	33 %	25 %
Final Exam #3 (Take home, due by noon Tues, Dec 6th)	33 %	25 %
Term Project (BB 583 only, due by noon Wed, Nov 30th)	–	25 %

Term Project (BB 581)

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 recently published primary report of a theoretical or experimental biophysical study of a biomacromolecule 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 the last week of the class.

The written report must be in your own words and be explicitly organized as follows:

1) *Introduction* (1 paragraph) – Includes what questions the researchers were hoping to answer in this study (the hypothesis they were testing), why is that of interest, and (briefly) the strategies that they used to obtain the results.
2) *Key methods (1-5 paragraphs)* – This section includes a description of each key method used, the principles behind it, what assumptions are made and what information can be obtained. 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. 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 format of the cited references should follow the APA (American Psychological Association) format.

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 no more than 3 pages single-spaced and typed in 12 point Times, Times New Roman, or 11 point Arial font.
2) Your chosen paper must be approved by 3 pm, Friday October 28th, and a paper copy is to be provided to me.
3) The written report is due by noon, Wednesday November 30th. The completed paper is to be submitted via the course's Canvas website. Late papers will be deducted 15 points/day.

Grading: The project will be worth 100 points, distributed as follows:

- 5 points for meeting the October 28th deadline for paper selection (all or none);
- 95 points for the written report. 10, 30, 15, 15, and 15 points for sections 1–5, respectively, and 10 points for overall grammar and style.

Outline of Schedule

	Readings	
Topic	van Holde, *et. al.*	Karplus
Basic concepts of macromolecular structure	Chap. 1	Chap. 2
Structure determination by x-ray crystallography	Chap. 6	Chap. 3
Structure determination by NMR spectroscopy	Chap. 12	Chap. 3
Molecular thermodynamics	Chaps. 2, 3, 4.1	Chaps. 5, 2, 6
Protein energy landscapes and hydrogen exchange	Pgs. 684-690	Chap. 6
Mass spectrometry	Chap. 15	–
Optical spectroscopy	Chaps. 9, 10, 11	–
Single molecule methods	Chap. 16	–

Statement Regarding Students with Disabilities	Please note: "Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations."
University Rules on Civility and Honesty	The University statement on student conduct and community standards can be found at: http://studentlife.oregonstate.edu/studentconduct/offenses-0. *Cheating or plagiarism by students is subject to the disciplinary process outlined in the Statement of Expectations for Student Conduct.* 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."*