BC512: Principles of Macromolecular Structure **Fall, 2020**

Instructor: Professor Robert Cohen
Office hours and location: Tuesdays, 1:00 – 2:00 PM (or by appointment) video chat
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Class hours & location: Tuesdays 9:00 – 9:50 AM
The first class on 8/25 will meet in A/Z E210, but subsequent classes will meet online (details will be discussed on 8/25 and posted on Canvas)

Course description: The objective of this course is to introduce modern methods for studying the structure, function, and solution behavior of macromolecules. The course is taught in a one-hour session each week and will combine lectures to introduce concepts with readings of scientific literature to provide case studies. Critical evaluation of experimental design and results in research papers will be emphasized.

BC512 is being taught in parallel with Physical Biochemistry (BC411), which is a prerequisite/co-requisite for the course. The course will require knowledge of fundamental concepts in physical chemistry and their application to understanding the behavior of biological systems, including basic principles of protein structure, thermodynamics, structure determination by NMR and crystallography, biochemical equilibria, reaction rates and kinetics, and spectroscopy.

Outcomes: Students in BC512 are expected to develop an appreciation of macromolecular structure-function relationships and an understanding of many of the biophysical techniques commonly used to study macromolecular structure and function.

Assessment: Students will read primary scientific research papers and explain the experimental methods and results in a group setting, as well as discuss issues raised during the class.

Grading: Students will be graded on how well discussions of assigned papers are led (25%), participation in discussions during the entire semester (during both lectures and discussions, 50%), and homework problems (25%).

Discussion Leaders (1 – 2 students per paper) are responsible for:

1. meeting with Dr. Cohen during the week prior to their assigned Discussion date to discuss the assigned paper
2. developing a list of points for class discussion following presentations of the results (i.e., presentations of the paper's figures, tables, etc)
3. introducing the paper by presenting relevant background material and explaining why the study is significant; leading discussion and answering questions during class (including important principles not covered in class)

The points identified for discussion (#2 above) need to be sent by the Discussion Leaders to Dr. Cohen to post on CANVAS by 5:00 PM on the Friday PRIOR to the discussion on Tuesday of the following week (*e.g.*, Discussion #1 discussion points will be posted on 9/4 for in-class discussion on 9/8). ***All students are responsible for reading the assigned papers and should be ready to present and discuss any of the results in the paper***.

Text: There is no required text for this course. Some material will be posted on the Canvas system, and students are expected independently to seek out other sources as necessary.

Important: All students should fill out a student-specific symptom checker each day before coming to class (https://covidrecovery.colostate.edu/daily-symptom-checker/). ***For BC512, that tentatively only will be on Aug. 25.*** In addition, please utilize the symptom

checker to report symptoms, if you have a positive test, or exposed to a known COVID contact. If you know or believe your have been exposed or are symptomatic, it is important for the health of yourself and others that you report it through this checker. You will not be in trouble or penalized in any way for reporting. If you report symptoms or a positive test, you will receive immediate instructions on what to do and CSU's Public Health Office will be notified. Once notified, that office will contact you and most likely conduct contact tracing, initiate any necessary public health requirements and/or recommendations and notify you if you need to take any steps. For the latest information about the University's response and guidelines for students, visit the **CSU COVID-19 site** (https://covidrecovery.colostate.edu/).

Tentative schedule

Date	Topic	Discussion papers (tentative)
8/25	Course introduction	— — —
9/1	*Protein Love-In:* Quantitative assays of protein	— — —
9/8	*Lecture:* Diffusion, FRAP, and correlation spectroscopy	— — —
9/15	*Discussion #1:* Single-cell protein quantitation	Wu & Pollard 2005, *Science*
9/22	*Lecture:* FRAP; liquid-liquid phase separation (LLPS)	— — —
9/29	*Discussion #2:* Dipeptide repeats and LLPS	Lee et al. 2016, *Cell*
10/6	*Lecture:* Single-molecule force measurements	— — —
10/13	***Lecture:* Single-molecule fluorescence applications	— — —
10/20	***Discussion #3: TBA*	— TBA —
10/27	*Lecture:* Mass spectrometry and proteomics I	— — —
11/3	*Lecture:* Mass spectrometry and proteomics II	— — —
11/10	*Discussion #4:* Quantitative analyses of ribosome inventory	An *et al.* 2020, *Nature*
11/17	*Lecture: TBA*	— — —
11/24	No class (Fall break)	— — —
12/1	*Lecture:* H/D-exchange ("HX") in proteins	— — —
12/8	*Discussion #5:* HX of chaperone-assisted folding	Ye *et al.* 2018, *PNAS*

* *Prof. Grant Schauer, guest lecturer/discussion moderator*

The list below is tentative. It will be updated with Discussion Leader assignments and possibly revised papers — new version(s) will be posted on Canvas.

Discussion Paper	Discussion Leaders

1. Wu & Pollard 2005, *Science*
   Counting cytokinesis proteins globally and locally in fission yeast
2. Lee et al. 2016, *Cell*
   C9orf72 Dipeptide Repeats Impair the Assembly, Dynamics, and Function of Membrane-Less Organelles
3. *TBA*
4. An *et al.* 2020, *Nature*
   Systematic quantitative analysis of ribosome inventory during nutrient stress
5. Ye *et al.* 2018, *PNAS*
   Folding of maltose binding protein outside of and in GroEL