BC512: Principles of Macromolecular Structure **Fall, 2022**

Instructor: Professor Robert Cohen
Class hours & location: Tuesdays 9:00 – 9:50 AM; classes will meet in **Walnut 111**
Office hours and location: Tuesdays, 10:00 – 11:00 AM (or, preferably, by appointment); MRB 273
E-mail: bob.cohen@colostate.edu

Course description: The objective of this course is to introduce modern methods for studying the structure, function, and behavior of macromolecules. The course is taught in a one-hour session each week and will combine lectures to introduce concepts with readings and discussions 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, 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. There will be short in-class quizzes or take-home assignments.

Grading: Students will be graded on how well discussions of assigned papers are led (25%) and quizzes/homework problems (75%).

Discussion Leaders (generally, 2-3 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. leading class discussion about specific elements of the paper (i.e., figures and tables; these will be pre-assigned) during 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. ***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.

Tentative schedule

Date	Topic	Papers	Discussion Moderators
8/23	Course introduction	— — —	
8/30	*Protein Love-In:* Quantitative assays of protein	— — —	
9/6	*Lecture:* Diffusion, fluctuations, and correlation spectroscopy	— — —	
9/13	*Lecture on FCS & Discussion #1:* Fluorescence-	Wu & Pollard 2005, *Science;*	

	based single-cell protein quantitation	Politi et al. 2018, *Nat. Protoc.*	
9/20	*Discussion #1b:* Fluorescence-based single-cell protein quantitation	Wu & Pollard 2005, *Science;* Politi et al. 2018, *Nat. Protoc.*	
9/27	*Lecture:* Mass spectrometry and proteomics	— — —	
10/4	*Lecture:* Quantitation in mass spectrometry	— — —	
10/11	*Discussion #2:* Protein inventory at loops and TADS (I)	Holzman et al. 2019, *eLife*	
10/18	*Discussion #3:* Protein inventory at loops and TADS (II)	Cattoglio et al. 2019, *eLife*	
10/25	*Lecture:* Proximity labeling assays	— — —	
11/1	*Discussion #4:* TBA	TBA	
11/8	*Lecture: Protein architecture by chemical crosslinking*	— — —	
11/15	*Discussion #5:* In-cell crosslinking analysis of a transcription-translation supercomplex	O'Reilly *et al.* 2020, *Science*	
11/22	No class (Fall break)	— — —	
11/29	*Lecture:* H/D-exchange ("HX") in proteins	— — —	
12/6	*Discussion #6:* HX of chaperone-assisted folding	Ye *et al.* 2018, *PNAS*	

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

Discussion Paper	Discussion Leaders

1. Wu & Pollard 2005, *Science*
https://science.sciencemag.org/content/sci/310/5746/310.full.pdf
Counting cytokinesis proteins globally and locally in fission yeast

Politi *et al.* 2018, *Nature Protocols*
https://www.nature.com/articles/nprot.2018.040.pdf
Quantitative mapping of fluorescently tagged cellular proteins using FCS-calibrated four-dimensional imaging

2. Holzman *et al.* 2019, *eLife*
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6606026/pdf/elife-46269.pdf
Absolute quantification of cohesin, CTCF and their regulators in human cells

3. Cattoglio et al. 2019, *eLife*
https://elifesciences.org/articles/40164
Determining cellular CTCF and cohesion abundances to constrain 3D genome models

4. To be announced

5. O'Reilly *et al.* 2020, *Science*
https://science.sciencemag.org/content/sci/369/6503/554.full.pdf
In-cell architecture of an actively transcribing-translating expressome

6. Ye *et al.* 2018, *PNAS*
https://www.pnas.org/content/pnas/115/3/519.full.pdf
Folding of maltose binding protein outside of and in GroEL

Academic Integrity & CSU Honor Pledge; Student Accommodations

This course will adhere to the CSU Academic Integrity/Misconduct policy as found in the General Catalog and the Student Conduct Code.

If you are a student who will need accommodations in this class, please contact me to discuss your individual needs. Any accommodation must be discussed in a timely manner. A verifying memo from The Student Disability Center may be required before any accommodation is provided.

Students seeking an exemption from attending class or completing assigned course work for a religious holiday will need to fill out the Religious Accommodation Request Form and turn it in to the Division of Student Affairs, located on the second level of the Administration building. Once turned in, the Division of Student Affairs will review the request and contact the student accordingly. If approved, the student will receive a memo from the Dean of Students to give to their professor or course instructor.

COVID-19

All students are expected and required to report any COVID-19 symptoms to the university immediately, as well as exposures or positive tests (even home tests).

- If you suspect you have symptoms, or if you know you have been exposed to a positive person or have tested positive for COVID (even with a home test), you are required to fill out the COVID Reporter (https://covid.colostate.edu/reporter/).
- If you know or believe you have been exposed, including living with someone known to be COVID positive, or are symptomatic, it is important for the health of yourself and others that you complete the online COVID Reporter. Do not ask your instructor to report for you.
- If you do not have internet access to fill out the online COVID-19 Reporter, please call (970) 491-4600.
- You may also report concerns in your academic or living spaces regarding COVID exposures through the COVID Reporter. You will not be penalized in any way for reporting.
- When you complete the COVID Reporter for any reason, the CSU Public Health Office is notified. Students who report symptoms or a positive antigen test through the COVID Reporter may be directed to get a PCR test through the CSU Health Network's medical services for students.

For the latest information about the University's COVID resources and information, please visit the CSU COVID-19 site: https://covid.colostate.edu/.