

BCH 6740 – STRUCTURAL BIOCHEMISTRY (BCH 6746, BCH 6747 and BCH 7515) – Spring 2023 –

Class Time: Period 4, 10:40 - 11:30 am, on Monday, Tuesday, Wednesday and Friday (with exceptions)

Class Location: Room R3-265 located on the third floor above ground level in the Academic Research Building (<https://campusmap.ufl.edu/#/index/0201>). **Lectures will not be recorded.**

Course Coordinator: Thomas H. Mareci, Ph.D.

Instructors:

Linda B. Bloom	lbloom@ufl.edu	352-294-8379
Joanna R. Long	jrlong@mbi.ufl.edu	352-294-8399
Thomas H. Mareci	thmareci@ufl.edu	352-273-5348
Robert McKenna	rmckenna@ufl.edu	352-294-8395
Mario Mietzsch	mario.mietzsch@ufl.edu	352-213-4182
Daniel L. Purich	dlpurich@ufl.edu	352-294-8400
Craig Vander Kooi	craig.vanderkooi@ufl.edu	352-294-8386

Office Hours: Contact individual instructors to arrange office hours.

Course Objectives: BCH 6740 is a 3-hour course that presents theoretical and practical aspects of structural biology and biophysical chemistry of biological molecules, and techniques for their study. The three 1-hour parts of this course are taught individually as BCH 6746 (Part A of BCH 6740), BCH 6747 (Part B of BCH 6740), and BCH 7515 (Part C of BCH 6740). Students taking all three parts should register for BCH 6740. The course is for graduate students and well-prepared undergraduates with interests in biochemistry, molecular and cellular biology, pharmacology, microbiology and cell science, chemistry, physics, plant sciences, and chemical engineering. Also, this course constitutes one of the three core courses in the Department of Biochemistry and Molecular Biology.

Prerequisites: Students should have completed undergraduate courses in chemistry and physics, or the equivalent, and organic chemistry is highly recommended as preparation for this course. Calculus is used throughout, so students should have completed a course in calculus or the equivalent.

Recommended textbooks and study materials: **Notes for all lectures are provided in UF eLearning.** Information about recommended textbooks and study materials is provided for each section of the course in the course schedules below.

BCH 6746; Structure of Biological Molecules

This course provides detailed information about the basic elements of biological macromolecular structure with emphasis on current understanding the dynamics of protein folding, and protein-protein and protein-nucleic acid structure motifs.

Course Coordinator for BCH 6746: **Robert McKenna, Ph.D.**

BCH 6747; Biophysical Methods for Structure Determination

This course focuses on the application of biophysical techniques (circular dichroism, fluorescence, nuclear magnetic resonance, X-ray crystallography) used to determine the structure of biological macromolecules and biophysical techniques for determining macromolecular properties, including ultracentrifugation and mass spectroscopy, and methods of molecular separation. Also hydrodynamic approaches to understand molecular properties are presented, including molecular diffusion, viscosity.

Course Coordinator for BCH 6747: **Thomas H. Mareci, Ph.D.**

BCH 7515; Kinetics and Thermodynamics

This course provides information about the fundamentals of chemical kinetics and thermodynamic analysis of equilibria. Emphasis is placed on the application of this knowledge to understanding basic enzyme kinetics, pulse-chase kinetics, protein polymerization, DNA dynamics, protein-nucleic acid interactions and cooperative ligand binding.

Course Coordinator for BCH 7515: **Daniel L. Purich, Ph.D.**

Class Attendance, Preparation and Make-up Exams: Class attendance is not required, but students who do not attend class will miss important discussion provided during the class period. Students should come to class prepared to interact and ask questions. **ABSENCE FROM SCHEDULED EXAMS IS STRONGLY DISCOURAGED.** Verifiable medical excuses are accepted, and a make-up exam will be arranged.

Grading: The grade for each part [BCH 6740, Part A (BCH 6746); BCH 6740, Part B (BCH 6747); BCH 6740, Part C (BCH 7515)] is based on the test score for that section. There is no comprehensive final exam on Parts A, B & C. Overall grade for BCH 6740 is based on test scores for each section (Lowest score will be given one-half the weight of the two higher scores). Letter grades and grade points are assigned according to University policy (<https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies> and <http://handbook.aa.ufl.edu/teaching/policies>).

Accommodations for Students with Disabilities: Students with disabilities, who experience learning barriers and would like to request academic accommodations, should contact the Disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. Then students should share their accommodation letter and discuss their access needs with their instructor early in the semester

Online Course Evaluation: Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via **GatorEvals**. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from **GatorEvals**, in their Canvas course menu under **GatorEvals**. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

Campus Resources:

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learningsupport@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Student Complaints: <https://ombuds.ufl.edu/student>

Complaints Filing Options: <https://hr.ufl.edu/manager-resources/employee-relations/employee-inquiry-and-complaint-procedures/complaint-filing-options/>

Health and Wellness

Your well-being is important to the University of Florida. The U Matter, We Care initiative (<http://www.umatter.ufl.edu>) is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-294-CARE. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing Staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

U Matter, We Care (<http://www.umatter.ufl.edu/>): If you or a friend is in distress, please contact umatter@ufl.edu or 352-294-CARE so that a team member can reach out to the student.

Counseling and Wellness Center (<http://www.counseling.ufl.edu>) at 352-392-1575), **Kognito** (<https://counseling.ufl.edu/resources/kognito/>), and the University Police Department: 352-392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services Contact U Matter, We Care (http://www.umatter.ufl.edu/sexual_violence): or Student Health Care Center, 352-392-1161.

University Police Department (<http://www.police.ufl.edu/>), 352-392-1111 (or 9-1-1 for emergencies).

Course Schedule

Part A (BCH 6746: Structure of Biological Molecules)

Recommended Text: *Protein Structure and Function*, G. A. Petsko and D. Ringe,

Lecture	Day	Date	Lecturer	Title
L-1	F,	1/13	Long	Protein chemistry and thermodynamic hypothesis
	M,	1/16		No lecture
Holiday --- Rev. Dr. Martin Luther King Jr. Memorial --- Monday, January 16				
L-2	T,	1/17	Long	Protein structure: thermodynamics and secondary structure
L-3	W,	1/18	Long	Protein structure: Tertiary structure patterns and resolution
L-4	F,	1/20	Long	Protein structure: Proteomics, PDB, bioinformatics
L-5	M,	1/23	Long	Protein structure: Quaternary interactions and protein assemblies
L-6	T,	1/24	Long	Membrane proteins: Lipids, protein partitioning, ion channels
L-7	W,	1/25	Long	Membrane proteins: GPCRs, sample preparation techniques
L-8	F,	1/27	Long	Protein folding: Basic concepts, experiments and computation
L-9	M,	1/30	Long	Protein folding: Computational approaches, applications of MD
L-10	T,	1/31	Long	Intrinsically disordered proteins
L-11	W,	2/01	Long	Liquid-liquid phase separation and protein regulation
L-12	F,	2/03	Long	Protein engineering – designed proteins
L-13	M,	2/06	McKenna	Protein Structure: DNA binding proteins
L-14	T,	2/07	McKenna	Protein Structure: RNA binding proteins
L-15	W,	2/08	McKenna	Protein Structure: Icosahedral viruses
Review	F	2/10	All Instructors	Review will cover L-1 through L-15
Exam-1	M,	2/13	BCH 6746 and Part A of BCH 6740 Monday evening, 6:00-8:00 pm	

Part B (BCH 6747, Biophysical Methods of Structure Determination)

Recommended textbooks: *Physical Biochemistry: Principles and Applications*, D. Sheehan
Biophysical Chemistry, C. Cantor & P. R. Schimmel

Lecture	Day	Date	Lecturer	Title
L-16	T,	2/14	Mareci	Molecular diffusion & viscosity
L-17	W,	2/15	Mareci	Ultracentrifugation
L-18	F,	2/17	Mareci	NMR: Chemical Shifts and Spin Coupling
L-19	M,	2/20	Mareci	NMR: Molecular Assignment
L-20	T,	2/21	Mareci	NMR: Relaxation and Molecular Dynamics
L-21	W,	2/22	McKenna	X-ray crystallography: Crystallization and diffraction
L-22	F,	2/24	McKenna	X-ray crystallography: Bragg's law, Fourier transform
L-23	M,	2/27	McKenna	X-ray crystallography: Phase problem and structural refinement
L-24	T,	2/28	McKenna	Neutron/X-ray free-electron laser structural biology
L-25	W,	3/01	Mietzsch	Cryo-electron microscopy: Sample preparation and 2D imaging
L-26	F	3/03	Mietzsch	Cryo-electron microscopy: 3D image reconstruction
L-27	M,	3/06	Vander Kooi	Structure Prediction: AlphaFold
L-28	T,	3/07	Vander Kooi	Mass Spectrometry: Structural applications
L-29	W,	3/08	Vander Kooi	Mass Spectrometry: Dynamics by HDX
L-30	F,	3/10	Bloom	UV/VIS absorption and CD spectroscopy

M-F, 3/13 – 3/17 **No lecture (Spring Break)**

Review	M,	3/20	All Instructors	Review will cover L-16 through L-30
Exam-2	W,	3/22	BCH 6747 and Part B of BCH 6740 Wednesday evening 6:00-8:00	

Part C (BCH 7515, Kinetics and Thermodynamics)

Study materials are provided free to all enrolled students.

Lecture	Day	Date	Lecturer	Title
L-31	F,	3/24	Bloom	Fluorescence spectroscopy
L-32	M,	3/27	Bloom	Measuring kinetics with absorption and fluorescence spectroscopy
L-33	W,	3/29	Purich	Introduction to Kinetics
L-34	F,	3/31	Purich	Chemical Kinetics: Measuring 1st, 2nd & pseudo-1st order reaction
L-35	M,	4/03	Purich	Chemical Kinetics: Understanding bimolecular rate processes
L-36	T,	4/04	Purich	Chemical Kinetics: Rapid-equilibrium <i>versus</i> Steady-state processes
L-37	W,	4/05	Purich	Basic Enzyme Kinetics: One-substrate enzyme reactions
L-38	F,	4/07	Purich	Basic Enzyme Kinetics: Two- & Three-substrate enzyme reactions
L-39	M,	4/10	Purich	Basic Enzyme Kinetics: Reversible & Product inhibition
L-40	T,	4/11	Purich	Basic Enzyme Kinetics: Distinguishing multi-substrate mechanisms
L-41	W,	4/12	Purich	Basic Enzyme Kinetics: Multi-substrate & Transition-state inhibitors
L-42	F,	4/14	Purich	Basic Enzyme Kinetics: Isotope exchange reactions
L-43	M,	4/17	Purich	Protein-Ligand Interactions: Enzyme Allostereism & Hysteresis
L-44	T,	4/18	Purich	Biochemical Kinetics: Metabolic pathways
L-45	W,	4/19	Purich	Biochemical Kinetics: Metabolite channeling
Review	F,	4/21	Bloom & Purich	Review will cover L-31 through L-45
Exam-3	M,	4/24	BCH 7515 and Part C of BCH 6740 Monday Evening, 6:00-8:00 pm	