

Biology 5357: Chemistry & Physics of Biomolecules**Fall 2018**

Class Meetings: Monday-Wednesday-Friday, Lecture, 12:00-1:00 pm, FTLC 204
Thursday, Discussion Section, 3:00-4:00 pm, McDonnell 264

Coursemaster: Jay Ponder (Louderman 453, 935-4275, ponder@dasher.wustl.edu)

Instructors: Greg Bowman (South 2915, 362-7433, g.bowman@wustl.edu)
Eric Galburt (McDonnell 251, 362-5201, egalburt@wustl.edu)
Kathleen Hall (North 2816, 362-4196, hallkathleen@wustl.edu)
Janice Robertson (McDonnell 223, 273-1682, janice.robertson@wustl.edu)
Andrea Sorranò (South 2913, 273-1632, soranno@wustl.edu)
John-Stephen Taylor (Lab Sciences 401A, 935-6721, taylor@wustl.edu)
Rui Zhang (McDonnell 253, 273-1663, zhangrui@wustl.edu)

Graduate Asst: Matthew Cruz (McDonnell 253, 362-7424, matthewcruz@wustl.edu)

Web Site: <https://dasher.wustl.edu/bio5357/>

Objectives: Biology 5357 explores the physicochemical basis for the structural integrity, thermodynamic properties and biological functions of proteins, nucleic acids, membranes and carbohydrates.

Exams: There will be three 1-hour exams as indicated in the schedule below. Each exam will cover an individual module of the course material.

Discussions: Required weekly discussion sections will each cover a pre-assigned article complementary to the lecture topics. Students will be expected to participate in the sections, and turn in a one-page critique of each discussion article.

Textbooks: There are no required texts, but the following books may be useful:

Textbook of Structural Biology, 2nd Edition, Liljas, *et al.*, 2016
The Molecules of Life, Kuriyan, Konforti & Wemmer, 2013
Introduction to Protein Structure, 2nd Edition, Branden & Tooze, 1999
Protein Actions: Principles and Modeling, Behar, Jernigan & Dill, 2017
Protein Physics, 2nd Edition, Finkelstein & Ptitsyn, 2016
Principles of Nucleic Acid Structure, Neidle, 2007
The Biophysical Chemistry of Nucleic Acids & Proteins, Creighton, 2010
Membrane Structural Biology, Luckey, 2008
Introduction to Glycobiology, 3rd Edition, Taylor & Druckamer, 2011
Essentials of Glycobiology, 3rd Edition, Varki, *et al.*, 2017

Other Info: Biology 5357 is required by the DBBS Graduate Program in Biochemistry, Biophysics and Structural Biology and is an elective for other DBBS programs. Prior courses in Biochemistry and in Physical Chemistry are recommended, but not required, for enrollment.

Module 1: Proteins

Aug 27	Taxonomy I: Primary & Secondary Structure	Ponder
Aug 29	Taxonomy II: Motifs & Supersecondary Structure	Ponder
Aug 31	Taxonomy III: Tertiary Structure & Fold Types	Ponder

Sep 3 **No Class – Labor Day**

Sep 5	Folding I: Forces that Determine Protein Structure	Ponder
Sep 7	Folding II: Mechanisms of Protein Folding	Ponder
Sep 10	Folding III: Characterization of Folding Pathways	Ponder
Sep 12	Basics of Molecular Dynamics & Monte Carlo Simulation	Ponder
Sep 14	History of Protein Dynamics	Bowman
Sep 17	Energy Landscapes	Bowman
Sep 19	Enhanced Sampling Techniques	Bowman
Sep 21	Markov State Models	Bowman
Sep 24	Visualizing Protein Structures & Trajectories	Bowman
Sep 26	Electron Microscopy & Protein Assemblies	Zhang

Sep 28 **Exam on First Module**

Module 2: Nucleic Acids

Oct 1	Structure & Properties of Nucleic Acid Components	Taylor
Oct 3	A vs. B vs. Z DNA, Triplexes and Quadruplexes	Taylor
Oct 5	Nucleic Acid Folds	Taylor
Oct 8	Single Molecule Methods	Galburt
Oct 10	Applications of Optical & Magnetic Tweezers	Galburt
Oct 12	Polymer Statistics I: Basic Theory	Sorrano

Oct 15 **No Class – Fall Break**

Oct 17	Polymer Statistics II: Real Chains & Applications	Sorrano
Oct 19	Polymer Statistics III: Mixtures of Polymers	Sorrano
Oct 22	Introduction to RNA Biology	Hall
Oct 24	Tertiary Interactions in RNA Molecules I	Hall
Oct 26	Tertiary Interactions in RNA Molecules II	Hall
Oct 29	Group I Intron Folding	Hall
Oct 31	Protein–Nucleic Acid Interactions	Hall

Nov 2 **Exam on Second Module**

Module 3: Membranes, Membrane Protein & Carbohydrates

Nov 5	Structure & Composition of the Cell Membrane	Robertson
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Nov 7	Assembly & Dynamics of Membranes	Robertson
Nov 9	Bilayer Structure & Simulations	Robertson
Nov 12	Membrane Permeation	Robertson
Nov 14	Active & Facilitated Transport	Robertson
Nov 16	No Class – Retreat for DBBS BBSB Program	
Nov 19	Self-Assembly in Membranes	Robertson
Nov 21	No Class – Thanksgiving Break	
Nov 23	No Class – Thanksgiving Break	
Nov 26	Introduction to Glycobiology	Ponder
Nov 28	Structures of Complex Carbohydrates	Ponder
Nov 30	Post-Translational Modifications & Glycoproteins	Ponder
Dec 3	Carbohydrate Recognition & Signaling	Ponder
Dec 5	Applications in Biochemistry & Medicinal Chemistry	Ponder
Dec 7	Exam on Third Module	