

**Biology 5357: Chemistry & Physics of Biomolecules****Fall 2023**

**Class Meetings:** Monday-Wednesday-Friday, Lecture, 12:00-1:00 pm, Becker Library 201  
Thursday, Discussion Section, 3:00-4:00 pm, Becker Library 201

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

**Instructors:** Baron Chanda (BJC Institute of Health 9305, 273-6811, bchanda@wustl.edu)  
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**Web Site:** <https://dasher.wustl.edu/bio5357/>

**Objectives:** Biology 5357 explores the physicochemical basis for the structural integrity, Thermodynamic and kinetic 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:

*The Molecules of Life*, Kuriyan, Konforti & Wemmer, 2012  
*Textbook of Structural Biology, 2nd Edition*, Liljas, *et al.*, 2017  
*Introduction to Protein Structure, 2nd Edition*, Branden & Tooze, 1999  
*Protein Actions: Principles and Modeling*, Behar, Jernigan & Dill, 2017  
*Introduction to Proteins, 2nd Edition*, Kessel & Ben-Tal, 2018  
*Polymer Physics, 2nd Edition*, Rubenstein & Colby, 2003  
*Principles of Nucleic Acid Structure*, Neidle, 2007  
*The Biophysical Chemistry of Nucleic Acids & Proteins*, Creighton, 2010  
*Introduction to Glycobiology, 3rd Edition*, Taylor & Druckamer, 2011  
*The Sugar Code: Fundamentals of Glycosciences*, Gabius, 2009  
*Essentials of Glycobiology, 4th Edition*, Varki, *et al.*, 2022  
*Membrane Structural Biology, 2nd Edition*, Luckey, 2014

**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 28	Taxonomy I: Primary & Secondary Structure	Ponder
Aug 30	Taxonomy II: Motifs & Supersecondary Structure	Ponder
Sep 1	Taxonomy III: Tertiary Structure & Fold Types	Ponder
Sep 4	<b>No Class – Labor Day</b>	
Sep 6	Folding I: Forces that Determine Protein Structure	Ponder
Sep 8	Folding II: Solvation, Hydrophobic Effects, Hydrogen Bonds	Ponder
Sep 11	Folding III: Mechanisms of Protein Folding	Ponder
Sep 13	Folding IV: Mutagenesis Studies of Folding & Stability	Ponder
Sep 15	<b>No Class – DBBS BBSB Fall Retreat</b>	
Sep 18	Introduction to Intrinsically Disordered Proteins	Holehouse
Sep 20	Experimental Techniques for Studying IDRs	Holehouse
Sep 22	Theoretical Methods & Case Studies for IDRs	Holehouse
Sep 25	Basic Theory of Molecular Mechanics & Dynamics	Ponder
Sep 27	Protein Structure Prediction & DeepMind's AlphaFold	Ponder
Sep 29	<b>Exam on First Module</b>	

## Module 2: Nucleic Acids

Oct 2	Polymer Statistics I: Basic Theory	Sorrano
Oct 4	Polymer Statistics II: Real Chains & Applications	Sorrano
Oct 6	Polymer Statistics III: Mixtures of Polymers	Sorrano
Oct 9	<b>No Class – WashU Fall Break</b>	
Oct 11	Nucleic Acid Components & Their Assembly	Hall
Oct 13	Structure, Conformation & Bending of A, B & Z DNA	Hall
Oct 16	Triple Stranded DNA, Quadruplexes and Other Structures	Hall
Oct 18	Introduction to RNA Biology	Hall
Oct 20	Tetrahymena Group I Intron, Part I	Hall
Oct 23	Tetrahymena Group I Intron, Part II	Hall
Oct 25	Small Ribozymes	Hall
Oct 27	Riboswitches	Hall
Oct 30	Basic Principles of Electron Microscopy	Zhang
Nov 1	Electron Microscopy & Biomolecular Assemblies	Zhang
Nov 3	<b>Exam on Second Module</b>	

### **Module 3: Carbohydrates, Membranes & Membrane Proteins**

Nov 6	Introduction to Glycobiology	Ponder
Nov 8	Glycan Structures & Analysis Methods	Ponder
Nov 10	Classes of Glycoproteins & Glycolipids	Ponder
Nov 13	Glycan Recognition in Cell Adhesion & Signaling	Ponder
Nov 15	Discovery of the Membrane & Embedded Proteins	Robertson
Nov 17	Chemical Composition of the Cell Membrane	Robertson
Nov 20	Membrane Structure & Mechanics	Robertson
Nov 22	<b>No Class – Thanksgiving Break</b>	
Nov 24	<b>No Class – Thanksgiving Break</b>	
Nov 27	Membrane Dynamics	Robertson
Nov 29	Ion Channels I: Permeation & Gating	Chanda
Dec 2	Ion Channels II: Permeation & Gating	Chanda
Dec 4	Membrane Protein Folding & Self-Assembly	Robertson
Dec 6	Direct & Secondary Active Transport	Robertson
Dec 8	<b>Exam on Third Module</b>	