

**Biology 5357: Chemistry & Physics of Biological Molecules****Fall 2011**

**Class Meetings:** Tuesday and Thursday, Lecture, 9:00-10:30am, 521 Becker Library  
Friday, Discussion Section, 2:30-3:30pm, 521 Becker Library

**Cross-Listing:** This course is cross-listed as Chemistry 5357 and Medical School M15

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

**Web Site:** <http://dasher.wustl.edu/bio5357/>

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

**Textbooks:** There are no required textbooks. The following books may be useful for parts of the course, and are available from WashU libraries and online booksellers:

*Introduction to Protein Structure, 2nd Edition*, Branden & Tooze, 1999

*Textbook of Structural Biology*, Liljas, et al. 2009

*Principles of Physical Biochemistry, 2nd Ed*, van Holde, Johnson & Ho, 2006

*Thermal Biophysics of Membranes*, Heimburg, 2007

*Membrane Structural Biology*, Luckey, 2008

**Other Info:** Biology 5357 is required by the DBBS Graduate Programs in Biochemistry and in Computational & Molecular Biophysics. Lectures coincide with the corresponding Medical School course, and 1st-year Medical and MSTP students may substitute Bio 5357 for credit. Prior courses in Biochemistry and in Physical Chemistry are recommended, but not required, for enrollment.

**Module 1: Peptides and Proteins: Structure and Folding**

|        |   |        |
|--------|---|--------|
| Aug 30 | Protein Taxonomy I: Primary & Secondary Structure         | Ponder |
| Sep 1  | Protein Taxonomy II: Motifs & Supersecondary Structure    | Ponder |
| Sep 2  | Discussion Section  | Ponder |
| Sep 6  | Protein Taxonomy III: Tertiary Structure & Fold Types     | Ponder |
| Sep 8  | Protein Folding I: Forces that Determine Structure        | Ponder |
| Sep 9  | Discussion Section  | Ponder |
| Sep 13 | Protein Folding II: Mechanisms of Protein Folding         | Ponder |
| Sep 15 | Protein Folding III: Characterization of Folding Pathways | Ponder |
| Sep 16 | Discussion Section  | Ponder |
| Sep 20 | Protein Folding IV: Mutagenesis Studies                   | Ponder |
| Sep 22 | Protein Folding V: Structure Prediction & Design          | Ponder |
| Sep 23 | Discussion Section  | Ponder |

**Module 2: Proteins in the Crystal and in Solution**

|         |  |         |
|---------|--|---------|
| Sep 27  | X-Ray I: Crystals, Symmetry, Diffraction, Bragg's Law  | Ponder  |
| Sep 29  | X-Ray II: Structure Factors, Density & Patterson Maps  | Ponder  |
| Sept 30 | Special Topics: Recent Applications of Crystallography | Fremont |

|        |   |                 |
|--------|---|-----------------|
| Oct 4  | X-Ray III: Phase Determination & Refinement       | Ponder          |
| Oct 6  | NMR I: Intrinsically Disordered Proteins          | Henzler-Wildman |
| Oct 7  | Discussion Section                                | Henzler-Wildman |
| Oct 11 | NMR II: More on Intrinsically Disordered Proteins | Henzler-Wildman |
| Oct 13 | NMR III: Protein Dynamics                         | Henzler-Wildman |
| Oct 14 | <b>No Class - Fall Break</b>                      |                 |
| Oct 18 | NMR IV: More on Protein Dynamics                  | Henzler-Wildman |

Oct 20 **Mid-Term Examination**  
 Oct 21 **No Class - DBBS Fall Retreat for BCM and CMBP**

**Module 3: Nucleic Acids: Structure and Interactions**

|        |  |      |
|--------|--|------|
| Oct 25 | DNA I: A-, B- and Z-Form Duplex Structures         | Hall |
| Oct 27 | DNA II: DNA Chips, Non-Standard Structure, Bending | Hall |
| Oct 28 | Discussion Section                                 | Hall |
| Nov 1  | RNA I: RNA Binding to Small Molecules              | Hall |
| Nov 3  | RNA II: Aptamers and Riboswitches                  | Hall |
| Nov 4  | Discussion Section                                 | Hall |
| Nov 8  | RNA III: The Hammerhead Ribozyme                   | Hall |
| Nov 10 | RNA IV: Structure and Stability                    | Hall |
| Nov 11 | Discussion Section                                 | Hall |
| Nov 15 | RNA V: Type I Intron & RNA Folding                 | Hall |
| Nov 17 | RNA VI: RNA-Protein Interactions                   | Hall |
| Nov 18 | Discussion Section                                 | Hall |

**Module 4: Membranes and Associated Molecules**

|        |  |                 |
|--------|--|-----------------|
| Nov 22 | Membranes: Composition, Properties, Structure & Function   | Schlesinger     |
| Nov 24 | <b>No Class – Thanksgiving Break</b>                       |                 |
| Nov 25 | <b>No Class – Thanksgiving Break</b>                       |                 |
| Nov 29 | Stabilizing Forces: Hydrophobic & vdW, and Surface Tension | Schlesinger     |
| Dec 1  | Forces Affecting Function: Curvature and Fluctuation       | Schlesinger     |
| Dec 2  | Special Topics: Proteins and Membranes                     | Henzler-Wildman |
| Dec 6  | Modeling: Fluidity, Diffusion and Inhomogeneity            | Schlesinger     |
| Dec 8  | Membrane Fusion and Membrane Pores                         | Schlesinger     |
| Dec 9  | Special Topics: Channels and Transport                     | Heuttner        |
| Dec 13 | Membrane Perturbations: Peptides and Proteins              | Schlesinger     |
| Dec 15 | <b>Final Examination</b>                                   |                 |