

## Syllabus and (tentative) topics to be covered

Lecture (date)	Topic	Approximate sections in various books <sup>‡</sup>
1 (26-Aug, W)	No lecture – Read Ch. 1, V & V	
2 (28-Aug, F)	Overview, Intro, & Motivation: Prokaryotic and Eukaryotic Cellular Life; Central Dogma...	
3 (31-Aug, M)	Classical genetics; Intro to DNA as the genetic material; Rudiments of DNA structure and function (replication)	V&V: Ch. 1 (except for §6, <i>Origin of Life</i> [later]) Ch. 5 (except for §5, <i>Molecular Cloning</i> [later]) Ch. 30 §1
4 (02-Sep, W)	DNA as genetic material: Classic experiments from viral genetics; Intro to structure & physical properties of DNA	
5 (04-Sep, F)	DNA replication; DNA → RNA transcription; Intro to idea of transcriptional control ( <i>lac</i> operon)	
6 (07-Sep, M)	RNA → Protein: Intro to proteins and translation (proteins as polymers, genetic code, tRNA, ribosomes, etc.)	
7 (09-Sep, W)	Aqueous solutions: Structure & properties of water; solid and liquid phases; radial distribution functions; clathrates; Hofmeister series; hydrophobic effect	V&V: Ch. 2 Ch. 4
8 (11-Sep, F)	Acid↔base equilibria; Chemical and physical properties of amino acids and nucleotides (stereochemistry, pKa's, etc.)	Kyte: Ch. 2 ( <i>Electronic Structure</i> )
9 (14-Sep, M)	Amino acids, cont'd: Electronic structure, tautomerization, side chain acid / base chemistry (trends in pKa shifts)	
10 (16-Sep, W)	Thermo: 1 <sup>st</sup> and 2 <sup>nd</sup> laws; idea of entropy; work and free energy; state functions; heat capacity; chemical equilibria; Boltzmann distribution as basic idea of statistical mechanics	V&V: Ch. 3, Ch. 16 §5-6, Ch. 20 §1 In-class lecture notes Widom: Ch. 1 (optional)
11 (18-Sep, F)		
12 (21-Sep, M)		
13 (23-Sep, W)		
14 (25-Sep, F)	<i>Practical tools: (1) Biochemical literature searches; (2) Databases (PDB); (3) Molecular graphics &amp; visualization</i>	V&V: Ch. 1 §6; Mostly in-class lecture notes & demos
15 (28-Sep, M)	<b>Nucleic Acids: Structures &amp; Properties</b>	
16 (30-Sep, W)	• Helical structures: DNA duplex; A, B, and Z-forms • Geometry and stereochemistry at the base, nucleotide, BP, and higher-order (helical) levels; sugar puckers; physical basis of conformational preferences; ion-binding	V&V: Ch. 29 C&S: Ch. 3 ( <i>Structures of nucleic acids</i> ) Ch. 6 ( <i>Conformational analysis and forces...</i> )
17 (02-Oct, F)	• Flexibility & dynamics case study: The B-Z transition	BCT: Ch. 8 ( <i>Conformational changes</i> ) Ch. 10 ( <i>Supercoiled DNA</i> )
18 (05-Oct, M)	• Biophysical properties of nucleic acids: Folding and assembly, conformational transitions	Historical Perspective by Klug ( <i>JMB</i> , 2004)
– (07-Oct, W)	No lecture	
19 (09-Oct, F)		Study of the B-Z transition by Harvey ( <i>NAR</i> , 1983)
20 (12-Oct, M)		Holbrook's Survey of Large RNA structures ( <i>Ann.Rev.Biochem.</i> , 2008)
– (14-Oct, W)	No lecture (Fall break / Reading days)	
21 (16-Oct, F)	<b>Nucleic Acids: Structures &amp; Properties (cont'd)</b>	
22 (19-Oct, M)	• Supercoiling and higher-order structures (chromatin)	Montange & Batey review of riboswitches ( <i>Ann. Rev. Biophys.</i> , 2008)
23 (21-Oct, W)	• Rich variety of RNA structures – tRNA as the classic example, and beyond (riboswitches...)	
24 (23-Oct, F)	<b>Protein Structure &amp; Dynamics</b>	V&V: Ch. 8 ( <i>Three-dimensional structures of...</i> ) Ch. 9 ( <i>Protein folding, dynamics, and ...</i> ) Ch. 10 ( <i>Hemoglobin: Proteins in Microcosm</i> )
25 (26-Oct, M)	• Elements of 2° structure ( $\alpha$ , $\beta$ ) and physical chemistry of their formation (intermolecular forces; thermodynamics); protein folding & dynamics (experiment & theory)	M&H: Chs. 3, 5 → 7 ( <i>Protein dynamics</i> )
26 (28-Oct, W)	• Principles of 3° structure and architecture; classification of "folds" (structural bioinformatics)	Review articles (~3-4 of them) by Sali, by Kuriyan & Eisenberg, etc.; to be assigned week before
27 (30-Oct, F)	• Protein assemblies: 4° structures; molecular 'machines'; nuclear pore complex	Meet to discuss (tentative) project ideas this week ? V&V: Chs. 13 → 15 C&S: Chs. 15, 16 ( <i>Ligand equilibria &amp; binding</i> )
28 (02-Nov, M)	<b>Protein Function &amp; Enzymology</b>	V&V: Ch. 7 §3,4 Ch. 9 §6
29 (04-Nov, W)	Enzymatic mechanisms; allosteric transitions; statistics of ligand-binding equilibria and binding kinetics; cooperativity	
30 (06-Nov, F)	<b>Protein ↔ nucleic acid interactions</b>	
	Recurring structural motifs; DNA recognition by trx factors;	

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31 (09-Nov, M)	RNA-binding and ribonucleoprotein architecture	RNAW: Ch. 11 ( <i>The RNP World</i> )
32 (11-Nov, W)	<b>Biomolecular Evolution</b> Molecular evolution (proteins, DNA); protein and RNA sequence analysis; bioinformatics; structure prediction	Kyte: Ch. 7
33 (13-Nov, F)		Reviews by Koonin, Sali, <i>et al.</i> ; Primers by S. Eddy B&T: Chs. 8 → 10
34 (16-Nov, M)		
35 (18-Nov, W)	Presentation Day 1	
36 (20-Nov, F)	Presentation Day 2	
37 (23-Nov, M)	Presentation Day 3	
38 (25-Nov, W)	Presentation Day 4	
– (27-Nov, F)	<i>No lecture</i> (Thanksgiving recess)	
– (30-Nov, M)	<i>No lecture</i> (Thanksgiving recess)	
39 (02-Dec, W)	<b>DNA → RNA: Transcription</b>	V&V: Ch. 30 ( <i>DNA Replication, Repair, and ...</i> ) V&V: Ch. 31 ( <i>Transcription</i> )
40 (04-Dec, F)	Post-transcriptional processing	RNAW: Ch. 13 ( <i>Spliceosome Structure &amp; Function</i> )
41 (07-Dec, M)	<b>RNA → Protein: Translation</b> Ribosome structure & function	V&V: Ch. 32 ( <i>Translation</i> ) RNAW: Ch. 9 (Moore & Steitz), Ch. 10 (Noller) Review article by Noller ( <i>Science</i> , 2005)
42 (09-Dec, W)	<i>Finals Week → Written Research Proposals (~5-10 pgs) due Friday, December 11<sup>th</sup></i>	

Books (only buy V & V – relevant excerpts will be provided for the others):

“BCT” = Bloomfield, Crothers, & Tinoco, *“Nucleic Acids: Structures, Properties, and Functions”*

“B&T” = Branden & Tooze, *“Introduction to Protein Structure”*

“C&S” = Cantor & Schimmel, *“Biophysical Chemistry”*

“E&C” = Eisenberg & Crothers, *“Physical Chemistry, with Applications to the Life Sciences”*

“Kyte” = Jack Kyte, *“Structure in Protein Chemistry”*

“M&H” = McCammon & Harvey, *“Dynamics of Proteins and Nucleic Acids”*

“RNAW” = The RNA World, 3<sup>rd</sup> Edition

“V&V” = Voet & Voet, *“Biochemistry”*

“Widom” = Benjamin Widom, *“Statistical Mechanics: A Concise Introduction for Chemists”*

**Note:**

As of this writing (Aug-2009), the above syllabus and course lay-out is *tentative* (especially beyond the first ~3 weeks). There will likely be very minor changes (in terms of content), and possibly some re-organization (in terms of projects and exams).