Department of Science
Grande Prairie Regional College

Biochemistry 3200

Structure and Catalysis

Course Outline
2007-2008

Instructor
Philip Johnson B.Sc., M.Sc., Ph.D., M.S.P.H.
office: J224
phone: 539 2863
e-mail: *johnson@gprc.ab.ca*

Course Description:	Designed to illustrate, in detail, the relationships between structure and function in biological molecules. It covers: the structure of proteins; techniques used to study proteins; contractile proteins and immunoglobulins as illustrations of protein function; enzyme catalysis, kinetics, and regulation; structural carbohydrates and glycobiology; the structure of lipids; biological membranes and mechanisms of transport; molecular mechanisms in biosignalling.
Pre-requisites:	BC 2000, CH 1020 and CH 2630
Notes:	1. Students with grades of less than B- in pre-requisite courses require consent of the department. 2. This course may not be taken for credit if credit has already been obtained in BC 2030 or BC 2050.
Transferability:	Biochemistry 320 – University of Alberta
Text-book:	Lehninger Principles of Biochemistry (4^{th} edition) (Chapters 3-7, 10-12) David Nelson & Michael Cox W.H. Freeman and Co. (2005) ISBN: 0-7167-4339-6
Requirements:	Since participation in lectures and completion of assignments are essential to achieving success in this course, regular attendance at classes is highly recommended. Those who chose not to attend must assume whatever risks are involved. In this regard, your attention is directed to the Academic Guidelines of Grande Prairie Regional College.
Evaluation:	Mid-term Exam I 30% Mid-term Exam II 30% Final Exam 40% Mid-term Exam I will test knowledge of material covered in the first third of the course. Mid-term Exam II will test knowledge of material covered since the first mid-term exam. The Final Exam will be cumulative and test knowledge of the entire course.

BC 3200 – Topic Outline & Required Readings

Hours	Topic	Readings
5	Amino acids, peptides, and proteins	
	Amino acids	
	Amino acids share common structural features	76-77
	Amino acids can be classified by R group	78-80
	Uncommon amino acids	80-81
	Amino acids as acids and bases	81-85
	Peptides and proteins	
	Peptides are chains of amino acids	85-86
	Sizes of biologically active peptides and polypeptides	86-87
	Amino acid composition and additional chemical groups	87-88
	Four levels of protein structure	88
	Working with proteins	
	Separation and purification	7-8
	Column chromatography	89-92
	Electrophoresis	92-95
	Activity and specific activity	94-95
	Covalent structure of proteins	
	Amino acid sequence determines protein function	96-97
	Amino acid sequence determination	97-100
	Other methods of amino acid sequence determination	100-104
	Chemical synthesis of peptides	104-106
	Biochemical information from amino acid sequences	106
	Protein sequences and evolution	
	Protein sequences and evolution	106-110
5	The three-dimensional structure of proteins	
	Overview	
	Weak interactions stabilize protein conformation	116-118
	The peptide bond and Ramachandran plots	118-120
	Protein secondary structure	
	Structure and stability of the α helix	120-122
	β sheets and β turns	123-124
	Characteristic bond angles and amino acid content	124-125
	Protein tertiary and quaternary structure	
	Tertiary structureand fibrous proteins (inc Box 4-2, 4-3)	125-129
	Tertiary structure and globular proteins	129-135
	Methods for determining the 3-D structure of a protein	Box 4-4
	Common structural patterns in globular proteins	138-141

	Protein structural classification	141-144
	Protein quaternary structure	144-146
	Protein denaturation and folding	
	Denaturation and renaturation of proteins	147-148
	Polypeptide folding	148-151
	Molecular chaperones and assisted folding	151-153
2	Protein function	
	Ligands and binding	157-158
	Protein interactions : molecular motors	
	Myosin and actin	182-184
	The organization of thin and thick filaments	184-185
	Sliding filaments and muscle contraction	185-186
6	Enzymes	
	An introduction to enzymes	
	The importance of enzymes	190-191
	Enzymes, cofactors and classification	191-193
	How enzymes work	
	Active sites and reaction coordinate diagrams	193-195
	Thermodynamic definitions- reaction equilibria and rates	195-196
	Catalytic power and specificity of enzymes	196-200
	Types of catalysis	200-202
	Enzyme kinetics and mechanism	
	Substrate concentration and reaction rate (inc Box 6-1)	202-205
	Kinetic parameters used to compare enzyme activities	205-207
	Bisubstrate enzyme-catalyzed reactions	207-208
	Enzyme inhibitors: reversible and irreversible (Box 6-2)	208-212
	Enzyme activity depends on pH	212
	Examples of reactions	
	Chymotrypsin—acylation and deacylation of a serine residue (including Box 6-3)	213-218
	Hexokinase—induced fit on substrate binding	218-219
	Enolase—use of metal ions	219, 222
	Regulatory enzymes	
	Allosteric enzymes and regulation of pathways	225-227, 167-170
	Kinetic properties of allosteric enzymes	227-228
	Regulation by covalent modification	228-232
4	Carbohydrates and glycobiology (4)	
	Monosaccharides and disaccharides	
	Aldoses, ketoses and stereoisomers	238-240
	Cyclic structures	240-243
	Hexose derivatives	243-244
	Disaccharides contain a glycosidic bond	245-246
	Polysaccharides	
	Homopolysaccharides	247-250
	Homopolysaccharide folding	250-252
	Heteropolysaccharides	252-255