MBMB 451b
http://www.siu.edu/departments/biochem/bmb_courses/mbmb451b_syllabus.html
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GENERAL INFORMATION:

MBMB 451b is the second semester of a two-semester biochemistry course for undergraduate and graduate students. We will cover enzymes, carbohydrate metabolism, membranes, lipid metabolism, amino acid metabolism, and nucleotide metabolism. Students should be familiar with analytical, organic, and physical chemistry as well as common mathematical approaches to problem solving. Familiarity with the internet is encouraged and recommended. Class meets on TR from 1-2:15 p.m. in the Life Sciences III Auditorium.

RESOURCES:

The course will use ***Biochemistry*** **by Voet and Voet (2nd edition, John Wiley & Sons, Inc., 1995)**, which is available from the campus bookstore. Appropriate readings are indicated in this handout, but you may wish to include additional materials (the WWW is a good example, check http://www.wiley.com/college/voet586501/bookmarks.html).

Two alternatives are *Fundamentals of Biochemistry* by Voet, Voet & Pratt (John Wiley & Sons, Inc., 1999, ISBN 0-471-58650-1) and *Biochemistry* by Garrett & Grisham (2nd edition, Saunders College Publishing, 1999, ISBN 0-03-022318-0).

You may find it beneficial to practice the problems that are included in the textbook! Remember, it is up to you to develop a comprehensive understanding of all the material that is assigned and presented. Lectures will focus on important concepts and illustrate key points. Select materials may be posted to this course web page. To develop a comprehensive understanding (your key goal), we suggest that you read the material several times, attend class, ask appropriate questions, practice problems from various resources (see On-Line quiz), and check this MBMB 451b Web site frequently.

GRADING POLICY:

Your performance in this course will be based on 2 tests and the comprehensive final exam. Each of the two tests and the final exam will consist of a combination of short-answer, multiple-choice, and problem-solving questions. Tests are scheduled for the week of March 6-10 and May 1-5, 2000. We will use the University's designated final exam day and time (Monday May 8, 2000 from 7:50-9:50 am).

As a general policy, there will be no make-up examinations.

Examination Breakdown			Typical Percentage Ranking	
Tests	2 @ 100 pts	= 200 pts	A = 90 to 100%	>360 pts
Final exam	1 @ 200 pts	= 200 pts	B = 80 to 89%	>320 pts
			C = 70 to 79%	>280 pts
Total potential points		= 400 pts	D = 55 to 69%	>220 pts
			F = less than 55%	<220 pts

COURSE OUTLINE:

This section will be presented by Eric C. Niederhoffer

An On-line Quiz will allow you to assess your learning as you progress through the course material.

Introduction to enzymes (**Read pp. 332-344**)
Historical perspective, substrate specificity, coenzymes, regulation of enzymatic activity, enzyme nomenclature

Rates of enzymatic reactions (**Read pp. 345-370**)
Chemical kinetics, enzyme kinetics, inhibition, effects of pH, bisubstrate reactions

Enzymatic catalysis (**Read pp. 371-410**)
Catalytic mechanisms, lysozyme, serine proteases, glutathione reductase

Sugars and polysaccharides (**Read pp. 251-276**)
Monosaccharides, polysaccharides, glycoproteins

Introduction to metabolism (**Read pp. 412-442**)
Metabolic pathways, organic reaction mechanisms, experimental approaches to the study of metabolism, thermodynamics of phosphate compounds, oxidation-reduction reactions, thermodynamics of life

Glycolysis (**Read pp. 443-483**)
Glycolytic pathway, reactions of glycolysis, fermentation, control of metabolic flux, metabolism of other hexoses

Glycogen metabolism (**Read pp. 484-512**)
Glycogen breakdown, glycogen synthesis, control of glycogen metabolism, glycogen storage diseases

Citric acid cycle (**Read pp. 538-562**)
Cycle overview, metabolic sources of acetyl-coenzyme A, citric acid cycle enzymes, citric acid cycle regulation, amphibolic nature of the citric acid cycle

Electron transport and oxidative phosphorylation (**Read pp. 563-598**)
The mitochondrion, electron transport, oxidative phosphorylation, control of ATP production

Other pathways of carbohydrate metabolism (**Read pp. 599-625**)
Gluconeogenesis, glyoxylate pathway, biosynthesis of oligosaccharides and glycoproteins, pentose phosphate pathway

Photosynthesis (**Read pp. 626-661**)

Chloroplasts, light reactions, dark reactions

First Examination - Enzymes, sugars and polysaccharides, carbohydrate metabolism and photosynthesis (week of March 6-10, 2000)

SPRING BREAK

This section will be presented by Peter Hardwicke

Lipids and membranes (**Read pp. 277-329**)

Lipid classification, properties of lipid aggregates, biological membranes, membrane assembly and protein targeting, lipid-linked proteins and lipoproteins

Transport through membranes (**Read pp. 513-537**)

Thermodynamics of transport, kinetics and mechanisms of transport, ATP-driven active transport, ion gradient-driven active transport

Lipid metabolism (**Read pp. 662-726**)

Lipid catabolism

Comparison of triglyceride and carbohydrate as energy stores, effect of low blood sugar-activation of catabolism

Effect of low blood sugar of triglyceride stores

Lipolysis, location in fat (and heart muscle), hormone sensitive lipase mediates the rate limiting step, distribution of the products of lipolysis, role of serum albumin - use of free fatty acid and glycerol by different tissues, use of glycerol for gluconeogenesis by liver and kidney, activation of free fatty acids for metabolism-formation of acyl CoA, β-oxidation of even chain fatty acids in mitochondria, acetyl CoA cannot be directly converted into carbohydrate, β-oxidation of odd chain fatty acids - propionyl CoA, methylmalonyl CoA, succinyl CoA - requirement for vitamin B_{12}, β-oxidation of unsaturated fatty acids, β-oxidation of very long chain fatty acids in peroxisomes, synthesis of ketone bodies-location in liver and kidney mitochondria, utilization of ketone bodies by brain and muscles, α- and ω-oxidation

Lipid anabolism

Biotin, accumulation of acetyl CoA in the form of citrate, regulatory role of acetyl CoA carboxylase, malonyl CoA, synthesis of palmitate by fatty acid synthase, elongation of fatty acids, desaturation of fatty acids, synthesis of triglyceride, synthesis of phospholipids - membrane biosynthesis, synthesis of cholesterol

Amino acid metabolism (**Read pp. 727-784, 785-794**)

Protein and amino acid catabolism

Effect of low blood sugar on protein catabolism - a third store of energy, transaminases, transfer of most α-amino acid N to α-ketoglutarate to give glutamate, Ser to Thr directly deaminated to pyruvate and α-ketobutyrate, asparaginase and glutaminase, oxidative deamination of glutamate by glutamate dehydrogenase yields energy/reducing power (NADH/NADPH) plus $NH4^+$, conversion of $NH4^+$ to urea in liver, the urea cycle, location of enzymes, $NH4^+$ and AspNH2 used to form urea, fumarate, oxaloacetate and α-ketoglutarate link urea formation and the citric acid cycle, use of carbon skeletons to give energy (and/or glucose in liver and kidney) - ketogenic and glucogenic amino acids, Ala, Ser, Cys, Gly and Thr (glucogenic) give pyruvate, Asp and Asn (glucogenic) give oxaloacetate, Gln, Glu, Pro, Arg and His (glucogenic) give α-ketoglutarate, Leu and Lys (ketogenic) give acetoacetate and/or acetyl CoA, Ile (glucogenic and ketogenic), Val (glucogenic) and Met (glucogenic)

give succinyl CoA - requirement for Vit B_{12}, Trp (glucogenic and ketogenic) gives Ala and acetoacetate, Phe and Tyr (glucogenic and ketogenic) give fumarate and acetoacetate, phenylketonuria, Leu, Ile and Val grouped as branched chain amino acids - maple syrup disease, use of alanine and lactate from muscles for gluconeogenesis in liver (alanine-glucose and Cori cycles), utilization of branched chain amino acids in the brain

Amino acid synthesis

C_1 carriers, tetrahydrofolate, *S*-adenosylmethionine, essential and non-essential amino acids

Purine and pyrimidine bases, nucleosides, nucleotides (**Read pp. 795-828**)

Basic chemistry, purine and pyrimidine catabolism, purine and pyrimidine biosynthesis - role of 5-phosphoribosyl-1-pyrophosphate (PRPP)

Second Examination - Membranes, lipid metabolism, amino acid metabolism, and nucleotide metabolism
(week of May 1-5, 2000)

Final Comprehensive Examination
Monday May 8, 2000
7:50 to 9:50 a.m.