SYLLABUS for CHEMISTRY 365
BIOCHEMISTRY
Spring 2004

INSTRUCTOR

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College of Letters & Science
Department of Chemistry

I. Course Description

A. Biochemistry **(Prerequisites: Chem 248, 326, 328)**

Introduction to Biochemistry includes the chemistry of living cell components, and the nature and mechanism of cellular reactions. The chemical structures and biological functions of the most common small biomolecules, molecular assemblies and polymers of living organisms - including carbohydrates, proteins (enzymes), lipids, nucleic acids, coenzymes, and intermediate metabolites are covered. The reaction mechanisms, enzyme catalysts and regulation of the fundamental metabolic pathways are discussed - including glycogenesis, glycogenolysis, gluconeogenesis, glycolysis, the pentose phosphate pathway, fatty acid metabolism, the citric acid cycle, the electron transport system, oxidative phosphorylation, amino acid metabolism, the urea cycle and nucleotide metabolism. Biological information flow is outlined - including DNA replication and repair; RNA transcription, processing and control of gene expression; and protein biosynthesis. The focus of the laboratory portion of the course is on techniques for analysis of small biomolecule mixtures, biopolymer characterization, and enzyme isolation and kinetic analysis. Techniques include computer spreadsheet and word processing, uv-vis and colorimetric spectrophotometry, thin layer chromatography, gel permeation chromatography, gas-liquid chromatography, specific activity and kinetic assay, and electrophoresis.

B. Information for Spring Semester

TIMES:	Lecture 1	T,R,F	8:00 - 8:50	Room Science A107
	Lab 1	W	8:00 - 10:50	Science D118
	Lab 2	T	14:00 - 16:50	Science D118
	Lab 3	W	14:00 - 16:50	Science D118

REQUIRED MATERIALS

TEXTBOOK: Garrett, Reginald; Grisham, Charles *Principles of Biochemistry With a Human Focus*; Harcourt: Philadelphia, 2002.

INSTRUCTOR: Dr. Tom Zamis Office B135 Phone 346-3258 e-mail: tzamis@uwsp.edu

Office Hours: T 9:00; W 11:00; R 9:00, 14:00 ; F 10:00
or other times by appointment.

II. Course Outline

Week #	Dates	Exam #	Topics
1	1/20 - 1/23		Biomolecule Structures
2	1/27 - 1/30		Water: The Medium of Life
3	2/3 - 2/6		Bioenergetics
4	2/10 - 2/13	1	Amino Acids; Peptides; Proteins
5	2/17 - 2/20		Protein Biosynthesis; Enzymes
6	2/24 - 2/27		Enzymes
7	3/2 - 3/5		Carbohydrates
8	3/9 - 3/12	2	General Principles of Metabolism; Pathways
9	3/16 - 3/19		Carbohydrate Metabolism; Glycogen
10	3/30 - 4/2		Carbohydrate Metabolism; Glycolysis and Gluconeogenesis
11	4/6 - 4/9		Carbohydrate Metabolism; Pentose Phosphate Pathway
12	4/13 – 4/16	3	Lipids, Membranes, Transport; Fatty Acid Metabolism
13	4/20 – 4/23		Aerobic Metabolism – Citric Acid Cycle
14	4/27 - 4/30		Aerobic Metabolism – Electron Transport System
15	5/4 - 5/7		Nitrogen Metabolism: Amino Acid Degradation and Synthesis, Urea Cycle, Nucleotide Biosynthesis

Exam 4 Tuesday May 11, 10:15 – 12:15

III. Principal Assignments

A. Textbook Reading

Garrett, Reginald; Grisham, Charles *Principles of Biochemistry With a Human Focus*; 2002.

CHAPTERS	TOPICS	PAGES
1	Biomolecules, noncovalent interaction	2-13, 13-20
2	Solvent and ionization properties of water	31-42, 45-49
3	Thermodynamics, free energy, equilibrium and coupled reactions	56-66
4, 5	Amino acids, peptides and proteins	68-77, 79-81, 85-88, 113-141
8, 25	Nucleotides, protein biosynthesis	241-258, 801-805, 812, 815-817
5, 10, 11, 14	Enzymes: catalytic mechanism, regulation, nomenclature	105-111, 320-323, 343-350, 364-372, 453-463
7	Monosaccharides, disaccharides, polysaccharides	205-226
14	Principles of metabolism	438-448
15, 19	Glycogen metabolism, glucose metabolism	471-487, 577-601
6	Lipid classes, membrane structure and transport	153-170, 171-187, 187-200
20	Fatty acid beta-oxidation and biosynthesis	603-613, 618-627
16, 17	Citric acid cycle, electron transport and oxidative phosphorylation	495-508, 519-540
21	Amino acid catabolism, Non-essential amino acid biosynthesis	657-660, 663-666, 669, 678-680
21	Nucleotide metabolism	680-683, 692-694

You are expected to understand all **terminology** listed in the objectives, and information presented as Tables and Figures on the reading assignment pages.

B. Supplementary Material

Handouts of lecture material from your instructor, or the Chem 365 Web page, are provided for easy reference and note-taking in class.

You are allowed to prepare, and bring with you to exams, a one page (8 1/2 x 11) "study sheet". These are prepared by you, and contain handwritten or typed summaries of your notes. **These may not contain any photocopies of handouts or book material.**

Your instructor will also make available, on the Chem 365 Web page, all course materials from lecture and discussion, and locations on the **World Wide Web** that have useful instructional materials.

IV. Conduct and Evaluation Procedures

A. Attendance

Attendance is not required for lecture, however the majority of the material that you will be responsible for is presented in lecture. Be sure to obtain notes from your peers on those rare occasions that you miss lecture.

Attendance is required for examinations and laboratory. An *excused absence* requires that **verifiable** arrangements be made with your instructor **in advance** for things like off-campus trips or personal appointments; or following an emergency or illness, a written note from a physician or university administrator is presented upon returning.

B. Student Conduct

The following are from the University publication "Community Rights and Responsibilities". The full document is available from the UWSP Web Page under Student Life.

Nearly 10,000 students, staff, faculty and visitors descend on our one square mile campus each day of the academic year. It is apparent that as a learning community, we need standards or codes of conduct which clarify the behavioral expectations for our academic and nonacademic environments. The policies and procedures spelled out in our Community Rights and Responsibilities publication provide for a sense of order for all while respecting the dignity and rights of individuals. Through these policies, civility within our learning community is affirmed, diversity is pursued, the importance of each person is honored and well defined procedures guide behavior for the common good.

UWSP 14.01 STATEMENT OF PRINCIPLES. The board of regents, administrators, faculty, academic staff and students of the University of Wisconsin system believe that academic honesty and integrity are fundamental to the mission of higher education and of the University of Wisconsin system. The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors. Students who violate these standards must be confronted and must accept the consequences of their actions.

See Section, UWSP 14.03 ACADEMIC MISCONDUCT SUBJECT TO DISCIPLINARY ACTION, for specific examples of academic standard violations.

C. Grading Policy

Exams will be held **Fridays** and will last from 7:50 until 8:50 AM. If you have a conflict with the scheduled exam time, please make arrangements with me for a makeup in advance. A makeup exam will be arranged for any **excused** absences. Your final grade will be based on the total points earned out of 1000. The distribution of points is as follows:

Hour Exams (4 @ 160 pts)	640 points
Lab Reports	305 points
Notebook	15 points
Deportment/Instructor	20 points
Deportment/Team	20 points

The tentative levels of achievement required for letter grades are:

"A" 900 points "B" 800 points "C" 700 points "D" 620 points.

These levels will not be raised.

V. Course Objectives

A. Philosophy

My teaching philosophy for this course has three components. First, one must master the fundamentals. Precise, biochemical definitions for terminology, and biomolecule names and Lewis structures must be learned. Chemical properties of organic functional groups must be understood. These ideas are brought together in studying biomolecules, which are polyfunctional, polymeric, organic molecules in aqueous solution. This level of understanding forms the base for the second level - biomolecule function and transformation. Finally, elements of the first two levels are brought together in the study of the basic biochemical pathways of intermediary metabolism. My hope is that you achieve enough of an understanding of the fundamental principles to allow you to explore and comprehend the latest developments in genetics, medicine, biochemistry and molecular biology.

It is your responsibility to learn the material listed as objectives in the Appendix of the syllabus. I will direct you through a sequence of topics that serve as a general introduction to biochemistry. I will present the material through interactive lectures and labs that incorporate computer graphics, videos, Web resources, current articles, real-world applications, handouts and study sheets when appropriate. I will give you individual help and guidance when you ask me to - and please feel free to ask me when you need it! Your learning will be evaluated with the use of exams that will cover only the material listed in the objectives and announced objectives from laboratory.

Because of the nature and scope of material covered in this one semester introduction to biochemistry, there will be four comprehensive hour exams but no comprehensive final. The exams will focus on the understanding of terminology, biomolecule names and Lewis structures, along with chemical properties, function, and transformation of biomolecules. For exams, you will be required to quickly comprehend questions and use specific examples, terms and concepts from the course objectives to clearly answer them.

Each exam will contain approximately 35 short answer questions.

B. General Objectives

1. Structure and Function of Biomolecules

You should recognize all of the common organic functional groups important in biomolecules, and understand how the group chemical properties relate to the biomolecular function. You should be able to recognize the names, abbreviations, functional groups and complete Lewis structures (correct atom, lone pair and bond arrangement, charges and partial charges) of biomolecules discussed in class. You should be able to write down specific structures of molecules that illustrate examples of classes of biopolymers (e.g. dipeptide, disaccharide, dinucleotide). Understand how functional groups relate to biomolecular reactions (e.g. redox, addition, substitution, acid/base), interactions (e.g. hydrogen bonding, ionic interaction, hydrophobic effect), or different molecular forms (e.g. reduced or oxidized, ionic form at a given pH, ring vs. chain form, resonance forms, stereoisomers).

2. Intermediary Metabolism

For all pathways discussed in class, you should be able to:

1) Recognize the structures and names of substrates and products in all enzyme catalyzed reactions.
2) Indicate the name of any enzyme catalysts and cofactors for any specific reaction. Know the general reaction type. Understand the general enzyme mechanisms and intermediate structures for those specific reactions discussed in class.
3) Understand the free energy considerations (production and use of ATP) and oxidation-reduction considerations (the general flow of electrons ($H\cdot$, $H:^-$, or e^-)) for each pathway.
4) You should understand the principles of regulation for each pathway, and the general integration of pathways in overall glucose, fatty acid and nitrogen metabolism.

3. Biological Information Flow

You should understand the structural relationships between deoxyribonucleic acids and ribonucleic acids in the processes of replication, transcription and translation. Understand electrophoresis, DNA sequencing, PCR, and DNA fingerprinting.

4. Laboratory

You should understand the general theory behind each experiment as described in each lab experiment handout. You should be able to solve quantitative problems similar to those performed in the laboratory.

Calculations involve:

1) dilutions; concentrations in mixtures
2) linear regression; slope/intercept; [Unknown] from standard curve
3) buffer concentrations; pH
4) enzyme units; specific activity
5) Michaelis-Menten kinetics linear plots
6) Absorption spectra; absorptivity
7) Average properties of mixtures