

CHEM 514 Biochemistry

Meets 8/25/2014 through 12/13/2014

MON 6-9 PM

COURSE DESCRIPTION

This course will address the biological diversity and chemical unity of living systems, such as chemical and physical properties of major macromolecules, nucleotides, amino acids, proteins, lipids and water; protein structure and stability; protein architecture, dynamics, folding, stability, and evolution; conformational changes, ligand binding, and kinetics; structure and function of carbohydrates and lipids. Explain the structure and properties of cell membrane, This biochemistry is intended to provide a foundation and in depth knowledge of biochemistry. This course will be covering many aspects of biochemistry, including: biomolecules and metabolism. The course consists of lectures sessions and the topic covered will be given in details in the course schedule.

In this gradate level course the major concepts introduced to the students will be reinforced with various types of team activities.

Team Based Learning Activity - Biochemistry and its relationship to other disciplines

Will provide an opportunity to the students to interact and work as a team to apply their advanced knowledge in biochemistry to practical scenarios. How to identify a research problem in the biochemistry field. How to apply the advanced biochemistry knowledge to design a research project/scientific publications and submit the findings How will you apply your biochemistry knowledge in the field of diagnosis and treatment of patients.

Students should have the advanced understanding of the structure and functional relationship of proteins to explain it to the peers and apply to design project proposals. Communicate Read and interpret scientific articles in biochemistry.

COURSE GOAL

The main objectives of this course are to provide a strong foundation and advanced understanding of the principles of modern biochemistry necessary to understand the structure and function of macromolecules. Students will be introduced to the major advanced concepts in regard to the structure and function of proteins, nucleic acids, lipids and carbohydrates. Each of these concepts will be reinforces with activities which will introduce them to experimental designing, data interpretation and critical analysis and review of scientific studies.

Students who successfully complete this course will be able to:

Explain and analyze the importance of weak interactive forces in biomolecular structure and function.

Analyze the types of non-covalent, reversible interactions and evaluate their in biochemistry?

Recognize and discuss the chemical structures of purine and pyrimidine nucleotides

Understand and analyze the structural organization of RNA and DNA

Evaluate the significant role of water and buffers in the biological system

Discuss the dynamics of Protein structure and function

Evaluate the primary, secondary, tertiary and quaternary structures of proteins

Explain the factors affecting protein structural stability

Explain and analyze the properties of the oxygen binding proteins: hemoglobin and myoglobin and describe the regulation of oxygen transport.
Analyze myoglobin as a storage protein and hemoglobin as a transport protein.
Explain the fundamental nature of the catalytic center of enzymes.
Explain and analyze the factors that affect the rate of enzyme catalysis
Apply Michaelis-Menten equation and explain how enzymes work
Describe the physiological signature of K_m & V_{max}
Describe the effect of activators and inhibitors on enzymes
Distinguish between reversible and irreversible inhibitors and list the types of reversible inhibitors
Recognize the structures of simple sugars and complex carbohydrates.
Understand the chemical nature of blood group antigens
Describe the different types of phospholipids and their functions
Recognize the structure of lipoproteins its biological function
List the kinds of biological transporters and understand their mechanisms
Explain the mechanism of 'bio-signaling' (signal transduction)
Discuss the dynamics of the role and mechanisms of enzymes and glucose as a major energy source
Explain and analyze how metabolic pathways are inter-linked.
Discuss the dynamics of metabolism and evaluate acetyl-Co-A serves as a key intermediate
Explain and analyze examples of diseases resulting from defects in metabolism

REQUIRED TEXTBOOK (S)

Required Text Book: BIOCHEMISTRY by Berg, Jeremy M.; Tymoczko, John L.; and Stryer, Lubert. New York: W. H. Freeman and Co: 7th edition

REQUIRED JOURNAL ARTICLE (S)

Lectures and other supplementary materials (Journal articles, case study material and assignments and quizzes) will be emailed to the students before the session.

RECOMMENDED TEXTBOOK (S)/READING (S)

Recommended for additional reading

Lehninger, Principles of Biochemistry, Fourth Edition
Biochemistry by Garrett and Grisham.
Biochemistry by Mathews and Van Holde

EXAMS

There will be three equally weighted exams given, two during the course and the third at the final exam time. The Students will be expected to be available and prepared for the exams at the specified times. **Missing an exam will result in a 0 score for that exam unless due to illness as documented by a doctor's note and the student notifies the instructor of the illness before the exam (e-mail, phone message, etc.).** Make-up exams will not be given ordinarily. The exams will contain a mix of multiple choice questions, long (explanation) questions, short (formulas and definitions) questions and graphical/diagrammatic questions.

COURSE GRADING

Grading: Your final grade is based on the performance in two intermediate exams (20% each), homework/assignments (20%), Problem based learning (PBL) (20%) and the final exam (20%)

Grading will be based on a standard percentage scale: 100-90 = A; 89-80 = B; 79-70 = C; 69-60 = D; 59-below = F. Dishonest scholarship will earn an automatic zero (0) and initiate prosecution to the fullest extent. Incomplete grades may be given only if the student has a current average ³70% and is precluded from completion of the course by a documented illness or family crisis.

SECURE TEST ITEM POLICY

Students are expected to adhere to the Texas A&M University, Commerce policy on conduct during the course and the examination sessions. Cheating on an examination will not be tolerated. A report of any cheating will be made in accordance with the policies of the University effective at the time of the occurrence.

POLICY ON LATE SUBMISSION

Your assignment needs to be submitted on time. Late submission of the assignments will result in deduction of 5%/day for that assignment unless the student have a valid reason like due to illness as documented by a doctor's note and the student notifies the instructor of the illness before the exam (e-mail, phone message, etc.).

POLICY ON ATTENDANCE

Students are expected to attend all the class. Students may miss a required session only with an excused absence from the Course Instructor. Please notify the instructor about your excused absence as soon as possible in order to schedule a makeup in another laboratory session. Exams and/or tests missed due to unexcused absences will be given a grade of zero. Exams or quizzes missed because of excused absences will be made up during a scheduled time selected by the instructor.

IMPORTANT NOTICE

The provisions contained in this syllabus do not constitute a contract between the student and the University. These provisions may be changed at any time for any reason at the discretion of the Course Instructor and Texas A&M University, Commerce Campus. When necessary, appropriate notice of such changes will be made available to the students. Please refer to the Texas A&M University, Commerce Campus students Hand BOOK for General policies and guidelines.

COURSE SCHEDULE

Date	Course Session Topic	Assigned Readings: Chapter in 7 th edition
8/25	Introduction to Biochemistry Structure and function of Major compounds in your body	1
9/8	<i>Water an excellent solvent, buffering against pH changes in biological system, bicarbonate buffer system</i>	Reading material and review material will be provided practice problems

9/8	Amino acids and Proteins, <i>composition and Structure</i>	2
9/15	<i>A portrait of protein in action – Hemoglobin Part -1</i>	7
9/15	<i>A portrait of protein in action – Hemoglobin Part -II</i>	
9/22	<i>Exploring proteins and proteomes Part -1 Protein, purification, characterization, immunological techniques, Mass spectrometry</i>	3 publication on protein purification
9/29	<i>Enzyme - – Biological catalysts- enzyme kinetics, enzyme inhibitors- Targeting enzyme inhibitors in drug discovery. Enzymes – Catalytic strategies and regulatory strategies</i>	8 review paper will be provided and discussed 9
10/6	<i>PBL -1 Small team based activity – A research problem will be given to the students and the students work as a team to come up with the research proposal with specific aims and experimental design followed by discussion (material covered will be lecture 1-7) (Preparation week No class)</i>	Material will be provided
10/13	<i>PBL presentation Nucleic acids structure and function- DNA, RNA and the flow of information Review</i>	4
10\20	<i>Exam -1(Based on lecture topic (1-9)</i>	
10\27	<i>Carbohydrate structure and function</i>	11
11/3	<i>Lipids composition, structure and function Lipoprotein transport- lipoproteins and liposomes in targeted drug delivery</i>	12 review paper will be provided
11/3	<i>PBL -2 - Small team based activity – A research problem will be given to the students and the students work as a team to come up with the research proposal with specific aims and experimental design (Preparation week No class)</i>	Material will be provided
11/10	<i>Cell membrane Bio signaling – membrane channels and pump</i>	13, 14 15,27

11\17	Overview of metabolism – function of major macromolecules – major metabolic pathways <i>Exam review</i>	
11/24	<i>Exam -2</i>	
12/1	<i>Review</i>	
Dec 2 nd week	<i>Final Exam</i>	

■ ALL DATES AND ASSIGNMENTS ARE TENTATIVE AND SUBJECT TO CHANGE

Student Learning Outcomes

After you have studied the lecture and reading materials, you should be able to:

Introduction to Biochemistry Structure of Major Components in Your Body

1. List the characteristics of living organisms
2. Understand the nature of molecules of life
3. Describe the levels of organization of life
4. Explain how the electronic structure of water accounts for its unique properties
5. Explain the importance of hydrogen bonding to biomolecular structure and function.
6. What are the types of non-covalent, reversible interactions and why are they important in biochemistry?

Nucleic acids Structure and Function

1. Recognize the chemical structures of purine and pyrimidine nucleotides
2. Understand the structural organization of RNA and DNA
3. Define the role of hydrogen bonds in 3-D structures of nucleic acids
4. List the differences between DNA and RNA
5. Describe the double helical structure of DNA
6. Identify the various kinds of RNA and their biological functions

Amino Acids and Proteins

1. Describe the general properties of amino acids
2. Describe their classification, based on their side chain composition.

3. List the non-protein amino acids
4. Understand the acid-base properties of amino acids
5. Describe the formation of peptides.
6. List the biologically important peptides and their functions.
7. Define primary, secondary, tertiary and quaternary structures of proteins

Structure and Functional Relationships of Protein

1. Explain the factors affecting protein structural stability
2. Understand the structural basis of protein denaturation.
3. List the properties of the oxygen binding proteins: hemoglobin and myoglobin and describe the regulation of oxygen transport.
4. Understand why myoglobin is a storage protein while hemoglobin is a transport protein.

Enzyme Kinetics

Understand the relation between enzyme catalyzed reaction and transition state of the reaction and enzyme inhibitors.

Describe the unique hallmarks of enzyme catalysis.

2. List the 6 basic types of enzyme reactions
3. List the coenzymes; know from which vitamins they are derived and their general type of catalytic functions.
4. Describe how enzymes increase the rate of catalysis
5. Explain the fundamental nature of the catalytic center of enzymes.
6. List the factors that affect the rate of enzyme catalysis
7. Use the Michaelis-Menton equation in describing how enzymes work
8. Describe the physiological signature of K_m & V_{max}
9. Explain the double reciprocal method of determining K_m and V_{max} .
10. Describe the effect of activators and inhibitors on enzymes
11. Distinguish between reversible and irreversible inhibitors and list the types of reversible inhibitors

Carbohydrates

Structure and function of monosaccharides and polysaccharides.

1. Understand the chemical nature of carbohydrates
2. Describe how carbohydrates are classified
3. Understand the stereoisomerism of carbohydrates and explain their existence as
 - (i) D & L-isomers, (ii) Anomeric forms, and (iii) Chair and boat conformations
4. Recognize the structures of simple sugars and complex carbohydrates.

5. Understand the chemical nature of blood group antigens

Structure and function of major lipids and lipoproteins

1. List the biological functions of lipids
2. Describe how lipids are classified
3. Explain the basic structure of triglycerides and their hydrolytic products
4. Describe the different types of phospholipids and their functions
5. Recognize the structure of cholesterol and its biological function

Cell membrane Biosignaling

1. Describe the 'lipid bilayer' and 'fluidic mosaic' models of membrane structure
2. Explain the composition of the biological membrane
3. List the functions of the biological membrane
4. List the kinds of biological transporters and understand their mechanisms
5. Distinguish among uniport, symport, and antiport systems
6. Explain the mechanism of 'bio-signalling' (signal transduction)

Overview of Metabolism

1. Explain the role of catabolic and anabolic pathways in cell metabolism
2. Distinguish between kinetic and potential energy
3. Distinguish between open and closed systems
4. Explain the role of ATP in the cell
5. Describe ATP's composition and how it performs cellular work
6. Understand the energy profile of a reaction including: activation energy, free energy change, & transition state
7. Describe the role and mechanisms of enzymes
8. Glucose as a major energy source
9. Explain how metabolic pathways are inter-linked.
10. Explain how acetyl-Co-A serves as a key intermediate
11. List examples of diseases resulting from defects in metabolism

Team Based Learning Activity - Biochemistry and its relationship to other disciplines

Will provide an opportunity to the students to interact and work as a team to to apply their knowledge in basic biochemistry to practical scenarios. How to identify a research problem in the biochemistry field. How to apply the basic biochemistry knowledge to design a research project/ scientific publications and submit the findings How will you apply your biochemistry knowledge in the field of diagnosis and treatment of patients.

Students should have the fundamental understanding of the structure and functional relationship of proteins to explain it to the peers and apply to design project proposals. Communicate Read and interpret scientific articles in biochemistry.

Special Needs and Accommodations

Please advise the instructor of any special problems or needs at the beginning of the semester.

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides

comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services

Texas A&M University-Commerce

Gee Library, Room 132

Phone (903) 886-5150 or (903) 886-5835

Fax (903) 468-8148

StudentDisabilityServices@tamuc.edu