SAHARA MEDICAL COLLEGE, NAROWAL
DEPARTMENT OF BIOCHEMISTRY

STUDENTS' GUIDE
1st Year
Learning Objectives

1: Introduction to Biochemistry and Membrane Phenomenon

At the end of lectures, students must understand and be able to describe the following:

- **Understand the importance of the ability of cell-free extracts of yeast of ferment sugars s,**
- **Appreciate the scope of biochemistry and its central role in the life sciences ,**
- **Biochemistry intimately related disciplines.**
- **understand disease,**
- **Identify potential therapies.**
- **Describe how genetic approaches have been critical for elucidating many areas of biochemistry,**
- **How the Human Genome Project has furthered advances in numerous aspects of biology and medicine.**

2: Vitamins:

At the end of lectures, students must understand and be able to describe the following:

- **What are the sources of various vitamins including Vitamin A, B complex, C, D, E, K,**
- **Dietary requirements of all vitamins**
- **How are vitamins processed in body**
- **What are the advantages of vitamins**
- **What disorders can occur in body with the deficiency of vitamins**
- **What disorders can occur in body with excess of vitamins**

3: pH, Water and Electrolyte Balance

At the end of lectures, students must understand and be able to describe the following:

- **Describe the properties of water that account for its surface tension,**
- **Viscosity,**
- **Liquid state at ambient temperature,**
- **Solvent power.**
- **Use structural formula to represent several organic compounds that can serve as hydrogen bond donors or acceptors.**
- **Explain the role played by entropy in the orientation, in an aqueous environment, of the polar and no polar regions of macromolecules.**
- **Indicate the quantitative contribution of salt bridges, hydrophobic interactions, and van der Waals forces to the stability of macromolecules.**
- **Explain the relationship of pH to acidity, alkalinity, and the quantitative determinants that characterize week and strong acids.**
- **Calculate the shift in pH that accompanies the addition of a given quantity of acid or base to the pH of a buffered solution.**
- **Illustrate how the Handerson-Hasselbalch equation can be used to calculate the net charge on polyelectrolyte a given pH**

4: AMINO ACIDS & PEPTIDES

At the end of lectures, students must understand and be able to describe the following:

- **Diagram the structures and write the three-and one-letter designations for each of the amino acids present in proteins.**
- **Diagram the contribution of each type of R group of protein amino acids to their chemical properties.**
- **List addition key function of amino acids**
- **Explain how certain amino acids in plant seeds can severely impact human health.**
- **Name the ionizable groups of the protein amino acids**
- **List their approximate pKa values as free amino acids in aqueous solution.**
- **Define pl and explain its relationship to the net charge on a polyfunctional electrolyte.**
- **Explain how pH, pKa and pl can be used to predict the mobility of a polyelectrolyte,**
- **Describe the directionality,**
- **nomenclature**

- **Primary structure of peptides.**
- **Describe the conformational consequences of the partial double-bond character of the peptide bond**
- **Identify the bonds in the peptide backbone that are free to rotate**

5: PROTEINS; & THEIR STRUCTURES:

At the end of lectures, students must understand and be able to describe the following:

- **Describe the Multiple Chromatographic Methods**
- **Describe the how electrophoresis in polyacrylamide gels can be used to determine a protein's purity relative mass,**
- **Isoelectric point.**
- **Describe the basis on which quadruple and time-of flight spectrophotometers determine molecular mass.**
- **Given three reasons why mass spectrometry (MS) has largely supplanted chemical methods for the determination of the primary structure of proteins**
- **The detection of posttranslational modifications.**
- **Explain why MS can identify posttranslational modifications that are undetectable by Edman sequencing or DNA sequencing.**
- **Describe how DNA cloning and molecular biology made the determination of the primary structures of proteins much more rapid and efficient.**
- **Explain what is meant by "the proteome"**
- **Cite examples of its ultimate potential significance.**
- **Describe the advantages and limitations of gene chips as a tool for monitoring protein expression.**
- **Describe three strategies for resolving individual proteins**
- **peptides from complex biologic samples to facilitate their identification by Ms.**
- **Comment on the contribution of genomics, computer algorithms,**
- **Databases to the identification of the open reading frame (ORFs) that encode a given protein.**
- **Indicate the advantages and drawbacks of several approaches to classifying proteins.**
- **Explain and illustrate the primary, secondary, tertiary, and quaternary structure of protein.**
- **Identify the major recognized types of secondary structure and explain super secondary motifys.**
- **Describe the information summarized by Ramachandran plot.**
- **Identify the physiologic roles in protein maturation of chaperones,**

- **Protein disulfide the principal biophysical techniques used to study tertiary and quaternary structure of proteins.**
- **Explain how genetic and nutritional disorders of college maturation illustrate the close linkage between protein structure and function.**
- **For the prion diseases, outline the overall events in their molecular pathology and name the forms each affect.**

6: PROTEINS: MYOGLOBIN & HEMOGLOBIN

At the end of lectures, students must understand and be able to describe the following:

- **Describe the important structure similarities and differences between myoglobin and hemoglobin.**
- **Sketch binding curves for the oxygenation of myoglobin and hemoglobin.**
- **Identify the covalent linkages and other close associations between heme and globin in oxymyoglobin and oxyhemoglobin.**
- **List addition key function of amino acids and explain how certain amino acids in plant seeds can severely impact human health.**
- **Describe three strategies for resolving individual proteins and peptides from complex biologic samples to facilitate their identification by Ms.**
- **Comment on the contribution of genomics, computer algorithms,**
- **Databases to the identification of the open reading frame (ORFs) that encode a given protein.**
- **Diagram the contribution of each type of R group of protein amino acids to their chemical properties.**

7: BIOENERGTICS & BIOLOGICAL OXIDATION

At the end of lectures, students must understand and be able to describe the following:

- **State the first second laws of thermodynamics and understand the biologic.**
- **Explain what is meant by the terms free energy,**
- **Entropy.**
- **Appreciate how reactions that are undergone may be driven by coupling.**
- **Understand the role of high-energy phosphates, ATP, other nucleotide**
- **Understand the meaning of redox potential**
- **Explain how it can be used to predict the direction.**
- **Identify the four action classes of enzymes (oxidoreductases) involved in oxidation.**

- **Describe the action of oxidizes and provide examples of where they play an important role in metabolism.**
- **Indicate the two main functions of dehydrogenases**
- **Explain the importance of NAD.**
- **Indicate the two types of enzymes classified as hydroperoxidases; indicate the reaction they catalyze.**
- **Explain their important.**
- **Give the two steps of reactions catalyzed by oxygenizes.**
- **Identify the two subgroups of this class of enzymes.**
- **Appreciate the role of cytochrome P450 in drug detoxification.**
- **Explain the steroid synthesis.**
- **Describe the reaction catalyzed by superoxide dismutase.**

8: OVERVIEW OF METABOLISM & THE PROVISION OF METABOLIC FUELS

At the end of lectures, students must understand and be able to describe the following:

- Explain what is meant by anabolic pathways
- Catabolic pathways
- Amphibole metabolic pathways.
- Describe in outline the metabolism of carbohydrates.
- Describe the ways in which flux of metabolic ions occur

9: ENZYMES

At the end of lectures, students must understand and be able to describe the following:

- **Appreciate and describe the structure relationships between specific B vitamins and certain coenzymes.**
- **Describe the concept of an "induced fit"**
- **How it facilitates catalysis.**
- **Outline the underlying principles of enzyme-linked immunoassays.**
- **Describe how coupling an enzyme to the activity of dehydrogenases can simplify assay of the activity of a given enzyme.**
- **Indicate the function of specific proteases in the purification of affinity-tagged enzyme.**
- **Discuss the events that led to the discovery that RNAs can act as enzymes,**

- **Briefly describe the evolutionary concept of an "RNA world."**

- **Describe the scope and objectives of enzyme kinetic analysis.**
- **Indicate whether ΔG, the overall change in free energy for a reaction. is dependent on reaction mechanism.**
- **Indicate whether ΔG is a function of the rates reactions.**
- **Contrast the effects of an increasing concentration of substrate on the kinetics of simple competitive and noncompetitive inhibition.**
- **Describe how substrates add to, and products depart from, an enzyme that follows a ping-pong mechanism.**
- **Describe how substrates add to, and products depart from, an enzyme that follows a rapid-equilibrium mechanism.**
- **Provide examples of the utility of enzyme kinetics in ascertaining the mode of action of drugs.**
- **Explain the concept of whole-body homeostasis and its response to fluctuations in the external environment.**
- **Discuss why the cellular concentrations of substrates for most enzyme tend to be close to Km.**
- **List multiple mechanisms by which active control of metabolite flux is achieved.**
- **Describe typical structure changes that accompany conversion of a proenzyme to the action enzyme.**
- **Describe the basic feature of a typical binding sits for metabolites and second messengers that regulate catalytic activity of certain anzymes.**
- **Describe two ways by which regulatory networks can be constructed in cells.**

10: BIOINFORMATICS &COMPUTATIONAL BIOLOGY

At the end of lectures, students must understand and be able to describe the following:

- **Describe the distinguishing features of genomic, proteomics, and bioinformatics.**
- **Describe the major features of computer-aided drug design and discovery.**
- **Describe possible future applications of computational models of individual pathways and pathway networks.**
- **Describe the functions served by HapMap, Entrez Gene, and the dbGAP datebases.**
- **Recognize the potential and challenges presented by genome-guided personalize medicine.**
- **Summarized the principal feature and medical relevance of ENCODE project.**
- **Explain how BLAST and deciphering of the folding code assist scientists in the elucidation.**
- **Outline the possible medical utility of "virtual cells".**
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11: CARBOHYDRATES OF PHYSIOLOGICAL SIGNIFICANCE

At the end of lectures, students must understand and be able to describe the following:

- **Explain what meant by the glycome,**
- **Explain what meant by glycobiology**
- **Explain what meant by the science of glycomics.**
- **Explain what is meant by the terms monosaccharide,**
- **Explain what meant by disaccharide.**
- **Explain the different ways in which the structure of glucose and other monosaccharides.**
- **Explain what is meant by the glycemic index of a carbohydrate.**
- **Describe the role of carbohydrates in cell membranes and lipoproteins.**

12: THE CITRIC ACID CYCLE: THE CENTRAL PATHWAY OF CARBOHYRATE, LIPID &AMINO ACID METABOLISM

At the end of lectures, students must understand and be able to describe the following:

- **Explain the importance of vitamins in the citric acid cycle.**
- **Explain how the citric acid cycle provides both a route for catabolism of amino acids.**
- **Explain how the activity of the citric acid cycle is controlled by the availability of oxidized cofactors.**
- **Explain how the hyperammonemia can lead to loss of consciousness.**
- **Describe the reactions of the citric cycle and the reactions that lead to the production of reducing equivalents that are oxidized in the mitochondrial electron transport chain to yield ATP.**
- **Describe the main anaplerotic pathways that permit replenishment of citric acid cycle intermediates.**
- **Describe the role of the citric acid cycle in fatty acid synthasis.**

13: GLYCOLYSIS &THE OXIDATION OF PYRUVATE

At the end of lectures, students must understand and be able to describe the following:

- **Describe the pathways of glycolysis and its control,**
- **How glycolysis can operate under anaerobic conditions.**
- **Describe the reaction of pyruvate dehydrogenase and its regulation.**
- **Explain how inhibition of pyruvate metabolism leads to lactic acidosis.**

14: METABOLISM OF GLYCOGEN

At the end of lectures, students must understand and be able to describe the following:

- **Describe the structure of glycogen.**
- **Its importance as a carbohydrate reserve.**
- **Describe the synthesis and breakdown of glycogen.**
- **How glycogen residues processe.**
- **Describe the various types of of glycogen storage diseases.**

15: GLUCONEOGENESIS & THE CONTROL OF BLOOD GLUCOSE

At the end of lectures, students must understand and be able to describe the following:

- **Explain the importance of gluconeogenesis in glucose homeostasis.**
- **Explain how plasma glucose concentration is maintained within narrow limits in the fed and fasting states.**
- **Describe the pathway of gluconeogenesis**
- **How irreversible enzymes of glycolsis are bypassed.**

16: THE PENTOSE PHOSPHATE PATHWAY & OTHER PATHWAY OF HEXOSE METABOLIM

At the end of lectures, students must understand and be able to describe the following:

- **Describe the pentose phosphate pathway and its roles as a source of NADPH.**
- **Describe the uronic acid pathway and importance for synthesis of glucuronic acid for conjugation reactions and (in animals for which it is not a vitamin)**
- **Describe and explain the consequences of large intakes of fructose.**
- **Explain the consequences of genetic defects of glucose-6-phosphate.**

17: LIPIDS OF PHYSIOLOGIC SIGNIFICANCE

At the end of lectures, students must understand and be able to describe the following:

- **Define simple and complex lipids and identify the lipid classes in each group.**
- **Indicate the structure of saturate and unsaturated fatty acids.**
- **Explain how the chain length.**
- **Understand the difference cis and Trans carbon-carbon double bonds.**
- **Outline the general structure of triacylgycerols and indicate their function.**
- **Outline the general structure of phospholipids and glycosphingolipids.**
- **Indicate the function of the different classes.**
- **Appreciate the importance of cholesterol as the precursor of many biologically important steroids, including steroid hormones, bile acids, and vitamins D.**
- **Understand that many lipid molecules are amphipathic, having hoth hydrophobic and hydrophilic group in their structure.**
- **Explain how this influences their behavior in an aqueous environment and explain certain classes, including phospholipids, sphingolipids, and cholesterol, to from the basic structure of biologic membranes.**

18: OXIDATION OF FATTY ACIDS: KETOGENESIS

At the end of lectures, students must understand and be able to describe the following:

- **Describe the processes by which fatty acids are transported in the blood and activated.**
- **Explain the transporte into the matrix mitochondria for breakdown to obtain energy.**
- **Outline the β-oxidation pathway by which fatty acids are metabolized to acetyl.**
- **Identify the three compounds termed "ketone bodies".**
- **Describe the reactions by which they are formed in liver mitochondria.**
- **Appreciate that ketene bodies are important fuels for exteahepatic tissues.**
- **Indicate the conditions in which their synthesis and use are favored.**
- **Understand that overproduction of ketene bodies leads to ketosis and, if prolonged, ketoacidosis.**
- **Identify pathological condition when this occurs.**

19: BIOSYNTHESIS OF FATTY ACIDS & EICONSANOIDS

At the end of lectures, students must understand and be able to describe the following:

- **Describe the reaction catalyzed by acetyl-CoA carboxylase and understand the mechanisms.**
- **Outline the structure of the fatty acid syntheses multienzyme complex.**

9. Biochemistry of Digestive Tract

Digestion and absorption Composition, function and daily secretion of saliva, gastric juice, gastric acid(HCL), pancreatic juice, bile, and intestinal secretion Digestion of proteins, carbohydrates, nucleic acids and lipids Biochemical disorders of GIT i.e achlorhydria, acid peptic disease, lactose intolerance and cholelithiasis

8. Biochemistry of Endocrine System: Chemistry, secretion, mechanism of action, regulation of various hormones.

Biochemical Genetics (Informational Flow in the Cell): 1. The structural basis of the cellular information 2. DNA, chromosomes, discovery and organization of DNA in genomes 3. Super coiling of DNA 4. The replication of DNA (DNA dependant DNA synthesis) DNA polymerase, its components and functions Initiation, elongation and termination of replication DNA repair, mutation and cancers 5. The Transcription (DNA dependant RNA synthesis) RNA polymerase, its components and functions Initiation, elongation and termination of transcription RNA processing RNA dependant synthesis of RNA and DNA Reverse transcription-DNA synthesis from Viral RNA Retroviruses in relation to Cancer and AIDS 6. The Translation (Protein Synthesis) The genetic codes and their characteristics Initiation, elongation, and termination of protein synthesis Post-translational modification Regulation of gene expression 7. Molecular biology technology DNA isolation DNA-recombinant technology Hybridization, blotting techniques 8. Genetic disorders

6. Metabolism of Nucleotide: De novo purine synthesis Synthesis of pyrimidine Recycling of purine and pyrimidine bases (the salvage pathway) Degradation of purine, formation of uric acid