



University of Management & Technology
School of Science
Department of Life Science

BC-313 Bioenergetics and Metabolism

Lecture Schedule	Tuesday (12:30 PM -13:45 PM) Friday (09:30 AM -10:45 AM)	Semester	Spring 2021
Pre-requisite	---	Credit Hours	3
Instructor	Ms Nabiha Naeem	Contact Moodle link	
Office	3S-37	Office Hours	See office window
Course Description	This course provides insights into energy, its production and regulation in living system and the essential aspects of intermediary metabolism and its importance to the overall biology of an organism.		
Expected Outcomes	<p>The students are expected to demonstrate</p> <ul style="list-style-type: none"> • Intermediary metabolism and its importance to the overall biology of an organism • Insights into energy, its production and regulation in living system 		
Textbook(s)	<ol style="list-style-type: none"> 1. Rodwell, V. W. (2018). Harper's illustrated biochemistry.31st Ed. McGraw Hill. 2. Voet, D. (2016). Fundamentals of biochemistry. 5th Ed. Chichester: Wiley. 3. Lehninger Principles of Biochemistry" by Nelson & Cox, (2017) 7th edition ISBN 13:978-0-7167-7108-1. 		
Grading Policy	<ul style="list-style-type: none"> • Quizzes 10% • Assignment 10% • Presentation 5% • Midterm: 30% • Final Exam: 45% 		

Course Schedule

Week	Lecture #	TOPICS	Chapter Name
1	1 2	Basic thermodynamic concepts of energy and free energy, Enthalpy Entropy and their relationships; endothermic and exothermic reactions	Part II Bioenergetics and Metabolism Ch:13 Principles of bioenergetics
2	1 2	Biological oxidation and reduction; high energy compounds Coupling mechanisms: substrate level phosphorylation	Ch:13 Principles of bioenergetics
3	1 2	Glucose central role in metabolism of plants, animals and micro-organism. Glycolysis, reactions of glycolysis. Fermentation: anaerobic fate of pyruvate, control of metabolic flux.	Ch: 14 Glycolysis, gluconeogenesis, And the pentose phosphate Pathway
4	1 2	Pentose Phosphate Pathway	Ch: 14 Glycolysis, gluconeogenesis, And the pentose phosphate Pathway
5	1 2	Citric Acid Cycle Electron Transport Chain,	Ch: 16 The Citric Acid Cycle Ch: 19 Oxidative Phosphorylation
6	1 2	Oxidative Phosphorylation (ATP synthesis), Glycerol-Phosphate Shunt, Malate aspartate shunt	Ch: 19 Oxidative Phosphorylation
7	1 2	Photosynthesis (Light Reaction) Calvin Cycle	Ch: 20 Carbohydrate biosynthesis In plants and bacteria
8	1 2	Nitrogen assimilation in biological systems Amino acid synthesis (Anabolism)	Ch: 22 Biosynthesis of amino acids, Nucleotides, and related Molecules
9	1 2	Midterm Exam Review Paper	
10	1 2	Amino acid degradation (Amino transferases) Urea Cycle	Ch: 18 Amino Acid Oxidation and the Production of Urea
11	1 2	Pathways of Amino acid degradation (Catabolism)	Ch: 18 Amino Acid Oxidation and the Production of Urea

12	1 2	Nucleic Acid metabolism (degradation and assimilation) and control Purine and Pyrimidine synthesis.	Ch: 22 Biosynthesis of Amino Acids, Nucleotides, and Related Molecules
13	1 2	Lipid metabolism: Introduction to lipid metabolism, β -oxidation of fatty acids, ketogenesis. .	Ch: 17 Fatty acid catabolism
14	1 2	Biosynthesis of fatty acids	Ch: 21 Lipid Biosynthesis
15	1 2	Biosynthesis of Cholesterol	Ch: 21 Lipid Biosynthesis

HEC COURSE CONTENTS

BIOENERGETICS

Introduction; basic thermodynamic concepts of energy and free energy, enthalpy, entropy and their relationships; endothermic and exothermic reactions; biological oxidation and reduction; high energy compounds; coupling mechanisms: substrate level phosphorylation, electron transport chain, oxidative and photo phosphorylation; autoregulation of energy production.

Lehninger Principles of Biochemistry, by David L. Nelson and Michael M. Cox, 6th Edition, Macmillan International Edition.

METABOLISM (4+0)

COURSE CONTENTS:

Carbohydrate metabolism: Glucose central role in metabolism of plants, animals and micro-organism. Glycolysis, reactions of glycolysis. Fermentation: anaerobic fate of pyruvate, control of metabolic flux. Regulation of glycolytic pathway. Entry of Galactose, Mannose and fructose into glycolytic pathway.

TCA cycle: Overview of TCA, Metabolic sources of Acetyl Coenzyme A. Amphibolic nature, anaplerotic reactions. TCA Cycle inhibitors, Regulation, pyruvate dehydrogenase complex enzyme.

Other pathways of carbohydrate metabolism: Gluconeogenesis, cori cycle, glycogenesis, glycolysis, glycogen storage diseases, Glyoxalate Cycle reactions, Pentose phosphate Pathway.

Carbohydrate synthesis: Synthesis of starch, cellulose and peptidoglycan, glycoproteins. Glycogen metabolism, Synthesis and breakdown, glycogen synthetase and phosphorylase and their regulation, Glycogen Storage diseases.

Lipid metabolism: Introduction to lipid metabolism, β -oxidation of fatty acids, ketogenesis. Biosynthesis of Fatty acids. Triacylglycerols and prostaglandins. Metabolism of phospholipids, glycolipids and cholesterol.

Lipoproteins: metabolism of HDL Disorder of plasma lipoproteins, fatty liver, obesity, atherosclerosis. Biosynthesis of triacylglycerols, Phospholipids, Cardiolipids, Glycolipids and sphingolipids. Arachidonate metabolism, Prostaglandins: Prostacyclins, Thromboxanes and eukotrienes, synthesis of cholesterol and steroid hormones; degradation to bile acids.

Protein metabolism: Digestion and absorption of proteins; General aspects of amino acids metabolism, deamination, transamination, transmethylation, transpeptidation and decarboxylation. Amino acid degradation and urea cycle. Inborn errors of metabolism. Nitrogen balance, biosynthesis of non-essential amino acids.

Major pathways and strategies of energy metabolism: Organ specialization Brain, Muscle, Adipose tissue, liver.

Metabolic adaptation –Starvation, Diabetes Mellitus. Shuttle systems: Introduction, importance of Shuttle Systems, Glycerol Phosphate shuttle, Malate aspartate shuttle

RECOMMENDED BOOKS:

1. Lehninger Principles of Biochemistry" by Nelson & Cox, 5th edition ISBN 13:978-0-7167-7108-1.
2. Fundamentals of Biochemistry (2008) 3rd edition By DJ Voet , GJ Voet and CW Pratt. J Wiley & Sons Inc.
3. Biochemistry (2007) 6th edition by JM Berg, JL Tymoczko & L Stryer WH Freeman & Co 28
4. Biochemistry 3rd Edition (Lippincott's Illustrated Reviews Series) by Richard A. Harvey.
5. Harpers Illustrated Biochemistry 29th Edition (LANGE Basic Science) by Robert Murray, D. Bender, Kathleen M. Botham and P.J. Kennelly (Feb 7, 2012)