

## The University of Jordan

**Faculty:** Medicine

**Semester:** First

**Course Name:** Metabolism for  
medical students

**Department:** Physiology and Biochemistry

**Academic Year:** 2023-2024

**Course Number:** 0501223

<b>Credit hours</b>	3	<b>Level</b>	2	<b>Prerequisite</b>	Organic Chemistry
<b>Coordinator/ Lecturer</b>	Prof. Nabeel Al-Bashir Prof. Mamoun Ahram Dr. Nafez Abu Tarboush Dr. Diala Abu Hassan	<b>Office Number</b>		<b>Office phone</b>	
<b>Course website</b>		<b>E-mail</b>		<b>Place</b>	

<b>Office hours</b>					
<b>Day/Time</b>	<b>Sunday</b>	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>
	TBD	RBD	TBD	TBD	TBD

### Course Description

This three-credit hour course is mandatory for second-year medical students. The course is preceded by Biochemistry I where the introduction to biochemistry via covering the basic concepts of structures and functions of macromolecules has been given. In this course, a detailed description of the various metabolic processes will be given. This includes the structure-function relationship of specific proteins, metabolism of energy, carbohydrates, lipids, proteins, and nucleic acids, followed by a brief material that covers nutrition and vitamins with respect to the human body.

### Learning Objectives

- 1) learn the structure-function relationship of specific proteins
- 2) Know the various human metabolic processes that affect different macromolecules
- 3) Link different macromolecules to the concept of nutrition and vitamins

### Intended Learning Outcomes (ILOs):

Successful completion of the course should lead to the following outcomes:

**A. Knowledge and Understanding:** The student is expected to

- A1- Understand the need for energy in the human body, list the phases of energy transformation, and be familiar with the different bioenergetic terms
- A2- Explain the concept of thermogenesis
- A3- Explain the concept of oxidation-reduction (Redox) reactions and differentiate between the different classes of enzymes responsible for them. Also, be able to calculate the energy requirements from the redox potential
- A4- Understand the caloric value of different nutritional fuels
- A5- Explain the concept of energy balance
- A6- Be able to answer why we need the TCA cycle, explain how different fuels get converted to Acetyl CoA with a detailed description of its fate in the TCA cycle
- A7- Understand and memorize the different reactions coenzymes and enzymes of the TCA cycle
- A8- Understand the concept of substrate-level phosphorylation
- A9- Be able to calculate the bioenergetics of the TCA cycle and understand how it is regulated, know the intermediates in relation to amino acids and explain the concept of anaplerotic reactions
- A10- define the oxidative phosphorylation process and know why we need it
- A11- List the requirements of oxidative phosphorylation, and explain the concept of the electrochemical potential gradient with a detailed description of the different oxidation-reduction components of the electron transport chain
- A12- Know the proton pumping mechanism & role
- A13- Explain the structure, mechanism, and role of ATP synthase
- A14- Understand the mechanism of oxidative phosphorylation blockers & uncouplers
- A15- Explain the classes of genetic diseases associated with the process
- A16- Explain how carbohydrates get digested, absorbed, & transported
- A17- Explain glycolysis (reactions, regulation, energy, disorders)
- A18- Know the metabolic fate of pyruvate under different conditions, reactions & enzymes involved in these processes
- A19- Explain gluconeogenesis (reactions, regulation, significance)
- A20- Explain glycogen metabolism: glycogenesis reactions, glycogenolysis reactions, significance, regulation, disorders
- A21- Explain the pentose phosphate pathway (reactions, regulation, significance, disorders)
- A22- Understand the concept of oxygen & reactive oxygen species (generation, major cellular sources, Fenton reaction, Haber-Weiss reaction)
- A23- Understand the concept of oxygen & reactive oxygen species
- A24- Discuss the effect of nitric oxide & reactive nitrogen-oxygen species, the formation of free radicals during phagocytosis & inflammation, cellular defenses against oxygen toxicity
- A25- Describe the uronic acid pathway (reactions & significance)
- A26- Know galactose metabolism & disorders associated
- A27- Know fructose metabolism & disorders associated
- A28- Discuss blood glucose level & regulation
- A29- Explain the general digestion & transport processes of dietary lipids

- A30- Explain the synthesis of chylomicrons, transport in blood & fate
- A31- Explain the synthesis of fatty acids, triacylglycerols, & the major membrane lipids
- A32- Explain the synthesis of triacylglycerols & VLDL particles, their storage & fate
- A33- Discuss the metabolism of glycerophospholipids & sphingolipids
- A34- Explain cholesterol absorption, transport, synthesis, metabolism & fate
- A35- Discuss eicosanoids (metabolism, sources, synthesis)
- A36- List fat-soluble vitamins & discuss their naming, detailed structure description, mechanism, function, & diseases associated with their excess or deficiency
- A37- Discuss the integration of carbohydrate & lipid metabolism (regulation in the fed & fasting states)
- A38- Discuss protein metabolism (digestion, absorption & transport)
- A39- Define the concept of nitrogen balance
- A40- Know the amino acids pool & protein turnover processes
- A41- Discuss protein degradation pathways (proteasomes vs. lysosomes)
- A42- Explain the metabolism of the amino group in amino acids (pathways, transamination reactions, diagnostic value of plasma aminotransferases, the oxidative deamination reactions, transport of ammonia)
- A43- Describe the urea cycle in detail (reactions, enzymes, regulation, & diseases associated)
- A44- Explain the metabolism of the carbon skeleton in amino acids (important coenzymes, amino acid synthesis (general features), amino acid degradation (general features), amino acids derived from intermediates of glycolysis, amino acids related to intermediates of the TCA cycle)
- A45- List and discuss diseases & metabolic defects in amino acid metabolism
- A46- Know the conversion process of amino acids to specialized products (porphyrin, catecholamines, histamine, serotonin, creatine, melanin, glutathione)
- A47- Discuss porphyrin metabolism (structure, detailed synthesis & degradation of heme, porphyrias, jaundice & its types, & determination of bilirubin concentration)
- A48- Know the general metabolism of catecholamines, histamine, serotonin, creatine, melanin, & glutathione
- A49- Explain nucleic acids digestion & absorption
- A50- Discuss the biosynthesis of purine nucleotides, de novo synthesis of purine nucleotides (precursors, major steps, & regulation), salvage pathway synthesis of purine nucleotides, synthesis of deoxyribonucleotides
- A51- Discuss the biosynthesis of pyrimidine nucleotides, DE NOVO synthesis of pyrimidine nucleotides & its regulation, salvage pathway for pyrimidine nucleotide synthesis
- A52- Explain the catabolism of purine & pyrimidine nucleotides, the significance of uric acid, & diseases associated with their metabolism
- A53- Discuss how metabolism is integrated and organized in addition to the Phenomena of obesity and diabetes.

**B. Intellectual Analytical and Cognitive Skills:** The student is expected to

- B1- Calculate the energy requirements for different reactions
- B2- Predict the favorability of biochemical pathways
- B3- Interpret data from biochemical calculations of human processes
- B4- Differentiate between various carbohydrate metabolic pathways
- B5- Differentiate between various lipid metabolic pathways
- B6- Integrate carbohydrate & lipid metabolism
- B7- Determine healthy diets through their compositions

## Teaching/Learning Methods

Teaching Method	ILO/s
Lectures and Discussions:	<b>90%</b>
Homework and Assignments:	<b>10%</b>
Projects:	<b>0%</b>
Presentation	<b>0%</b>

## **Course Contents**

<b>Topic</b>	<b>No. of lectures</b>	<b>Week</b>	<b>Reference</b>	<b>ILOs</b>
Bioenergetics of the cell	3	1	Marks, Ch 19	A1-5
Energy Metabolism (TCA cycle)	2	2	Marks, Ch 20	A6-9
Energy Metabolism (Oxidative Phosphorylation)	3	2,3	Marks, Ch 21	A10-15
Carbohydrate metabolism & ROS	9	3-7	Lippincott, Ch. 7,8, 10-14 & handout	A16-28
Lipid metabolism and lipid-soluble metabolism	9	7-10	Lippincott, Ch. 15-18, 24, 28	A29-36
Amino acids & protein metabolism	5	10-12	Lippincott, Ch. 19-20	A37-44
Conversion of amino acids to specialized products	2	12	Lippincott, Ch. 21	A45-47
Nucleic acid metabolism	4	13,14	Lippincott, Ch. 22	A48-52
Diabetes and obesity	2	15	Lippincott, Ch.	A53

## **Learning Methodology**

Lectures and homework

## **Projects and Assignments**

None

## **Evaluation**

<b>Evaluation</b>	<b>Point %</b>	<b>Date</b>
<b>Midterm Exam</b>	40%	TBD
<b>Project</b>	0	
<b>Assignments</b>	10%	Sudden
<b>Homework</b>	0	
<b>Final Exam</b>	60%	TBD

### **Main Reference/s:**

Lippincott's illustrated reviews, Biochemistry, 7<sup>th</sup> edition

Marks' Basic Medical Biochemistry: A Clinical Approach, 3<sup>rd</sup> Edition

### **References:**

- NCBI Bookshelf:  
(<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books>)
- The Medical Biochemistry Page:  
(<http://web.indstate.edu/thcme/mwking/home.html>)
- Biochemistry, Garret and Grishan, Second Ed.:  
<http://web.virginia.edu/Heidi/home.htm>

## **Intended Grading Scale**

0-39	<b>F</b>
45-49	<b>D<sup>-</sup></b>
50-54	<b>D</b>
54-69	<b>D<sup>+</sup></b>
60-64	<b>C<sup>-</sup></b>
65-69	<b>C</b>
70-73	<b>C<sup>+</sup></b>
74-76	<b>B<sup>-</sup></b>
77-80	<b>B</b>
81-84	<b>B<sup>+</sup></b>
85-89	<b>A<sup>-</sup></b>
90-100	<b>A</b>

### **Notes:**

- Concerns or complaints should be expressed in the first instance to the module lecturer; if no resolution is forthcoming, then the issue should be brought to the attention of the module coordinator (for multiple sections) who will take the concerns to the module representative meeting. Thereafter, problems are dealt with by the Department Chair and if still unresolved the Dean and then ultimately the Vice President. For final complaints, there will be a committee to review grading the final exam.
- For more details on University regulations please visit:  
<http://www.ju.edu.jo/rules/index.htm>