

Teaching program of **Biochemistry** – Integrated course of **Biochemistry**

Course year II – I Semester

N° CFU 5

Total hour 60

Learning goals

This course provides an overview of the main aspects of biochemistry by relating molecular interactions to their effects on the organism as a whole, especially as related to human biology. Biochemical and molecular mechanisms underlying pathophysiological processes in different organs will be explored. The essential theoretical knowledge accrued from this biochemistry course will represent a basis for subsequent professional application.

Expected learning Results

Knowledge and understanding: Upon completion of the course, the student should be able to explain the biochemical functions and the regulation of metabolic process occurring in individual cells, tissues as well as the whole human body.

Applying knowledge and understanding: The student should be able to apply the knowledge acquired to understand and solve problems. In particular, the student should be able to predict the metabolic effects caused by alterations on individual reaction step of a process, and to describe and explain connections between molecular changes and alterations in the metabolism for the most common diseases.

Making informed judgements and choices: The student should be able to integrate knowledge and develop an autonomy of judgment that should be applied in the subsequent courses.

Communicating knowledge and understanding: The student should know how to describe and communicate the main concepts of systematic biochemistry.

Capacities to continue learning: The student should have developed skills in reading and understanding reviews and original research papers concerning major biochemical aspects.

Contents

The course focuses on the integration of metabolism and hormonal regulation that usually exists between our organs. Specifically, the course will cover the following main topics:

1. Metabolic regulation of Biochemical pathways
2. Cell-to-cell communication and signalling
3. Reactive Oxygen Species (ROS)
4. Detoxification Reactions
5. Fast and Feed Cycle
6. Gastrointestinal system
7. Liver
8. Adipose tissue
9. Muscle
10. Bone
11. Nervous system
12. Blood

ECTS credit details

Lectures:

CFU 5

Hours 60

Laboratory classes **CFU 0** **Hours 0**

Prerequisites/requirements

Chemistry and biochemical propedeutics

Teaching methods

Lectures classes (Powerpoint); Group activity (Presentation of scientific articles)

Evaluation methods

The examination consists of written test followed by a subsequent oral dissertation on the topics developed during the theoretical lectures. The evaluation of the preparation of the student occurs on the basis of established criteria. Entrance Test and *In-Itinere* Tests could be also proposed in order to check the acquisition of the main basal concepts.

The final vote will be a weighted average of the vote of this course, of Biochemistry part I and Molecular Biology. Since Molecular Biology and Biochemistry II are two distinct parts of one integrated course, students must do both exams within a maximum of 3 exam sessions.

Evaluation criteria

Knowledge and understanding: Describe the functions of the main metabolic pathways in different organs, and their regulation.

Applying knowledge and understanding: Describe the interconnections of the metabolic processes in different organs throughout different conditions.

Making informed judgements and choices: Understand the importance of the main metabolic pathways in physiological and pathological conditions and the way to control them.

Communicating knowledge and understanding: Capacity to read, summarize and communicate experiments and results from original research articles.

Capacities to continue learning: Individual study and research based on scientific reviews and original articles to analyse in details and keep update the knowledge about the metabolic processes.

Textbooks

Marks' Basic Medical Biochemistry, 5th Edition. *Michael Lieberman – Alisa Peet*. Wolters Kluwer
Textbook of Biochemistry with Clinical Correlations, 7th Edition. *Thomas M. Devlin*. Wiley
Biochemistry, 9th Edition. *Jeremy M. Berg, Lubert Stryer, John L. Tymoczko*, Macmillan

Subject Teacher

Dr. Elena Piccinin, RTDA

Dipartimento di Scienze Mediche di Base, Neuroscienze e Organi di Senso (DSMBNOS)

Nuovo Complesso delle Scienze Biologiche, 1st floor

Università degli Studi di Bari "Aldo Moro"

Piazza Giulio Cesare, 11

70125 Bari (Italy)

elena.piccinin@uniba.it

Visiting hours

Only by previous agreement. Tutoring could be also on e-learning platforms. Please, send an email.

Syllabus

Main Topic	Topic	Description
Metabolic regulation of Biochemical pathways	Metabolic regulation of Biochemical pathways	Principle of Metabolic Regulation Key points of metabolic regulation (carbohydrates and lipids)
	Transgenic Animal model	Principal characteristic and applications of transgenic; knock-in and knock out mice
	Cancer	Cancer Metabolism
Cell-to-cell communication and signalling	Cell-to-cell communication	Classification
	Hormones	Classification; Steroid Hormones; Thyroid Hormones
	Hormone-Receptor Interaction	Scatchard analysis; RIA and ELISA techniques
	Receptors	Classification; GPCR; Tyrosine-Receptor; Hormone Receptor
	Receptor Regulation	Key Points of Receptor Regulation
	Second Messenger	cAMP; DAG; IP3
Reactive Oxygen Species	ROS	Definition and Characterization of ROS; Assays to test oxidative stress
	Mechanism of ROS regulation	Antioxidant Scavenging Enzymes; Non enzymatic antioxidants
	Oxidative Stress by-products	ROS damage to Nucleic Acids, Lipids, Proteins
	Pathophysiological role of ROS	ROS in protein activity and immunological response; Free mediated radical cell injury
	Ageing and ROS	Ageing; Progeria
Detoxification Reactions	Detox reaction	Phase I and Phase II reactions
	Cytochrome P450	Microsomal and Mitochondrial CYP450: structure, characteristics and reactions
	Acetaminophen Metabolism	APAP metabolism: physiology and pathology
	Ethanol Metabolism	Principal reactions; Enzymes involved; Acute Effects of Alcohol
Fast and Feed cycles	Glycemia	Glucose homeostasis; Glucose Regulation; Randle Cycle
	Fast-Feed Cycle	Characteristic and metabolic control of: Well Fed State; Early fasting state; Fasting State; Early Refed State; Starvation.
	Hormonal regulation of fuel metabolism	Glucagon and Insulin: characteristic and main functions
	Pathological conditions	Diabetes Mellitus Type 1 and Type 2; GTT; HbA1c
	Physiological Conditions	Pregnancy; Lactation
	Gastrointestinal System	Characteristic

Gastrointestinal System	Digestion and Absorption	Digestion and Absorption of Carbohydrates; Proteins and Lipids; Glycaemic Index
	Gut Microbiota	Description; Principal functions
Liver	Liver	Structure and Characteristics
	Hepatic Metabolism	Main aspects of Hepatic Metabolism; Metabolic control of hepatic metabolism
	Bile Acids Metabolism	Bile; Enterohepatic circulation; FXR
	Heme catabolism	Heme Catabolism; Jaundice
	Fatty Liver Disease	ALD; NAFLD
Adipose Tissues	Adipose Tissues	Characteristic of White, Brown, Beige and Pink Adipose Tissue
	WAT metabolism	Lipoprotein Lipase; Biosynthesis and degradation of TAG; TAG Cycle
	BAT metabolism	Thermogenesis; UCP family
	Adipokines	Leptin; TNF α ; Adiponectin
	Obesity and Metabolic Syndrome	Main characteristic and criteria; Insulin Resistance; PPAR
Muscle	Skeletal Muscle	Structural organization; Skeletal muscle contraction; Muscular Dystrophy
	Cardiac Muscle	Characterization and differences with skeletal muscle
	Smooth muscle	Smooth muscle contraction; Action of NO; NO Synthase; Myoglobin
	Calcium homeostasis	Calcium homeostasis; Protein regulated by calcium
	Muscle metabolism	Muscle fibers; Creatine Phosphate; Muscle metabolism; Myocardial infarction
Nervous System	Nervous System	Characterization; Membrane potential; Action Potential; Patch clamp techniques
	Ion channels	Ion Channels; Voltage Gated Channel
	Synapses	Electrical and chemical synapses
	Neurotransmitters	Acetylcholine; Catecholamines; Serotonin; Histamine; Glycine; Glutamate; GABA
	Receptors	Ionotropic and metabotropic receptors
Bone	Bone	Characteristic; Bone remodelling Cycle; Collagen; Bone mineralization process
	Vitamin D	Vitamin D metabolism; Vitamin D deficiency and excess
	Parathyroid hormone	
	Calcitonin	
Blood	Blood	Blood composition
	Lipoproteins	Classification and metabolism; Reverse Cholesterol Transport; Tangier Disease

Cholesterol	Lipid Rafts; Cholesterol biosynthesis; Cholesterol homeostasis; Atherogenesis; LXR
Heme Metabolism	Heme synthesis and function; Heme catabolism; Progeria
Biochemistry of erythrocytes and other blood cells	Red Blood Cells; Erythropoiesis; Vitamin B12; Type of Hemoglobins; Bohr Effect; 2,3BPG; Thalassemias
Coagulation	Hemostasis; Fibrinolysis; Vitamin K; Gla-residues
Iron Metabolism	Regulation and pathological aspect