UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

DIPARTIMENTO DI FARMACIA-SCIENZE DEL FARMACO

General Information	
Academic subject	**General and molecular biochemistry**
Degree course	**Pharmacy**
ECTS credits	10
Compulsory attendance	Yes
Course language	Italian
Academic year	2022/23

Subject teacher		
Course A-E	*Name Surname*	*Role*
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Course F-N	*Name Surname*	*Role*
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Course O-Z	*Name Surname*	*Role*
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ECTS credits details			
Basic teaching activities	*Area*	*SSD*	*CFU/ETCS*
	05	Bio/10	10

Class schedule	
Period	II semester
Year	2
Type of class	Open lecture

Time management	
Hours	300
In-class study hours	100
Out-of-class study hours	200

Academic calendar	
Class begins	2023, February 20th
Class ends	2023, June 16th

Syllabus	
Prerequisites/requirements	Basic knowledge of Biology, General and Inorganic Chemistry and Organic Chemistry. Foundations of the aforementioned subjects will be assessed by means of an anonymous multiple-choice entrance test that takes place during the first lesson
Expected learning outcomes	• *Knowledge and understanding* Course learning objectives: ○ chemical structure and function of the molecules making up living being ○ fundamentals of enzymatic kinetics and inhibition ○ biomolecules main metabolic transformations ○ energy transformation pathways ○ biochemical mechanisms underlying genetic information conservation and expression processes During the course, the student is guided in understanding macromolecules structure/function relationships and in developing an overview of the metabolic pathways operating in living cells. • *Applied knowledge and understanding* ○ use of a correct biochemical terminology ○ evaluation of influence of biomolecular structure alterations, induced by intra- or extracellular environment, on their function ○ use of kinetic enzymatic knowledge for simple problems solving ○ evaluation of possible effects of modulators on enzymatic activity in therapeutic field ○ ability to orient themselves in main metabolic pathways and understand the impact on them of physiological variations • *Making informed judgments* ○ development of the ability to integrate knowledge and make judgments even on partial and constantly evolving data • *Communication skills* ○ ability to communicate in oral and written form the fundamental contents of Biochemistry with both specialists and peers, and with primary and secondary school students • *Continuous learning* ○ autonomous understanding of Biochemistry contents in-depth studies at increasing complexity level
Contents	The cell and its compartments. Water Structure, properties and its effects on biological molecules.

	Sugars Monosaccharides, disaccharides and oligosaccharides of biological interest. Structural (cellulose and chitin) and storage (glycogen and starch) polysaccharides. Complex heteropolysaccharides: hyaluronic acid, keratan sulphate, chondroitin sulphate, heparan sulphate and heparin. Glycoproteins, proteoglycans and peptidoglycans. Lipids Fatty acids, triacylglycerols, glycerophospholipids, sphingolipids and sterols. Biological membranes and transport mechanisms across membranes. Nucleotides and nucleic acids Structure, function and nomenclature of nucleotides. Modified nucleotides, cyclic nucleotides. Coenzymes with nucleotide structure. Structure and function of DNA. B, A, Z DNA and H DNA. Structure and function of tRNA, mRNA and rRNA. Amino acids Structure, properties, titration curves and isoelectric point. Nomenclature of the 20 protein amino acids. Non-standard amino acids. Proteins Properties and functions of proteins. Peptide bond and peptides. The primary structure of proteins. The three-dimensional structure of proteins: secondary, tertiary and quaternary structures. Supersecondary structures. Fibrous and globular proteins. Denaturation and renaturation of proteins. Relations between three-dimensional structure and biological activity of proteins. Transport proteins of biological membranes. Oxygen carrying proteins: myoglobin and haemoglobin. Saturation curves. Cooperative bond. Bohr effect and 2,3-bisphosphoglycerate effect. Enzymes Structure, function, classification and specificity. Enzyme kinetics. Michaelis-Menten equation: meaning of Km, Vmax and Kcat. Lineweaver-Burk equation. Enzymatic inhibition: reversible and irreversible. Competitive, non-competitive, uncompetitive and mixed inhibition. Isoenzymes and ribozymes. Catalytic mechanisms. Oligomeric enzymes. Cooperativity and sigmoidal kinetic. Allosteric effectors. Allosteric, reversible covalent and by proteolysis enzymatic regulation. Regulation hormonal and by compartmentalization. Hormone receptors and examples of signal transduction mechanisms. Water-soluble vitamins. Coenzymes: structure and mechanisms of action. Principles of bioenergetics and thermodynamics Oxidation-reduction reactions of biological interest. Variations of free energy in a reaction. Meaning of standard biochemical conditions. Exergonic and endergonic reactions. “High energy” compounds. Role of the ATP. Coupled processes. The metabolic pathways. Overview of the metabolism. Sugar metabolism Glycolysis: reactions of the preparatory phase and of the energy production phase. Metabolic destiny of pyruvate. Aerobic and anaerobic glycolysis. Alcoholic and lactic fermentation. Catabolism of hexoses other than glucose. Disaccharide catabolism. Gluconeogenesis. Cori cycle. Regulation of glycolysis and gluconeogenesis. Glycogen metabolism: degradation, synthesis and regulation. Pathway of pentose phosphates. Lipid metabolism Digestion and absorption of triacylglycerols. Degradation of glycerophospholipids. Oxidation of fatty acids.

	Metabolism of ketone bodies. Biosynthesis of fatty acids. Biosynthesis of triglycerides and glycerophospholipids. Biosynthesis of cholesterol. Regulation of lipid metabolism. Metabolism of amino acids, nucleotides and other nitrogenous molecules Degradation of proteins and amino acids. Deamination and transamination. Destiny of the carbonaceous skeletons of amino acids. Transport of amino groups to the liver. Glucose-alanine cycle. Urea cycle. General lines of the biosynthesis and degradation of purine and pyrimidine nucleotides. Biosynthesis of deoxyribonucleotides. Biosynthesis of glutathione. Heme metabolism. Biosynthesis of biological amines. Terminal oxidative catabolism Transport of metabolites across the inner mitochondrial membrane. Oxidative decarboxylation of pyruvate. Krebs cycle. Amphibolic function and anaplerotic reactions of the Krebs cycle. Glyoxylic acid cycle. Transfer of reducing equivalents from cytoplasm to mitochondria (shuttle systems). Electron transport chain. Oxidative phosphorylation. Structure and function of the ATP synthase. Inhibitors and decoupling of oxidative phosphorylation. Energy balance of the oxidation of glucose and fatty acids. Conservation, transcription and translation of genetic information DNA replication: proteins and enzymes involved. Catalytic mechanism and types of DNA polymerase. DNA-dependent RNA synthesis (transcription). Catalytic mechanism and types of RNA polymerase. Post-transcriptional modifications of mRNA and tRNAs. Genetic code. Codon-anticodon pairing. Hypothesis of oscillation. Activation of amino acids. Protein biosynthesis (translation).

Course program	
Bibliography	Nelson, Cox, I principi di biochimica di Lehninger, Zanichelli Denise R. Ferrier, Le basi della Biochimica, Zanichelli Voet, Voet, Pratt, Fondamenti di biochimica, Zanichelli C.K. Mathews K.E. Van Holde D.R. Appling S.J. Anthony-Cahill, Biochimica, Piccin
Notes	To support the official texts for the F-N and O-Z channels, educational material is available at the following site: https://www.uniba.it/docenti/depalma-annalisa
Teaching methods	The course is developed through open lectures on all the topics indicated in the teaching contents. During the lessons various tools are used for teaching enhancement such as power point presentations, diagrams and bibliographic indications in addition to the classic use of the blackboard. A continuous dialogue with students is used for attention and understanding monitoring.
Assessment methods	*In itinere* written tests (optional) and final oral exam
Evaluation criteria	• *Knowledge and understanding* ○ knowledge of biochemical structures of various complexity and their nomenclature ○ ability to describe in detail the fundamental metabolic pathways and localize them in cellular compartments and tissues. • *Applied knowledge and understanding* ○ Ability to use enzymatic kinetics knowledge to solve simple graphical or numerical problems ○ Ability to understand and evaluate the effect of enzymatic activity modulators in therapeutic field • *Making informed judgements* ○ ability to integrate knowledge of biochemistry with other disciplines ones • *Communication skills* ○ Ability of argumentative clarity ○ Acquisition of a scientifically correct language • *Continuous learning* ○ Acquisition of the essential methodology for fully autonomous understanding of Biochemistry contents in-depth studies
Further information	