BASI MOLECOLARI DELLA VITA (ITO112)

Integrated course

1. language

Italian.

2. course contents

Coordinator: Prof. ANDREA SILVESTRINI
Year Course: 1
Semester: 1
UFC: 5
Modules and lecturers:
- BIOCHIMICA (ITO11A) - 2 cfu - ssd BIO/10
Prof. Andrea Silvestrini, Alvaro Mordente
- BIOLOGIA (ITO14A) - 1 cfu - ssd BIO/13
Prof. Flaminia Baldoni
- FISICA APPLICATA (ITO12A) - 1 cfu - ssd FIS/07
Prof. Cristina Ghignone
- GENETICA APPLICATA (ITO15A) - 1 cfu - ssd MED/03
Prof. Pietro Chiurazzi

3. BIBLIOGRAPHY

E.E.Abali et al.“Le basi della Biochimica”, Zanichelli, 2023

D.L. Nelson, M.M. Cox “Introduzione alla Biochimica di Lehninger”, Zanichelli, Settima edizione, 2018

V. Monaco, R. Sacchi, A. Solano “Elementi di Fisica” Ed. McGraw-Hill, Milano 2007

E. Solomon et al. “Elementi di Biologia” EdiSES VII edizione

D. Sadava et al. “Elementi di Biologia e Genetica” Zanichelli quinta edizione

G. Neri, M. Genuardi “Genetica umana emedica” EDRA quarta edizione 2017

The student will have to use a reference text, for each course, chosen from those recommended or another text after approval by the teacher.

4. LEARNING OBJECTIVES

At the end of the course the student must be able to understand the chemical, biochemical, physical, biological and genetic phenomena underlying the vital processes of living organisms and of the human organism in particular.
Knowledge and understanding (Dublin 1) At the end of the course the student must have acquired a preparation of chemistry and biochemistry aimed at understanding the properties, structural

organization and functions of biological macromolecules, the main metabolic pathways and the mechanisms the cellular metabolism. They will also have to know the physical phenomena related to the practice of the nursing

profession, in particular the dynamics of fluids and the principle of communicating vessels in order to understand the most common pathophysiological phenomena; he will also have to acquire the elementary principles of statistics. Have the basic knowledge on the composition, structure and functions of the cell, as well as on the main cellular processes concerning DNA: duplication, transcription and translation, fundamental processes for understanding the complex flow of genetic information. Finally, knowing how to define the structure of genes and chromosomes and describe the pathologies connected to them (chromosomal and monogenic) according to a model integrated with clinical practice.
Applied knowledge and understanding (Dublin 2) - At the end of the course the student must be able to connect the knowledge of the notions learned during the course in the different clinical, physiological and pathological contexts.
Making judgments (Dublin 3) - At the end of the course the student will have to be able, independently, to interpret and connect the notions learned in the context of the course in the situations that will arise in clinical practice. The course will contribute to forming a nurse capable of autonomously dealing with even critical situations, typical of her activity, with competence and awareness.
Communication skills (Dublin 4) - At the end of the course the student must be able to present and explain, using the appropriate scientific language, the notions learned both to professionals in the sector and to people without scientific preparation.
Learning skills (Dublin 5) - At the end of the course the student must have acquired the learning skills necessary to undertake subsequent studies of anatomy, physiology, pathology for which the basic knowledge of the course in question is essential. Furthermore, students must be able to update and/or expand their knowledge by independently drawing on texts, scientific articles and online sources specific to the sector.

5. prerequisites

Basic school knowledge of the scientific subjects of chemistry, physics and mathematics is required.

6. TEACHING METHODS

The teaching of the course is divided into frontal lessons carried out with the aid of the projection of computer images and films. The courses of Physics and Genetics are integrated with the carrying out of exercises in the classroom.

7. OTHER INFORMATIONS

The teachers will be available to students, for clarifications and information, at the end of the lessons.

8. METHODS FOR VERIFYING LEARNING AND FOR EVALUATION

The verification of learning is aimed at ascertaining the knowledge of the contents of the four modules of the Course and the student's ability to understand, re-elaborate and explain. The written test will consist of multiple choice closed questions (some are mnemonic, others involve links conceptual, some require reasoning skills) and/or open-ended questions. Students with an evaluation equal to or greater than 18/30 for each single module, will be able to take the oral exam to supplement the vote. Students with more than two failings will not pass the exam and finally students with one or two slight failings (16 or 17/30) will have to take the oral test in order to pass the exam. The final grade will be expressed out of thirty and will result from the weighted average of the grades obtained in the individual modules. The evaluation will take into account the correct knowledge of the contents of the four modules of the course, the level of integration between the various contents of the course, the property of the scientific language as well as the organic vision of the topics addressed and an adequate presentation capacity.

9. program

Biochemistry

Solutions (Concentration of solutes, Osmolarity, Diffusion and osmosis, Physiological solution). pH and Buffer Solutions (pH of the main biological liquids, acidosis and alkalosis). Chemical composition of the human body: Water (chemical-physical properties and biological role) and Minerals (macro and micro minerals). Molecular logic of life. General concepts of biochemical propaedeutics. Composition of the human body: biological molecules and macromolecules. Carbohydrates: structure and function of monosaccharides, oligosaccharides and polysaccharides. Lipids: structure and function of fatty acids, triacylglycerols, phospholipids and sterols. Amino acids, peptides and proteins. Proteins: three-dimensional structure and biological role. Hemoglobin, Myoglobin and oxygen transport. Water-soluble and fat-soluble vitamins. Enzymes: general properties and mechanisms of regulation of enzyme activity. Bioenergetics and Metabolism. Thermodynamics of biological systems. Biological redox reactions. Introduction to metabolism: catabolism and anabolism. ATP and energy metabolism. Krebs cycle. Mitochondrial oxidative phosphorylation. Carbohydrate metabolism: glycolysis, the pentose phosphate pathway, gluconeogenesis, glycogenolysis and glycogen synthesis. Lipid metabolism: digestion, absorption and transport of lipids. -oxidation of fatty acids. General information on the biosynthesis of fatty acids, triglycerides and cholesterol. Formation of ketone bodies. The oxidative metabolism of amino acids. Metabolic fate of amino groups: transamination, oxidative deamination and urea cycle. Metabolic fate of the carbon skeleton of amino acids. Biochemical role of hormones: protein and steroid hormones.

Applied physics

Notes on physical quantities and measures. Mechanics: kinematics; dynamics of rigid bodies; statics of rigid bodies; levers and applications to the human body. Work and Energy. Fluid statics: aggregation states of matter; principles of Pascal and Stevino; communicating vessels; sphygmomanometer; Archimedes' principle. Fluid dynamics: perfect liquids and real liquids; scope; hydrodynamics of viscous fluids; applications of the laws on fluids to the cardiovascular system. Osmotic phenomena in capillaries. Thermology and thermodynamics: temperature and heat; outline of the first and second law of thermodynamics; conservation of energy in the human body; metabolism. Electromagnetism: electric field, energy and potential difference; electric current and Ohm's law; Joule effect; electrical activity in the human body, electrocardiogram, electroencephalogram; biological effects of electric currents; magnetic field; electromagnetic induction. Wave phenomena: characteristic quantities. Acoustic waves: sound and the ear; ultrasound and ultrasound; Doppler effect and its applications in the diagnostic field. Electromagnetic waves: light, the eye, vision and the main visual defects.

Biology

Living organisms. General characteristics; prokaryotes and eukaryotes, autotrophism and heterotrophism: fundamental chemical components of living matter, notes on energy metabolism with particular reference to the ATP molecule, redox coenzymes and the importance of enzymes. Concept of reversible protein-ligand affinity interaction. The cell. Cell theory; morpho-functional organization of the eukaryotic cell; cellular organelles: nucleus and nucleolus, cell membrane (the way it passes through the membrane), cytoskeleton, ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria (role of ATP-synthase). DNA, three-dimensional structure and replication mode. The chromosomes, euchromatin and heterochromatin. Biological role of nucleic acids. Protein synthesis, gene expression, chemical structure and role of m-r-t-RNA. Cell replication, cell cycle and its regulation. Mitosis and Meiosis. Outline of mutations. Post-

translational modifications of proteins and their destination inside and outside the cell: exocytic and endocytic pathways.

Applied genetics

Anatomy of the human genome. Cytogenetics. Karyotype preparation. Chromosome number and structure abnormalities. Monogenic diseases: autosomal dominant, autosomal recessive, X-linked. Family trees and recurrence risks. Family cancers. Prenatal diagnosis of genetic disease.