UNICUSANO
ROME

Code: BIO/10 **Credits: 6**
Course: Biological Chemistry
Main language of instruction: Italian
Other language of instruction: English

Teaching Staff

Head instructor
Prof. Serena Castelli - serena.castelli@unicusano.it

Introduction

1. *Objective of the course:*

The biochemistry course aims to provide the student with the necessary knowledge to recognize organic compounds and biological macromolecules, studying their structural and functional characteristics. The properties of the different functional groups of organic compounds will be illustrated, useful in understanding the different properties of biological macromolecules and necessary to be able to classify them. Particular attention will be paid to the relationship between the structure and function of proteins. The course also aims to provide basic knowledge of the metabolism of carbohydrates, lipids and proteins. The structural and functional characteristics of the cell will be presented to enable the student to localize, in the cellular context, the different biochemical processes examined.

Objectives

2. *Course Structure:*

- Introduction of biological molecules and functional groups
- Characteristics of biological macromolecules
- Correlation between protein structure and function
- Metabolism of biological macromolecules with the possible connections between the different metabolic pathways

Competencies:

A. Knowledge and understanding:

At the end of the course the student will know the characteristics of the different carbon compounds with particular attention to the functional groups that characterize biological macromolecules.
Furthermore, the student will have acquired knowledge of the metabolism of carbohydrates, lipids and proteins and will have understood the possible connection points between the different metabolic pathways. He will also have understood the structure and characteristics of the cell.

B. Applying knowledge and understanding:

The student will be able to use the knowledge obtained on the structural and functional characteristics of the different carbon compounds to be able to describe and identify them, indicating and describing the metabolic pathway of each individual class of compounds.

C. Making judgements:

The student will be able to classify organic molecules.

D. Communication skills:

The student will be able to describe and hold conversations on topics related to biochemistry with adequate language skills.

E. Learning skills:

At the end of the course the student will have knowledge of the fundamental notions necessary for understanding metabolism. All this will allow him to continue his engineering studies with greater maturity.

Syllabus

3. *Programme of the course:*

Module 1: The chemistry of carbon (1 video-recorded theory lesson for a duration of 8 hours - week 1) Electronic configuration of carbon, hybridization of orbitals and carbon bonds, classification of carbon compounds, hints of isomerism.
Module 2: Carbon compounds (5 video-recorded theory lessons for a duration of 25 hours - week 1 and 2) General structural characteristics of aliphatic and aromatic hydrocarbons. Functional group concept General structural characteristics of alcohols, aldehydes, ketones, carboxylic acids, amines, esters, anhydrides and amides.
Module 3: Biological macromolecules (11 video-recorded theory lessons for a duration of 50 hours - week 3, 4,5) Carbohydrates: functional and structural characteristics, classification, the glycosidic bond, difference between simple and complex carbohydrates, starch and glycogen reserve polysaccharides Lipids: functional and structural characteristics, classification, fatty acids, triglycerides,

phospholipids and cholesterol Proteins: functional and structural characteristics, classification, the peptide bond and its geometric characteristics. The covalent structure of proteins: primary, secondary (alpha helix and beta strand) and tertiary (motifs and domains) structure. Fibrous proteins. (The collagen helix). Globular proteins. Quaternary structure. Structure-function relationships. Structure of myoglobin and hemoglobin. The bond of oxygen. Notes on enzymes and enzymatic kinetics. Notes on antibodies. Nucleic acids: functional and structural characteristics, classification, nitrogenous bases. Nucleosides. Nucleotides. RNA. DNA. Notes on the process of duplication, replication, translation and post-translational modifications **ETIVITY 1** (week 5- for a 5 hour commitment) Choose a class of biological macromolecules and describe all its functional (also identifying any functional groups present) and structural characteristics.
Module 4: The cell (1 video-recorded theory lesson for a duration of 7 hours - week 6) Structure and organization of the cell, cellular compartments, cellular organelles
Module 5: Hormones (1 video-recorded theory lesson for a 7-hour commitment - week 6) Classification and general mechanisms of action.
Module 6: Metabolism (6 video-recorded theory lessons for a commitment of 40 hours - week 7,8,9) Metabolism and anabolism concept Carbohydrate metabolism: Anaerobic and aerobic glycolysis. Energy balance. Control of glycolysis. Breakdown and synthesis of glycogen. Gluconeogenesis. Hormonal regulation of blood sugar Citric acid cycle: Production of acetyl-CoA from pyruvate. Reactions of the citric acid cycle. Electron transport chain Lipid metabolism: Fatty acid metabolism, beta-oxidation. Formation and fate of acetyl-CoA. Ketone bodies and ketosis. Energy balances. Metabolism of amino acids: Transamination, deamination, decarboxylation. Formation, transport and fate of ammonia. The urea cycle.
ETIVITY 2 (week 9 - for a 5 hour commitment) Relative to the class of biological macromolecules chosen in activity n 1, describe the biochemical processes involved in this class. Practice on exam tasks (3 practice lessons for a duration of 15 hours – week 10).

Evaluation system and criteria

The exam consists of a written test lasting 60 minutes, aimed at ascertaining the ability to analyze and re-elaborate the concepts acquired. The exam is rated from 0 to 28 and can be carried out in written form. The written test includes 4 open-ended questions, 13 multiple choice questions. The performance of the 2 Etivities is not mandatory but can be evaluated up to a total of 2.5 points (overall for the 2 Etivities): the evaluation depends on the originality and accuracy with which the activities in question are carried out. During the written test it is NOT permitted to use handouts, notes, periodic tables, texts or forms in paper or digital format.

Bibliography and resources

4. *Materials to consult*

Notes written by the instructor are available in Italian. Suggested books are:
- "Introduzione alla biochimica di Lehninger". Nelson & Cox
- Samaja Paroni- chimica e biochimica per le lauree triennali dell'area biomedica- Piccin-Nuova Libraria-2017