

Course Unit	Biochemistry	Field of study	Science Base
Bachelor in	Biomedical Laboratory Sciences	School	School of Health
Academic Year	2023/2024	Year of study	1
Type	Semestral	Semester	2
Level	1-1	ECTS credits	5.0
Code	9995-804-1203-00-23		
Workload (hours)	135	Contact hours	T - - TP 22,5 PL 30 TC - S - E - OT 7,5 O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Rossana Veviana Centeio Cardoso, Rui Miguel Vaz de Abreu, Tayse Ferreira Ferreira da Silveira

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. To identify the distinct types of macromolecules and understand their biological functions
2. To have knowledge about the different levels of structure in proteins
3. To identify the importance of enzymes as biological catalysts
4. To distinguish the main lipids and carbohydrates
5. To understand and to delineate the main processes involved in the transformation of the energy of carbohydrates, lipids and nitrogen compounds into chemical energy and reducing power.
6. To calculate energetic yields and to explain the importance of metabolic regulation
7. To compare the metabolic profile of organs such as liver, muscle and adipose tissue, integrating the metabolic pathways used by each one

### Prerequisites

Before the course unit the learner is expected to be able to:

1. To have knowledge in acid-base equilibrium and in buffer solutions
2. To have knowledge in functional groups of organic molecules and stereochemistry

### Course contents

1. Review on structural and functional properties of biological molecules
2. Proteins
3. Enzymes
4. Carbohydrates
5. Lipids
6. Metabolic pathways involved in the degradation and synthesis of carbohydrates, lipids and nitrogen compounds.
7. Integration of metabolism: key-points, metabolic profiles of the most important organs and hormonal regulation.

### Course contents (extended version)

- I. Biochemistry overview
  - The chemical features of the living organisms; Functions of the essential chemical elements
- II. Proteins
  - Aminoacids: Structure, nomenclature, classification, chemical properties.
  - Structure and function of proteins. The peptidic bond. Structural levels.
  - Fibrous proteins (silk, keratins, collagen). Globular proteins (hemoglobin).
- III. Enzymes
  - Classification, function, specificities and cofactors.
  - Importance of vitamins in the synthesis of enzymatic cofactors.
  - Enzyme Kinetics: the Michaelis-Menten and Lineweaver – Burk models.
  - Ways to regulate the enzymatic activity: pH and temperature.
  - Reversible and irreversible inhibitors (competitive inhibition, uncompetitive and non-competitive).
  - Regulatory enzymes: allosteric interactions and covalent modifications.
  - Proteolytic cleavage of enzyme precursors; Isoenzymes and examples of their biological importance.
- IV. Hydrocarbons
  - Classification. Major classes of sugars and of non-sugars.
  - Monosaccharides (chemical composition, nomenclature, stereochemistry and occurrence).
  - Cyclization of monosaccharides. Glycosidic linkage and disaccharides (maltose, lactose and sucrose).
  - Homopolysaccharides. The relationship between their structure and function.
  - Specific examples of storage (starch, glycogen) and structural (chitin, cellulose) polysaccharides.
  - Applications of some homopolysaccharides and heteropolysaccharides.
- V. Lipids
  - Classification Fatty acids: structure and properties.
  - Simple lipids (terpenes and steroids) and complex (triacylglycerides and phosphoglycerides).
  - Lipoproteins.
- VI. Introduction to the metabolism
  - Catabolism, anabolism and relation-sheep. Transference of energy in the biological systems.
  - ATP and NADP cycles. Phases and main objectives of metabolism.
- VII. Metabolism of carbohydrates
  - Reactions, regulation and energetic balance of Glycolysis. Gluconeogenesis. Glycogen metabolism.
  - Cycle of Cori. Shuttle systems for cytosolic NADH. Pathway of phosphate-pentoses.
  - Oxidative decarboxylation of pyruvate to acetyl-CoA: Cycle of citric acid: Individual reactions.
  - Energetic balance; Regulation; Amphibolic character.
  - Electron transport chain and oxidative phosphorylation. Respiration.
- VIII. Metabolism of lipids
  - Biological sources of lipids: diet, adipocytes and biosynthesis. Catabolism of fatty acids.
  - Degradation of saturated, unsaturated and ramificated fatty acids.
  - Energetic balance. Biosynthesis of saturated and unsaturated fatty acids. Sources of Acetyl-CoA.
  - Regulation. Ketone bodies: synthesis and energetic function.
- IX. Metabolism of nitrogen compounds
  - Metabolism of amino acids: Hydrolysis of proteins; Glycogenic and ketogenic amino acids.
  - Reactions of transamination, decarboxylation, desamination and desamination.
  - Metabolism of ammonia: sources, transport in the circulation and elimination pathways.
- X. Integration of metabolisms
  - Main metabolic pathways and regulation centres. Key-connections: glucose-6-P, pyruvate, acetyl-CoA.
  - Metabolic profiles of the most important organs. Hormonal regulation of the energetic metabolism.

### Recommended reading

1. Lehninger, A. L. , Nelson, D. L. , Cox, M. M. (2014). Principles of Biochemistry (6th ed. ), New York, NY: W. H. Freeman.
2. Quintas, A. , Ponces, A. , Halpern, M. J. (2008). Bioquímica, Organização Molecular da Vida. Lidel.

**Recommended reading**

3. Voet, D. , Voet, J. G. (2014). Biochemistry (3rd ed. ). New York, NY: John Wiley & Son.
4. Campos, L. S. (2008). Entender a Bioquímica (5ª ed). Escolar Editora.

**Teaching and learning methods**

Theoretical Classes: Lectures of theoretical contents. Practical laboratorial Classes: Realization of experimental protocols in the Structural and Metabolic Biochemistry area.

**Assessment methods**

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Intermediate Written Test - 30%
  - Final Written Exam - 30%
  - Reports and Guides - 16%
  - Final Written Exam - 24%
2. Alternative 2 - (Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 60%
  - Final Written Exam - 40%
3. Alternative 3 - (Regular) (Supplementary, Special)
  - Final Written Exam - 60%
  - Final Written Exam - 40%

**Language of instruction**

1. Portuguese
2. English

**Electronic validation**

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18-04-2024	19-04-2024	19-04-2024	22-04-2024