1. OVERVIEW

Subject Area	Biochemistry I
Degree	Bachelor's Degree in Medicine
School/Faculty	Biomedical and Health Sciences
Ac. Year	1º
ECTS	6
Type	Compulsory
Language(s)	Spanish
Delivery Mode	On campus
Semester	S1

2. INTRODUCTION

Biochemistry I is taught in the first year of the Degree in Medicine. It forms part of students' basic learning and provides a sound base for academic and professional development. Biochemistry currently has a huge contribution to modern scientific medicine, mainly due to its ability to identify the molecular bases of many pathological processes. The spectacular and continued progress in biochemical concepts and techniques applied to the study of disorders is seeing exponential growth which is revolutionising medical practice. Therefore, Biochemistry is an essential part of the core learning for Health Science professionals in general and particularly for future doctors.

3. SKILLS AND LEARNING OUTCOMES

Key skills (CB, by the acronym in Spanish):

- C1: Students have shown their knowledge and understanding of a study area that builds on general secondary school education, and are usually at the level where, with the support of more advanced textbooks, they may also demonstrate awareness of the latest developments in their field of study.

General skills (CG, by the acronym in Spanish):

- CG7: Understand and recognise the normal structure and function of the human body. This includes studies of molecules, cells, tissue, organs and systems in the different stages of life.

Cross-curricular skills (CT, by the acronym in Spanish):

- CT1: Communication: ability to engage in active listening, ask questions and respond in a clear and concise way, as well as to effectively express ideas and concepts. This includes concise and clear written communication.
- CT3: Teamwork: ability to integrate and collaborate actively with other people, areas and/or organisations to reach common goals, evaluate and integrate contributions from the rest of the group members and create a good working environment.
- CT4: Adaptability: ability to detect, interpret and respond to a changing environment. Ability to equip themselves and work effectively in different situations and/or with different groups or individuals. This means adapting to change depending on circumstances or needs. It involves the confidence to take on crucial challenges on a personal or group level, maintaining a good physical and mental health to allow work to be carried out effectively.
- CT8: Planning and organization: ability to set objectives and choose the right means to fulfil them through the efficient use of time and resources.
- CT10: Independent learning: the ability to govern your own development by choosing the most effective lines of action, strategies, tools and opportunities to independently learn and apply knowledge to practice.

Specific skills (CE, by the acronym in Spanish):

- **CE1.1.1: Recognising the structure and function of cells. Biomolecules. Metabolism. Metabolic regulation and integration.**
- CE1.1.2: **Understanding the fundamentals of human nutrition.** Cell communication. Excitable membranes. The Cell Cycle. Cellular differentiation and proliferation. **Gene expression, information and regulation.** Heredity. Embryo development and organogenesis.
- CE1.2.2: **Using basic laboratory techniques and materials.** Interpreting a normal analysis. Using macroscopic, microscopic and imaging techniques to recognise the morphology and structure of tissue, organs and systems. Performing functional tests and determining vital signs and how to interpret them. The basic physical examination.

Learning outcomes (RA, by the acronym in Spanish):

- Recognise the main classes of biomolecules and explain their function or activity in terms of their chemical structure.
- Understand how biomolecules interact to give rise to supramacromolecular structures.
- Understand the structure and properties of water to know the structure of macromolecules, their properties and biological functions.
- Be aware of the general principles of enzymology and understand the importance of enzymes as essential tools in cell metabolism.
- Understand the main metabolic strategies in living beings for obtaining and using energy.
- Breakdown the metabolic processes and the main classes of biomolecules, their interactions and their bioenergetic budgets.
- Analyse the role of biological membranes in the processes of generation and use of biological energy and the compartmentalisation of the vital processes.
- Understand the molecular bases of the signal transduction pathways.
- Associate the metabolic alterations in the physiopathological processes with the most common biochemical analysis parameters, evaluate the origin of these changes and the physiological consequences of these alterations.
- Evaluate the biochemical processes as a fundamental basis for life and all the vital processes and functions.
- Be aware of the principles of the main biochemical techniques, particularly those most used in diagnosis (electrophoresis, ELISA, etc.).

The following table shows how the skills developed in the course match up with the intended learning outcomes:

Skills	Learning outcomes
C1, CG7, CT1, CT3, CT8, CT10, CE1.1.1, CE1.2.2	Recognise the main classes of biomolecules and explain their function or activity in terms of their chemical structure.
C1, CG7, CT1, CT3, CT8, CT10, CE1.1.1	Understand how biomolecules interact to give rise to supramacromolecular structures.
	Understand the structure and properties of water to know the structure of macromolecules, their properties and biological functions.
	Be aware of the general principles of enzymology and understand the importance of enzymes as essential tools in cell metabolism.
	Understand the main metabolic strategies in living beings for obtaining and using energy.

	Breakdown the metabolic processes and the main classes of biomolecules, their interactions and their bioenergetic budgets.
	Analyse the role of biological membranes in the processes of generation and use of biological energy and the compartmentalisation of the vital processes.
	Understand the molecular bases of the signal transduction pathways.
C1, CT1, CT3, CT4, CT8, CT10, CE1.1.1	Associate the metabolic alterations in the physiopathological processes with the most common biochemical analysis parameters, evaluate the origin of these changes and the physiological consequences of these alterations.
	Evaluate the biochemical processes as a fundamental basis for life and all the vital processes and functions.
C1, CT1, CT3, CT4, CT8, CE1.2.2	Be aware of the principles of the main biochemical techniques, particularly those most used in diagnosis (electrophoresis, ELISA, etc.).

4. CONTENTS

1.- Water

1.1.- Chemical structure

1.2.- Physicochemical properties

1.2.1.- Vaporisation heat

1.2.2.- Surface tension

1.2.3.- Capacity of water as solvent

1.2.3.1. - Dissolutions

1.2.3.2. - Colloids

1.2.3.3. - Suspensions

1.2.4.- Ionisation

1.2.4.1. - Electrolytes

1.2.4.2. - pH

1.2.4.2.1 - Acids

1.2.4.2.2 - Bases

1.2.4.3. - Buffer system concept

1.2.4.3.1.-Intracellular buffer

1.2.4.3.2.-Extracellular buffer

1.2.5.- Solubility

1.2.5.1- Hydrophobic and nonpolar substances

1.2.5.2.-Hydrophile or polar substances

2. - Three-dimensional structure of the biomolecules

2.1. - Geometry of the carbon bonds

2.2. - Configuration

2.3. - Isomers

2.3.1. - Configurational isomers

2.3.2. - Geometric isomers

2.4. - Conformation

3. - Proteins

3.1. - Amino acids

3.1.1. - Structure

3.1.2. - Properties

3.1.3. - Proteinogenic amino acids

3.1.4. - Non-proteinogenic amino acids

3.1.5. - Peptide bone

3.2. - Peptides and proteins

3.2.1. - Primary structure

3.2.2. - Properties

3.3. - Three-dimensional structure

3.3.1. - Secondary structure

3.3.1.1. - Alpha helix

3.3.1.2. - Beta conformation

3.3.1.3. - Fibrous proteins

3.3.1.3.1.-Keratins 3.3.1.3.2.-Collagen 3.3.1.3.3.-Elastin 3.3.1.3.4.-Fibroin

3.3.2. - Tertiary structure

3.3.2.1. - Globular proteins Myoglobin.

3.3.3. - Quaternary structure Haemoglobin

3.4. - Denaturing.

4. - Basic thermodynamics.

4.1. Concept and definition of energy Living beings and energy

4.2. Thermodynamics

4.2.1 First law of thermodynamics

4.2.2 Second law of thermodynamics

4.3. Chemical reactions

4.3.1 Exergonic and endergonic reactions

4.3.2 Energy coupling

4.3.3 ATP and energy transfer

4.3.4 Redox reactions and energy transfer

5. - Enzymatic catalysis

5.1. - Classification of enzymes

5.2. - Cofactors

5.3. - Specificity

5.4. - Types of enzymatic catalysis

5.4.1. - General acid-base catalysis

5.4.2. - Covalent catalysis

5.4.3. - Metal ion catalysis

5.5. - Enzymatic kinetics

5.5.1. - Michaelis-Menten equation

5.5.2. - Double reciprocals

5.6. - Enzymatic inhibition

5.6.1. - Reversible inhibition

5.6.1.1. - Competitive inhibition

5.6.1.2. - Noncompetitive inhibition

5.6.1.3. - Mixed inhibition

5.6.2. - Irreversible inhibition

5.6.3. - Factors which affect enzymatic activity Denaturing

6. - Enzymatic regulation

6.1. - Allosteric enzymes

6.2. - Covalent modification regulation

6.3. - Regulation by binding to the control proteins

6.4. - Regulation by proteolytic rupture

7. - Structure and function DNA

7.1. - Structure of nucleotides Chemical properties of the nitrogen bases

7.2. - DNA structure

7.2.1-Double helix of DNA

7.2.2.-Structural variations

7.3. - Denaturing.

7.4. - Non-enzymatic modifications

7.5. - Other functions of nucleotides

7.5.1. - Energy transporters

7.5.2. - Enzymatic cofactors

7.5.3. - Regulating molecules

7.6. - DNA replication

7.6.1. Semi-conservative replication

7.6.2. - Enzymes involved in replication: DNA polymerases I and III

7.6.3. - Origin of replication

7.6.4. - Continuous and discontinuous synthesis of DNA synthesis: Okazaki fragments

7.6.5. - Replication in prokaryotics General view of the process

7.6.6. - Replication in eukaryotics

7.7. - DNA repair

7.7.1. - Mismatch repair Methylation of DNA

7.7.2. - Base excision repair DNA glycosylases

7.7.3. - Nucleotide excision repair Excinucleases

7.7.4. - Direct repair Pyrimidine dimers

7.7.5. - Repair by recombination

8. - Metabolism of RNA

8.1. - RNA synthesis

8.1.1. - Enzymes involved in the process RNA polymerases, transcription factors

8.1.2. - Start of transcription Promoter structure

8.1.3. - RNA synthesis in prokaryotes General view of the process

8.1.4. - RNA synthesis in eukaryotes General view of the process RNA polymerase II

8.1.5. - Transcription regulation

8.2. - RNA maturity

8.2.1. - Maturity of the primary transcript

8.2.2. - Type of introns

8.2.2.1. - Type I introns

8.2.2.2. - Type II introns

8.2.2.3. - Spliceosomal introns

8.2.2.4. - tRNA introns

8.2.4. - Differential maturation of RNA

8.2.5. - Maturation of ribosomal and transfer RNA

8.3. - RNA synthesis and RNA-dependent DNA

8.3.1. - Reverse transcriptase RNA-dependent DNA polymerase

8.3.2. - Telomerase mechanism of action

9. - Biosynthesis of proteins

9.1. - The genetic code

9.2. - Activation of amino acids

9.3. - Start

9.4. - Elongation

9.5. - Termination and release

9.6. - Folding and post-translational modification

10. - Regulation of gene expression

10.1. - Principles of gene regulation

10.1.1. - Initial transcription regulation 10.1.2.- Structure and organisation of the operons
10.1.3.- Repressors
10.1.4.- Activators

10.2. - Gene expression regulation in prokaryotes: lactose operon 10.3.- Regulation of gene expression in eukaryotes

10.3.1. - Transcriptionally active chromatin vs Transcriptionally inactive chromatin

10.3.2. - Chromatin remodelling

10.3.3. - Transactivators and coactivators which facilitate the assembly of transcription factors

10.3.4. - Intracellular and intercellular regulators
10.3.5.- Regulation by phosphorlyation
10.3.6.- Gene silencing by RNA interference

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

Problem-based learning. Case study sessions.
Specialised seminars. Lecture.
Learning based on specific laboratory teaching.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

Learning activity	Number of hours	Attendance mode
Theory/practical learning activities	68 h	100
Directed learning activities	17 h	100
Knowledge tests	2 h	100
Self-study	45 h	0
Tutorials	18	100
TOTAL	**150 h**	

7. ASSESSMENT

The assessment methods, plus their weighting in the final grade for the course, are as follows:

Assessment system	Weighting
Practical content (activities and laboratory practice)	25%
Objective tests	70%
Attitude	5%

The objective tests assessment includes the evaluation of the theory content, as well as skills and knowledge acquired during the practical subject activities.

The assessment of the practical part includes: laboratory sessions, integrated activities, raising questions, clinical case studies, etc. It also includes an evaluation of the student's attitude.

On the Virtual Campus, when you open the subject area, you can see all the details of your assessment activities and the deadlines and assessment procedures for each activity.

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