

Biochemistry I

Code: 100877
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	FB	1	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Other comments on languages

Mainly in Spanish but some teaching materials will be in Catalan

Prerequisites

It is recommended that students have done the subjects from the first semester, in particular the subject of Basic Instrumental Techniques.

Objectives and Contextualisation

The subject Biochemistry I constitutes the first part of a main subject "Biochemistry" in the Degree of Biochemistry. Biochemistry I is focused on the study of the structural and functional characteristics of the biomolecules. This knowledge will be useful in the second part of the subject, named "Biochemistry II". Moreover, the topics worked in this subject will be also relevant in most of the subjects from this Degree.

Competences

- Be able to self-evaluate.
- Define the structure and function of proteins and describe the biochemical and molecular bases of their folding, intracellular traffic, post-translational modification and replacement.
- Demonstrate understanding and use of the mechanisms of biological catalysis based on the structure of biological catalysts and chemical reactions.
- Identify molecular structure and explain the reactivity of the different biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- Interpret experimental results and identify consistent and inconsistent elements.
- Manage bibliographies and interpret the information in the main biological databases, and also know how to use basic ICT tools.
- Manage information and the organisation and planning of work.
- Read specialised texts both in English and ones own language.
- Use ICT for communication, information searching, data processing and calculations.

Learning Outcomes

1. Be able to self-evaluate.
2. Calculate and interpret the kinetic and thermodynamic parameters that define enzyme reactions.
3. Correctly use the terminology of biochemistry and its text and reference books.
4. Describe the basic structural and functional characteristics of amino acids, proteins, glucids, lipids and biological membranes, nucleotides and nucleic acids.
5. Describe the catalytic mechanisms of enzyme reactions and their inhibition and regulation mechanisms.
6. Describe the structure, function and regulation of proteins involved in oxygen transport and provide examples of deficiencies in these that are involved in pathologies.
7. Identify structural protein domains and motifs and their functional and evolutionary relationships.
8. Interpret experimental results and identify consistent and inconsistent elements.
9. Interpret the parameters that define the binding of ligands to macromolecules.
10. Manage information and the organisation and planning of work.
11. Read specialised texts both in English and ones own language.
12. Select the most suitable experimental approaches to studying the structure and function of biomolecules.
13. Use ICT for communication, information searching, data processing and calculations.

Content

SYLLABUS:

Topic 1. ELEMENTS, MOLECULES AND PHYSICAL ENVIRONMENT.

Levels of structural organization of biomolecules. Types of bonds in molecules. The biological importance of water. Non-covalent interactions. Ionization of water. Acid-base. Ion balance and buffering systems.

Topic 2. PRINCIPLES OF BIOENERGETICS.

The transformations of energy to living organisms and thermodynamics. Free energy and equilibrium constant. Coupled reactions. Transfer of phosphate groups, and ATP paper. Oxidation reactions.

Topic 3. PROTEINS 1: PRIMARY STRUCTURE AND BIOLOGICAL FUNCTIONS.

Protein classes and their functions. Structure and properties of amino acids. Stereoisomers. Peptides and the peptide group. Analysis of the composition of amino acids and the sequence of proteins.

Topic 4. PROTEINS 2: THREE-DIMENSIONAL STRUCTURE OF PROTEINS.

Structuring levels of proteins. Secondary structure. Fibrous proteins. Globular proteins Protein folding: factors that determine it. Molecular Chaperones. Introduction to conformational diseases. Prediction of the protein structure. Quaternary structure. Determination of the three-dimensional structure of macromolecules by means of nuclear magnetic resonance and X-ray diffraction.

Topic 5. PROTEINS 3: RELATION STRUCTURE-FUNCTION AND EVOLUTION OF PROTEINS

Storage and transport of oxygen: myoglobin and hemoglobin. Myoglobin and hemoglobin as examples of protein evolution. Use of protein sequences for the analysis of evolutionary relationships. Allosterism and cooperativity of hemoglobin. Different forms of hemoglobin: physiological adaptation and molecular pathology.

Topic 6. BIOLOGICAL CATALYSIS

Nature and function. Classification and nomenclature of enzymes. Effects of catalysts on chemical reactions: general mechanisms. Description of enzymatic mechanisms. Enzymatic kinetics: Michaelis-Menten model. Enzymatic cofactors. Enzymatic inhibition. Regulation of enzymatic activity: allosterism, covalent modification and changes in enzyme concentration. Biomedical and biotechnological applications.

Topic 7. SUGARS AND POLYSACCHARIDES

Monosaccharides: description and properties. Classification. Monosaccharide derivatives. Disaccharides and Oligosaccharides. Structural and reserve polysaccharides. Glycoproteins, proteoglycans, and glycolipids. Oligosaccharide Markers

Topic 8. NUCLEIC ACIDS

Nature and function. Nucleotides. Primary structure of nucleic acids. Secondary structure: Watson and Crick model and alternative structures. Tertiary structure: overlap of DNA and transfer RNA. Complex DNA-proteins: organization of the chromosome.

Topic 9. RECOMBINANT DNA TECHNIQUES.

DNA cloning materials and methodology. Construction of DNA libraries. Selection and search for DNA sequences: hybridization. The sequence of DNA. Genome projects Some applications of genetic engineering. Genomics and proteomics.

Topic 10. LIPIDS AND BIOLOGICAL MEMBRANE

Types of lipids and functions. Membrane structural lipids. Other lipids with specific biological activity. Lipoproteins Structure and properties of biological membranes.

PROBLEMS

The content of this section, which will be presented in the form of a dossier at the beginning of the semester. It will include a with a selection of problems to be solved and defended "in situ". Those sessions will focus on certain aspects as: acid-base, chemical equilibrium, free energy and constant equilibrium, methods of purification and analysis of macromolecules and enzyme kinetics.

**Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.*

Methodology

The training activities are divided into two sections: lectures and problem-based learning sessions, each of them with their own specific methodology.

Note: The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	37	1.48	2, 5, 6, 4, 7, 9, 12, 3
Problem-based sessions	8	0.32	13, 2, 5, 4, 12, 1, 3
Type: Supervised			
Autonomous problem resolution	23	0.92	13, 12
Type: Autonomous			
Research of information and autonomous study	64	2.56	5, 6, 4, 10, 7, 9, 11, 1, 3

Assessment

*ASSESSMENT:

Midterm exams:

The total weight of the two midterm exams will be 75%. The minimum mark is 4.0 points out of 10. In case someone obtains a mark lower to 4.0, he or she will need to perform a final exam.

Problems

The problems will have a continuous assessment. The weight of the problem assessment will be 25% of the total. This will be split into two parts: 1) Resolution of problems and their oral defence in groups of 4 people (10%); 2) *In situ* resolution and delivery of problem (15%). The lack of attendance at problem sessions will penalize the individual mark.

The problems will not be reassessed.

Additional points:

This subject will be passed when the sum of the different parts weighted by their specific weight in the subject equals or exceeds 5.0 out of 10 points. The mid-term exams must be overcome with a minimum of 4.0 points in order to be eligible to add the 25% of problem marks.

In order to be eligible for performing the final exam, according to UAB regulations, students must have done a set of activities, the weight of which equals a minimum of two-thirds of the total mark in the subject. Therefore, the students will get a "Not assessable" qualification when the sum of activities carried out have a weight lower than 67% of the total.

Those students who must do the final exam will not be eligible for the maximum grade of honour.

Those students who couldn't attend to a midterm exam due to a relevant reason (such as illness, the death of a first-degree relative, an accident ... etc), and provide the corresponding prove to the degree-coordinator, will have the opportunity to perform his/her assessment in a different date.

**Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.*

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Defense of resolved problems	10%	8	0.32	13, 2, 5, 10, 8, 12, 1, 3
Deliveries of problems resolved in the classroom	15%	4	0.16	2, 5, 4, 10, 7, 9, 8, 12, 1, 3
Theory examinations	75%	6	0.24	2, 5, 6, 4, 10, 7, 9, 8, 11, 12, 1, 3

Bibliography

Bibliography (by alphabetical order):

- Stryer, L, Berg J.M., Tymoczko, J.L., Gatto Jr. G. J "Biochemistry" (2019) 9^aed. Ed. W.H. Freeman & Co Ltd.
- Berg, J.M., Tymoczko, J.L., Stryer, L. Bioquímica. Curso Básico (2012) Ed. Reverté
- McKee, T i McKee, J.R. "Bioquímica. Las bases moleculares de la vida" (2014) 5^a ed. Ed. McGraw-Hill-Interamericana.

- Nelson, D.L. i Cox, M.M. Lehninger. Principios de Bioquímica (2018) 7ª Edición ed. Omega.
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