Universitat Autònoma de Barcelona

2019/2020

Biochemistry I

Code: 100877
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	FB	1	2

Contact

Name: María Rosario Fernández Gallegos
Email: Rosario.Fernandez@uab.cat

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 in Catalan

Prerequisites

It is recommended that the student has acquired the knowledge taught in the subjects of the first semester, in particular the contents of Foundations of General Chemistry, Cell Biology, and especially Basic Instrumental Techniques.

Objectives and Contextualisation

The subject Biochemistry I constitute the first part of the Subject "Biochemistry" of the Degree of Biochemistry and in which the structural and functional characteristics of the biomolecules from a basic point of view is studied. The knowledge acquired here, especially what refers to the structure and function of enzymes and concepts of bioenergetics, will be used in the second part of the subject, called Biochemistry II, which is taught in the third semester. In the same way, the concepts of structure and function of biomolecules are important for the follow-up of most subjects of the Degree in Biochemistry.

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

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

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, consists of a determined amount of statements of problems related to the topics developed in theory. The own characteristics of the different parts of the Theory's subject matter make the statements of the problems concentrate on certain aspects that are: chemical equilibrium and shock absorbers, free energy and constant equilibrium, methods of purification and analysis of macromolecules and Enzymatic kinetics.

Methodology

The training activities are divided into two sections: theory classes and problem classes, each of them with their specific methodology.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem sessions	8	0.32	13, 2, 5, 4, 12, 1, 3
Theory sessions	37	1.48	2, 5, 6, 4, 7, 9, 12, 3
Type: Supervised			
Problem solving	23	0.92	13, 12
Type: Autonomous			
Research of information and study	63	2.52	5, 6, 4, 10, 7, 9, 11, 1, 3

Assessment

Theory:

The total weight of the evaluation of the theoretical part will be 80% of the total mark of the subject. The main evaluation of this part of the subject will have the format of continuous evaluation with a mid-course exam. Each exam must be overcome with a minimum of 4.0 points out of 10. In case someone obtains less than 4.0, he (or she) will be able to do the exam suspended in the final exam.

Problems

The problems will have continuous evaluation. The weight of the problem evaluation will be 20% of the total. This will be broken down into three parts: 1) solving problem cases and defending them in the classroom, in groups of 4 people (5%); 2) Resolution and delivery of problems in the classroom (10%); 3) Individual examination of problems (5%) (on the same day set for the second partial theory). The lack of attendance at problem sessions will penalize the individual mark.

The evaluation of the problems will not be re-evaluated in the final exam.

Overall evaluation:

The 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 partial must be overcome with a minimum of 4.0 points out of 10 in order to add the note of problems in the overall score.

To participate in the final exam, according to UAB regulations, students must have been previously evaluated in a set of activities the weight of which equals a minimum of two thirds of the total grade of the subject. Therefore, the students will obtain the "Not Evaluable" qualification when the evaluation activities carried out have a weight lower than 67% in the final grade. This implies that the students must have attended to the two partial exams previously if they wants to opt for recovery, and that failure to attend a partial will imply a "non-evaluable".

Students who mustdo the final exam will not be eligible for the maximum grade of honor, but may opt at most to the excellent.

Students who can not attend an individual exam for a justified reason (such as illness, death of a first-degree relative, by accident ... etc), and provide the corresponding official documentation to the Degree Coordinator, can do the exam in a later date.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Defense of resolved problems	5%	8	0.32	13, 2, 5, 10, 8, 12, 1, 3
Deliveries of problems resolved in the classroom	10%	4	0.16	2, 5, 4, 10, 7, 9, 8, 12, 1, 3
Examination of problems	5%	1	0.04	13, 2, 5, 4, 10, 7, 9, 8, 12, 1, 3
Theory examinations	80%	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) 9ªed. 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) 5ª ed. Ed. McGraw-Hill-Interamericana.

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

· Nelson, D.L. i Cox, M.M. Lehninger Principles of Biochemistry: International Edition (2017). 7th ed. MacMillan Education.

. Voet,D and Voet, J.G. "Biochemistry" (2010) 4th ed. John Wiley & Sons Ltd.