Universitat Autònoma de Barcelona

2018/2019

Structure and Function of Biomolecules

Code: 101916
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	FB	1	1

Contact

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Use of languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Other comments on languages

All assessable participation in English will have a maximum multiplier factor of 1.2 and a minimum of 1

Prerequisites

There are no official prerequisites to follow the course successfully. Nonetheless it would be desirable if students were familiar with basic knowledge of biology and chemistry.

Much of the literature is in the English language, which is also used in the figures projected in theory classes.

Objectives and Contextualisation

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The course Structure and Function of Biomolecules is the first part of the subject "Biochemistry" in the Biomedical Sciences degree; it covers the structural and functional characteristics of biomolecules from a point of view which is basic and simple but also with the necessary depth required for further use, mainly related to the structure and function of enzymes and the bioenergetics concepts that will be used in the second part of the subject to be taught in the third term under the name Biomolecules Metabolism. Similarly, the concepts on the structure and function of biomolecules are essential for the understanding of more specialized courses in the Biomedical Sciences degree.

Objectives:

- To understand, based on previously acquired chemistry knowledge, the fundamental structural characteristics of biological molecules, being able to draw conclusions about their stability, functionality and ability to replicate structures.
- To acquire the conceptual basis of bioenergetics processes as a primer to the second part of the subject Biochemistry, dedicated to metabolism.
- To understand the kinetics of enzymatic action in the context of the study of biological reactions and their metabolic relationships.
- To understand the basic methods of purification, characterization, structural analysis of biomolecules and recombinant DNA methodologies.

Content

Content

THEORY

1. Introduction to the study of the structure and function of biomolecules .

The chemical logic of biological processes. Chemical elements in living species. Biomolecules. Levels of structural organization of biomolecules. Biological importance of water. Non-covalent interactions in water. Ionization of water, ionic balance and buffer systems. Energy transformations in living organisms and the laws of thermodynamics. Free energy and equilibrium constant. Common biochemical reactions. Transfer of phosphate groups and ATP. Oxidation-reduction reactions.

2. Proteins: composition, structure and biological functions.

Classes of proteins and their functions. Structure and properties of amino acids. Stereoisomerism and acid -base behavior. Peptides and peptide bond. Analysis of the amino acid composition and protein sequencing methods. Secondary structure. a helices and β sheets. Tertiary structure. Fibrous proteins. Globular proteins. Protein folding: factors that determine it. Molecular chaperones. Introduction to conformational diseases. Protein structure prediction. Quaternary structure. Introduction to techniques for purification and

characterization of proteins.

3. Structure-function relationship and evolution of proteins.

Storage and transport of oxygen: hemoglobin and myoglobin. Allosterism and cooperativity in hemoglobin. Myoglobin and hemoglobin s examples of protein evolution. Using protein sequences for the analysis of evolutionary relationships.

4. Biological catalysts, enzyme kinetics and regulation.

What they are and how they work. Enzyme cofactors. Classification and nomenclature of enzymes. Effects of catalysts in chemical reactions. Examples of enzymatic mechanisms. Enzyme kinetics: the concept of initial velocity; Michaelis-Menten model. Enzyme inhibition. Regulation of enzyme activity: (inhibition), allosterism, covalent modification. Biomedical and biotechnological applications.

5. Carbohydrates.

Types of carbohydrates and their functions. Monosaccharides: Description and properties. Derivatives of monosaccharides. Glycosidic bond. Oligosaccharides. Structural and storage polysaccharides. Glycoconjugates: glycoproteins, proteoglycans, and glycolipids. Carbohydrates as "informative" molecules.

6. Nucleic acids. Levels of organization

Basic concepts. Nucleotides. Primary structure of nucleic acids. Secondary structure: Watson and Crick model and alternative structures. Tertiary structure: DNA supercoiling and tRNA conformation. DNA-protein complexes: chromosome organization.

7. Replication and Transcription of DNA

Replication in prokaryotes: DNA polymerases I and III. Helicases, binding proteins, ligases and primases. Initiation and termination of the replication in E. coli. Replication in eukaryotes: eukaryotic DNA polymerases. Telomeres and telomerases. Reverse transcriptase and retrotransposition. Structure and function of prokaryotic RNA polymerase: Structure and binding to the promoter. Termination of transcription. Transcription control in prokaryotes. Nuclear RNA polymerases and transcription control. Post-transcriptional modifications: Pre-mRNA processing.

8. The genetic code and protein synthesis

The genetic code. Transfer RNA. Aminoacyl-tRNA synthetases. The structure of ribosomes. Protein synthesis: initiation; elongation; termination. The post-translational modifications. Molecular mechanisms for protein sorting and degradation.

9. Recombinant DNA.

Materials and methods for DNA cloning: restriction enzymes, vectors, recombinant protein expression and purification methods. The most common methods of recombinant DNA technology. Applications to the production and modification of proteins. DNA sequencing and genome projects. Some applications of genetic engineering. Genomics and proteomics.

10. Lipids and biological membranes.

Lipid and functions. Lipid storage. Structural membrane lipids. Other lipids with specific biological activity. Lipoproteins. Structure and properties of biological membranes. Membrane proteins. Transport through membranes.

PROBLEMS

This section will be based on a dossier that will be delivered at the beginning of the semester consisting of a series of problems related to the topics developed in the theory lectures. The characteristics of the various parts of the syllabus theory impose a concentration of the problems proposed on certain specific aspects: chemical balance and buffer systems, free energy and equilibrium constant, purification methods and analysis of macromolecules, enzyme kinetics and recombinant DNA.

LABORATORY

Two four-hour sessions: PCR assay for detection and genotyping of CCR5 receptor, agarose gel analysis.