UAB
Universitat Autònoma de Barcelona

Biochemistry

Code: 100812
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500251 Environmental Biology	FB	1

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no official prerequisites. However, it is assumed that the student has acquired the basic knowledge taught in the subjects of Biology and Chemistry of the baccalaureate.

Objectives and Contextualisation

In the Biochemistry course, the structural and functional characteristics of biomolecules from a basic and general point of view, focusing on proteins, and especially on enzymes, are studied in the first part. In a second part the concepts will be applied dynamically to understand the bioenergetics, the biosignalisation and the main routes of the metabolism. The general objective of the subject is to provide the basics of the molecular and metabolic aspects and concepts necessary for the follow-up of different subjects of the Degree in Environmental Biology.

Specific objectives of the subject:

- Understand the fundamental structural features of biological molecules, knowing how to draw conclusions about their stability, their functionality and their capacity for replication of structures.
- Understand the kinetic concepts of enzymatic action in the context of the study of biological reactions and their regulation.
- Describe the general mechanisms through which living things get and transform the energy of the environment.
- To know the main molecular mechanisms of signal transduction.
- Describe the main routes of intermediate metabolism of glucids, lipids and nitrogen compounds, their regulation and coordination.
- Learn how to apply the knowledge studied to solve qualitative and quantitative problems.

Competences

- Develop bioassays and apply biotechnological processes.

- Develop self-directed learning.
- Display basic knowledge of mathematics, physics and chemistry.
- Obtain information, design experiments and interpret results.
- Reason critically.
- Solve problems.
- Understand the bases of regulation of vital functions of organisms through internal and external factors, and identify environmental adaptation mechanisms.

Learning Outcomes

1. Acquire a solid grounding in the principal metabolic pathways.
2. Develop self-directed learning.
3. Identify the physical and chemical properties of biomolecules.
4. Know the basic biological functions of biomolecules.
5. Master the concepts of enzyme catalysis and bioenergetics.
6. Obtain information, design experiments and interpret results.
7. Reason critically.
8. Recognise the chemical structure of biomolecules.
9. Recognise the molecular bases of the principal biological structures and functions.
10. Solve problems of acid-base balance, enzyme kinetics and bioenergetics.
11. Solve problems.
12. Understand the basic language of biochemistry.

Content

THEORY

UNIT 1. ELEMENTS, MOLECULES AND PHYSICAL ENVIRONMENT OF THE VIUS ISSUES.

The chemical logic of biological processes. Chemical elements present to living beings. Biomolecules Levels of structural organization of biomolecules. Biological importance of water. Non-covalent interactions in aqueous medium. Ionization of water, ion balance and shock absorber systems.

UNIT 2. PROTEINS: FUNCTIONS AND STRUCTURE.

Types of proteins and their functions. Structure and properties of amino acids. Classification of amino acids. Peptides and peptide link. Composition and sequence of amino acids in proteins. Structuring levels of proteins. Description of the helix alpha and the folded beta leaf. Fibrous proteins. Globular proteins Quaternary structure. Prions

UNIT 3. GLUCIDS

Types of glucides and their functions. Description and properties of monosaccharides. Glycosidic link Oligosaccharides. Polysaccharides Glycoproteins and glycolipids.

UNIT 4. NUCLEIC ACIDS

Composition, classes and functions of nucleic acids. Primary structure and higher order structures of nucleic acids. Chromatin and chromosome organization. Amplification and sequencing of nucleic acids.

UNIT 5. PROTECTION FUNCTION AND EVOLUTION: OXYGEN TRANSPORTATION PROTEINS

Oxygen storage: myoglobin. Oxygen transport: hemoglobin. Allosterism and cooperativity of hemoglobin. Examples of protein evolution. Different forms of hemoglobin: physiological adaptations and associated pathologies.

UNIT 6. ISOLATION AND CHARACTERIZATION OF MACROMOLÈCULES

Separation methods: centrifugation, chromatography and electrophoresis. Spectroscopic methods and their applications. Determination of three-dimensional structures. Immunological methods.

UNIT 7. ENZIMS, ENZYMATIC CINETICS AND REGULATION.

Enzymes: nature and function. Classification and nomenclature ofenzymes. Effects of catalysts on chemical reactions. Enzymatic mechanisms. Initial speed Enzymatic kinetics. Enzymatic cofactors. Enzymatic inhibition. Regulation of enzymatic activity: allosterics, covalent modification and changes in enzyme concentration. Biomedical, biotechnological and environmental applications.

UNIT 8. LIPIDS AND BIOLOGICAL MEMBRANE.

Types of lipids and functions. Structure and function of lipoproteins. Biological membranes

UNIT 9. INTRODUCTION TO METABOLISM.

Metabolism: concept, organization and type. Biochemical and thermodynamic reactions: free energy in biological processes. Role of ATP and other phosphorylated compounds. Biological reactions of oxidation-reduction and paper of the electron transporters. Regulation of metabolic processes.

UNIT 10. BIOSENALIZATION.

Extracellular chemical signals: hormones, neurotransmitters, nitric oxide and growth factors. Properties of the signal transduction mechanisms. Signal transduction main systems: membrane and intracellular receptors.

UNIT 11. METABOLISM OF GLUCIDS.

Degradation of glucose: glycolysis and pathway of phosphate pentoses. Fermentation Gluconeogenesis. Synthesis and degradation of glycogen. Use of other glucides.

UNIT 12. CENTRAL ROUTES OF OXIDATIVE METABOLISM AND OXIDATIVE FOSFORILLATION.

Production of acetyl-CoA. Cycle of citric acid. Energy performance and regulation. Anaplerotic reactions. Cycle of glioxylate. Chain of mitochondrial electronic transport and oxidative phosphorylation. Respiratory control Decoupling agents

UNIT 13. PHOTOSYNTHESIS.

Basic process of photosynthesis. Photosynthetic pigments. Absorption of the energy of light. Electronic transport and photophosphorylation. Assimilation of carbon dioxide and photosynthesis biosynthesis of glucides (Calvin cycle). Regulation of photosynthesis. Photorespiration Metabolism of C4 and Crude plants.

UNIT 14. METABOLISM OF LIPIDS

Metabolism of fatty acids. Regulation of the metabolism of fatty acids. Ketogenesis. Cholesterol and lipoprotein

metabolism.

UNIT 15. METABOLISM OF NITROGENATE COMPOUNDS

Nitrogen cycle Basic mechanisms of amino acid degradation. Elimination of ammonia and urea cycle. Biosynthesis of amino acids. Degradation of nucleic acids and nucleotides. Synthesis and recovery of nucleotides.

PROBLEMS

The content of this section, which will be submitted 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 characteristics of the various parts of the Theory's agenda make the statements of the problems concentrate on certain aspects that are: chemical equilibrium and shock absorber systems, methods of purification and analysis of macromolecules, enzymatic kinetics and bioenergetics and free energy Constant equilibrium

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practices	12	0.48	4, 5, 7, 9
Problem classes	9	0.36	2, 5, 7, 11
Theory classes	31	1.24	1, 2, 4, 5, 7, 9
Type: Supervised			
Tutoring	3	0.12	2, 4, 7
Type: Autonomous			
Study	86.5	3.46	1, 2, 4, 5, 7, 9, 11

The training activities are divided into three sections: theory classes, problem classes and laboratory practices, each one with its specific methodology.

Theory classes

The teacher will explain the content of the syllabus with the support of audiovisual material that will be available to the students in the Virtual Campus (Moddle) of the subject in advance at the beginning of each of the subjects of the course. These lectures will be the most important part of the theory section. It is recommended that students have the material published on the Moddle in printed form so that they can follow the classes more comfortably.

Under the guidance of the professor and through communication through the CV, the knowledge of some parts chosen from the syllabus will have to be searched and studied through autonomous learning by the students.

Problem classes

The group will be divided into two subgroups of approximately 30 students, whose lists will be made public at the beginning of the year. Students will attend the sessions programmed by their group.

At the beginning of the semester a dossier of statements of subject problems will be presented through the Virtual Campus that will be resolved throughout the sessions. In these sessions distributed throughout the semester, the problem professor will present the experimental and calculation principles necessary to work on the problems, explaining the guidelines for their resolution and at the same time reinforcing the knowledge of different parts of the laboratory classes.

Laboratory practices

The group will be subdivided into three subgroups, whose lists will be announced in advance and that will be the same for all the subjects of the semester. It is necessary to appear in practices with a lab coat, theprotocol of internships (available on the Moddle) printed and previously read and a notebook to write down the observations made and the data obtained.

On the days set in the calendar, students will be summoned to the Biochemistry laboratory to carry out basic experiences in the determination of properties and in the analysis of biomolecules. The practices, as well as their evaluation, will be carried out in groups of two people. At the end of each session you will have to submit a questionnaire with the results of the experiment and the answers to the questions posed. The attendance to the practices is obligatory, except in cases where there is a documented just cause.

Material available on the Moddle of the subject

· Teaching guide

· Presentations used by the teacher in theory classes

· Dossier of problem classes

· Protocols of the practical classes

· Calendar of teaching activities (classroom, laboratory classes, tutorials, assessments ...)

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Problem exams	20%	2.5	0.1	2, 3, 4, 5, 7, 8, 10, 11, 12
Questionnaire of practices	10%	1.5	0.06	4, 5, 6, 7, 9
Theory exams	70%	4.5	0.18	1, 2, 3, 4, 5, 7, 8, 9, 12

The evaluation of the subject will be carried out by means of a continuous evaluation consisting of two tests, corresponding each one to approximately half of the theoretical and problem agenda. Each test will have two parts. The first part will consist of several test questions and may also include short questions. In the second part, the student will have to solve one or two problems. Those students who have not passed the partial tests will have to complete a final test in order to recover these partial tests. The final test will have two parts. In the first part the student will find a test with questions like a test, which may also include short questions, for each partial to retrieve. In the second part, the student will have to solve two problems, one for each partial to retrieve. The final test will also be open to any student who, having passed the continuous assessment, wishes to improve the grade obtained in the continuous evaluation. In this case, the student resigns to the previous note.

Each of the laboratory practices will be evaluated just after its completion by answering a questionnaire related to the practice carried out.

The final grade obtained will be calculated as follows:

A) Students who have passed the subject during the continuous evaluation:

- 70% of the average of the first part of each partial test (35% each partial test)

- 20% of the average of the second part of each partial test (10% each partial test)

- 10% of the average of the practices.

They will only promise those qualifications in the partial test that are equal or superior to four.

B) Students who present themselves to the final exam:

- 70% of the first part of the final test (35% each partial test)

- 20% of the second part of the final test (10% each partial test)

- 10% of the average of the practices

To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score

Attendance to practical sessions is mandatory. Students missing more than 20% of programmed sessions will be graded as "No Avaluable".

Single Evaluation Test:

Student who take the single evaluation must do the Laboratoty Practices sessions and it is a requirement to have them approved. They will have a weight of 10%.

The single evaluation consists of a single test with test-type questionds (may include short questions) on the contents of the entire theory program, (70%); as well as 2 problems to solve (20%).

The single evaluation test will coincide with the samme date fixed ion the calendar for the last continuous evaluation test. A sema recovery system will be applied as for the continuous evaluation.

Bibliography

Basic bibliography (by alphabetical order):

THEORY

Berg, J.M., Tymoczko, J.L., Stryer L. "Bioquímica. Curso básico" (2014) Ed. Reverté. Correspon a la traducció de la 2a. Ed. en llengua anglesa.
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Mathews, C.K., van Holde K.E. i Ahern, K. G. "Bioquímica" (2002) 3a. Ed. Addison/Wesley.
McKee, T i McKee, J.R. "Bioquímica. Las bases moleculares de la vida" (2011).4a. Ed. McGraw-Hill-Interamericana.
Nelson, D.L. i Cox, M.M. "Lehninger Principles of Biochemistry" (2008) 5th Ed. W.H. Freeman & Co. Traduïda la 5a. Ed: "Principios de Bioquímica" (2009). Omega.

PROBLEMS

van Eikeren P. (1987) Guía de Principios de Bioquímica de Lehninger. Ed. Omega.
Macarulla J.M., Marino A. i Macarulla A. (1992) Bioquímica Cuantitativa. Ed. Reverté.
Segel I.H. (1976) Biochemical Calculations. Ed. Wiley & Sons.

Software

There are not computer programs for this subject

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	211	Catalan/Spanish	first semester	morning-mixed
(PAUL) Classroom practices	212	Catalan/Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	211	Catalan/Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	212	Catalan/Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	213	Catalan/Spanish	first semester	morning-mixed
(TE) Theory	21	Catalan/Spanish	first semester	afternoon