

Biochemistry

Code: 100999
ECTS Credits: 6

Degree	Type	Year	Semester
2500502 Microbiology	FB	1	1

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

Teachers

Maria del Mar Marquès Bueno

Prerequisites

There are not mandatory requirements.

Objectives and Contextualisation

In Biochemistry subject is divided in two parts, the first is dedicated to structural and functional properties of biomolecules from a general perspective, emphasising enzymes and proteins. In the second part, metabolism pathways and the bases of biosignaling and bioenergetic are studied. The objective is to provide the molecular and metabolic bases needed for the correct understanding of other subjects of the Microbiology bachelor.

The specific objectives are:

Understand the general structural bases of biological molecules.

Understand the kinetics and enzymatic action in the biological context and their regulation.

Know the main molecular mechanism of signaling transduction

Describe the main metabolic pathways of carbohydrates, lipids and nitrogen compounds and their regulation.

Apply knowledge in quantitative and qualitative exercises.

Competences

- Communicate orally and in writing.
- Develop critical reasoning skills in the field of study and in relation to the social context.
- Identify and solve problems.
- Interpret, on a molecular scale, microbial mechanisms and processes.

- Recognise the different levels of organization of living beings, especially animals and plants, diversity and bases of regulation of vital functions of organisms and identify mechanisms of adaptation to the environment.
- Work individually or in groups, in multidisciplinary teams and in an international context.

Learning Outcomes

1. Acquire a sound knowledge of the principal metabolic pathways.
2. Communicate orally and in writing.
3. Develop critical reasoning skills in the field of study and in relation to the social context.
4. Identify and solve problems.
5. Identify the mechanisms that regulate the vital functions of living beings.
6. Know the basic biological functions of biomolecules.
7. Know the molecular bases of the organisation of living beings.
8. Master the concepts of enzyme catalysis and bioenergetics.
9. Recognise the chemical structure and the physical and chemical properties of biomolecules.
10. Solve problems on physical and chemical properties and functions of biomolecules.
11. Work individually or in groups, in multidisciplinary teams and in an international context.

Content

THEORY

BASIC CONCEPTS

Chapter 1. Essential concepts.

Biochemistry: definition and objectives. Chemistry elements of living beings. Type of biomolecule bonds. Free energy or Gibbs energy. The importance of weak interactions in biology. Water structure and properties. pH and pKa concept.

BIOMOLECULES: STRUCTURE AND FUNCTION

Chapter 2. Amino acids and peptide bond.

Type of protein and function. Amino acids classification and properties. Peptide bond. Amino acid sequence and protein composition: primary and secondary structure. Sequence comparison and protein evolution.

Chapter 3. Proteins.

Level of protein structure. Secondary structure: Alpha helix, beta strands, beta turn. Tertiary structure: fiber and globular proteins. Quaternary structure. Protein folding and determinant factors. Conformational diseases.

Chapter 4. Carbohydrate.

Monosaccharide: aldose, ketose and isomer. Glycosidic bond. Disaccharide and polysaccharides. Glycoconjugate: proteoglycans, glycoproteins and glycolipids. Carbohydrate as Information molecules. Sugar code.

Chapter 5. Nuclei acids.

Nucleotides. Primary structure of nuclei acid. Secondary structure of DNA: Watson and Crick model and alternative structure. Nuclei acid ternary structure: tRNA and DNA supercoil. Chromosome organization.

Chapter 6. Function and protein evolution: oxygen transport proteins.

Oxygen store: myoglobin. Oxygen transport: hemoglobin: Allosteric and cooperative binding. Protein evolution example. Different hemoglobin shapes: physiologic adaptation and molecular pathology.

Chapter 7. Enzymes, enzymatic kinetics and regulation.

Nature and function. Classification and nomenclature of the enzymes. Catalytic effect in chemistry reactions. Enzymatic mechanism. Enzymatic cofactors. Enzymatic inhibition: allosteric, covalent modification. Biomedical and biotechnological applications.

Chapter 8. Lipids and biological membranes.

Lipid types and function. Structure and function of lipoprotein. Biological membrane.

METABOLISM

Chapter 9. Metabolism Introduction.

Metabolism: concept, organization and types. Biochemistry and thermodynamic reactions: Free energy in the biological process. ATP and other rich energy compounds. Oxidation-reduction biological reactions and electrons transporter. Metabolic process regulation.

Chapter 10. Biosignaling.

Properties of the transduction signal mechanism. Eukaryotic signal transduction system: main receptors. Introduction to signal transduction in prokaryotic.

Chapter 11. Carbohydrates metabolism.

Glycolysis. Lactic and alcoholic fermentation. Pentose phosphate path. Gluconeogenesis. Synthesis and degradation of glycogen. Carbohydrate Metabolism regulation.

Chapter 12. Principal path Oxidant metabolism.

Acetyl-CoA synthesis. Acid citric cycle. Anaplerotic reactions. Glyoxylate cycle.

Chapter 13. Energy transduction: oxidative phosphorylation and photosynthesis.

Quimio-osmotic connection. Mitochondrial electron transport chain and oxidative phosphorylation. Photosynthetic transport chain and phosphorylation. CO₂ assimilation (Calvin cycle). Introduction to respiratory chain in bacterial photosystems.

Chapter 14. Lipid catabolism and nitrogen compounds bases.

Triacylglycerol and lipoprotein mobilization. Beta-oxidation of fat acids. Ketogenesis. Nitrogen cycle and urea cycle.

Exercises

In seminars, we will practice, from a quantitative and numeric point of view, the following topics studied previously in the subject:

- pH and buffer systems. (Part 1),
- Macromolecules purification and characterization. (Part 2)
- Kinetic enzymatic (Part 3),
- Gibbs energy and equilibrium constant (Part 4),
- Reduction potential and redox reactions (Part 5).

The exercises list will be delivered through Campus Virtual during the course.

Methodology

Teaching methods

The educational content is divided in two parts: theory and exercises. Each part with a different methodology. These activities could be complemented with tutorials previously appointed with the professor.

Theory lessons.

The professor will explain the content of the syllabus with the support of the graphic material (class presentations) that will be available to students on the subject's Virtual Campus in advance at the start of each of the course's topics.

These expository sessions will constitute the most important part of the theory section. It is recommended that students have the material published in the CV in printed or in computer/tablet to follow classes properly.

Practical lessons.

Throughout the course, 10 hours will be dedicated to problem class sessions.

The group will be divided into two subgroups, the lists of which will be made public at the beginning of the course. Students will attend scheduled sessions for their group.

At the beginning of the semester, the dossier with the problems of the subject to be solved during the course will be delivered through the Virtual Campus.

The dossier will contain 5 blocks, the exercises will be solved and discussed during the problems sessions

Tutorials

The professor will be available for individual or small groups consultations when previously agreed.

Available material in Campus Virtual

Subject guide

Calendar for educational activities

Power point slides used during the lesson

Exercises list and complementary material

Evaluation description

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises/problems Seminars	10	0.4	3, 8, 4, 10, 2
Lectures (Theoretical concepts)	35	1.4	1, 7, 3, 8, 5, 6, 9
Type: Supervised			
Tutoring	3	0.12	1, 7, 3, 8, 5, 4, 6, 9, 10, 2

Type: Autonomous

Solving exercises/problems	28	1.12	3, 8, 4, 10, 2, 11
Study	65	2.6	1, 7, 8, 5, 6, 9, 11

Assessment

Evaluation description

Continuous assessment

The evaluation of this subject will be continuous and it is based on the following elements:

There are two evaluations, each of them correspond approximately to half of the units (theoretical concepts and exercises).

Theoretical concepts: Individual evaluation in two partial exams (evaluations 1 and 2 in the calendar) with 30 multiple choice questions. The minimum qualification to pass this part is equal or higher than 3.5 points over 10. The theoretical concepts corresponds to the 75% of the final assessment.

Exercises/problems: Individual evaluation in one exam (evaluation 2 in the calendar) with several exercises, different from those performed during the lessons. Exercises/problems correspond to the 25% of the final qualification.

The students have to be evaluated at minimum 2/3 or 67% of the activities to complete the subject. Any student with less than 67% of the activities evaluated will be designated as "non evaluable".

Qualification Improving. Any student has the right to repeat any segment of the evaluation in order to improve the previous qualification. However, if the new qualification is lower, the new qualification will be the final one.

Students pass the subject when the following situations are achieved:

Final average qualification is 5 or higher (out of 10) following these calculation: Final theoretical test qualification (75%) and exercises (25%): $\text{Final qualification} = (\text{Average Theory qualification} \times 0,75) + (\text{Average exercises qualification} \times 0,25)$.

All the parts of the evaluation have at least 3.5 points (out of 10) in the qualification.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First Test (Theoretical concepts)	37,5%	3	0.12	7, 3, 8, 5, 4, 6, 9, 2
Second Test (Problems)	25%	3	0.12	1, 7, 3, 8, 5, 4, 6, 9, 10, 2, 11

Bibliography

Bibliography

Theory (por orden alfabético)

- Feduchi E., Blasco I., Romero C. & Yáñez E. (2011) Bioquímica. Conceptos esenciales. 1ª ed. Ed. Médica Panamericana
- McKee, T. y McKee, J.R. Bioquímica. Las bases moleculares de la vida. (2014). 5a ed. Mc Graw Hill Editores. <http://global.oup.com/us/companion.websites/9780199316700/>
- Murray, R.K. et al. Harper Bioquímica Ilustrada. (2013) 29a ed. Mc Graw Hill Editores..
- Nelson, D.L. and Cox, M.M. Lehninger-Principios de Bioquímica. (2014) 6a ed. Ed. Omega..
- Nelson, D.L. and Cox, M.M. Lehninger-Principles of Biochemistry. (2017) 7a ed. Ed. W.H. Freeman.
- Tymoczko, J.L., Berg, J.M. Stryer L. Bioquímica. Curso básico. (2014) Ed. Reverté.
- Voet D., Voet J.G. and Pratt C.W. Principles of Biochemistry. (2012) 4a ed. Wiley.

PROBLEMS

- Lehninger, Mathews, Stryer books contain problem at the end of each chapter.

Software

There are no specific software associated to this course.