Structure and Function of Biomolecules

Code: 101916
ECTS Credits: 6

2025/2026

Degree	Type	Year
Biomedical Sciences	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 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.

To be able to attend the sessions of laboratory practices, the student must justify having passed the biosafety and security tests that will be found in the Virtual Campus and be knowledgeable and accept the operating regulations of the laboratories of the Faculty of Biosciences.

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.

Learning Outcomes

1. CM12 (Competence) Analyse how the study of biomolecular structure and function contributes to the Sustainable Development Goals.
2. CM13 (Competence) Evaluate the contributions of women to the study of biomolecular structure, catalytic mechanisms and metabolism.
3. KM16 (Knowledge) Define the structure, reactivity and function of biomolecules and their basic units, as well as the molecular mechanisms involved in catalysis, enzymatic inhibition, signal transduction, substance transport and metabolism.
4. KM17 (Knowledge) Define the principles of safety and quality in biomedical sciences, good laboratory practices, and bioethical standards related to this field.
5. KM18 (Knowledge) Describe the experimental techniques used in the study of the structure, function and metabolism of biomolecules.
6. SM15 (Skill) Interpret the kinetic and thermodynamic parameters of enzymatic reactions, as well as those involved in the ligand binding to biomolecules.
7. SM16 (Skill) Select the most appropriate experimental techniques for studying the structure, function and metabolism of biomolecules.

Content

Content

THEORY

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

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. Principles of Bioenergetics: the transformations of energy to living beings and the laws of Thermodynamics. Free energy and constant equilibrium. Most common biochemical reactions. Transfer of phosphate and ATP groups. Oxidation-reduction reactions.

2. Proteins: Primary structure and biological functions.

Protein classes and their functions. Structure and properties of amino acids. Stereoisomery and acid-base behavior. Peptides and peptide link. Analysis of the composition of amino acids and the sequence of proteins.

3. Three-dimensional structure of proteins.

General concepts about the structure of proteins. Secondary structure Helix α and leaves β. Fibrous proteins. Globular proteins Protein folding: factors that determine it. Molecular Chaperones. Introduction to conformational diseases. Prediction of the protein structure. Quaternary structure. Introduction to protein purification and characterization techniques.

4. Relation between structure and function in proteins: oxygen transporting 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.

5. Biological catalyst, enzymatic kinetics and regulation.

What they are and how they work. Enzyme cofactors. Classification and nomenclature of enzymes. Effects ofcatalysts 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.

6. Carbohydrates.

Types of monosaccharides. Glycosidic and polysaccharide link. Glycoproteins and proteoglycans.

7. Lipids and biological membranes.

Types of lipids and functions. Biological membranes: composition, fluidity, asymmetry. Membrane proteins. Structure and function of lipoproteins and intracellular lipid bodies.

8. Nucleic acids. Levels of structural organization.

Nucleotides. Primary RNA and DNA structure. Secondary structure: Watson and Crick model and alternative structures. Tertiary structure: DNA transfer and supernatant RNA. Complex DNA-proteins: the eukaryotic nucleosome.

9. Replication and transcription of DNA.

Replication to prokaryotes. Differential features of eukaryotic replication: telomeres. DNA repair. Transcription to prokaryotes. Differential features of transcription to eukaryotes: RNA processing. Reverse transcription of RNA to DNA. Common principles and specific mechanisms for the regulation of gene expression in prokaryotes and eukaryotes.

10. The genetic code and the synthesis of proteins.

Genetic code Protein synthesis to prokaryotes and eukaryotes. Mechanisms to maintain the fidelity of the message to the translation process. Signals for intracellular localization of proteins. Post-translation modifications of proteins.

11. Recombinant DNA.

Restriction enzymes DNA cloning materials and methodology. Construction of DNA libraries. Selection and search for DNA sequences: hybridization. Sequence of DNA. Genome projects Chips to quantify gene expression. Some applications of genetic engineering.

PROBLEMS

This section will be based on a dossier that willbe 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.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practices	8	0.32	KM17, SM15, SM16, KM17

Problem sessions	10	0.4	KM16, SM15, KM16
Theory sessions	36	1.44	KM16, KM17, KM18, KM16
Type: Supervised			
Individual tutorials	2	0.08	
Self-learning exercises and exercicies delivery through CV	14	0.56	SM15, SM16, SM15
Type: Autonomous			
Delivery of dossiers / practical sessions questionnaires	4	0.16	CM12, CM13, KM18, CM12
Group work for problem solving	15	0.6	KM16, SM15, KM16
Scientific seminars preparation	53	2.12	CM12, CM13, KM17, SM16, CM12

"I hear and forget, I see and remember. I do and learn. " Chinese Proverb attributed to Confucius (551-470 BC). This maxim summarizes something quite accepted in the field of pedagogy, the best way to learn is trying to understand or solve a problem, with individual work or contributing to a group effort. A vital part to help maintain the motivation of the student must be a continuous evaluation of the effort made and its result, which will be discussed in the Evaluation section.

Given this, the main teaching emphasis will be placed in the supervised or autonomous activity section, either individual or group, so classroom lectures or classroom practices will be focused on providing basic minimum information and Questions (theory) that work more quantitatively in the classes of classroom practices and thus give critical answers in the form of work commissions that will be made accessible on a regular basis through the Virtual Campus.

Theory classes: will provide basic information accessible to the recommended reference book but will always have a certain interactive part of questions to the student. These questions will then be addressed in more detail in the sessions of problems, tutoring and Virtual Campus, thus reinforcing the basic concepts and strategies that you want to learn to repeat. The language of oral work will be Catalan (or Spanish if there are participations in this language). On the other hand, the main language in the query and main reference texts (reading) will be English. Written or oral participations will have an added value (see the Evaluation section) the use of the English language.

Scientific seminars: The students will work in small groups. They will prepare a Scientific seminar focused on the topic structure-function relationship and disease. They have to use consistent and evidence-based information for the preparation of the seminar. On the stablished dates they will present it to the rest of the class and solve the doubts of the audience.

Problem based learning: The group will be divided into two subgroups whose lists will be made public at the beginning of the course and each person will attend the sessions programmed by their group. At the beginning of the semester a dossier of statements of problems of the subject will be delivered through the Virtual Campus that will be resolved throughout the sessions. In a limited number of sessions distributed during the semester, the teachers of problems will expose the experimental and calculation principles necessary to work them, explaining the guidelines for their resolution and at the same time giving a part of the complementary subject to the classes of theory The problems will be prepared outside the class schedule, in work groups that will be maintained throughout the course. Additionally, new statements will be proposed that will have to work in groups in the same class and those who must deliver their resolution at the end of the session.

Laboratory practices are reduced to only two sessions, although an important part of practical training related to EFB will also be applied to another first subject (Laboratory I). These sessions should allow the student to have a perspective of the distance between using critically data found in the scientific literature and producing them with their own hands.

In order to be able to attend the sessions of laboratory practices, the student must justify having passed the biosafety and security tests that he will find in the Virtual Campus and be knowledgeable and accept the rules of operation of the laboratories of the Faculty of Biosciences.

Use of Artificial Intelligence

In this course, the use of Artificial Intelligence (AI) technologies is permitted as an integral part of the development of the work, provided that the final result reflects a significant contribution from the student in terms of analysis and personal reflection. The student must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these tools have influenced both the process and the final outcome of the activity. Lack of transparency in the use of AI will be considered a breach of academic honesty and may result in a grade penalty for the activity, or more severe sanctions in serious cases.

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
Delivery of dossiers / practical sessions questionnaires	15%	1	0.04	KM17, SM15, SM16
Delivery of solved problems and in class resolution of exercicies	0,5%	1.5	0.06	KM18, SM15, SM16
Partial test exams	55%	3	0.12	KM16, KM17, KM18, SM15, SM16
Problems examination	15%	1	0.04	CM12, KM16, SM15, SM16
Scientific seminars	10%	1.5	0.06	CM13, SM16

Evaluation

The evaluation of this subject will have the format of continuation. The purpose of evaluation continued (of which form part of the assessment of the evidence partial, the seminars and the deliveries a class of problems) is the encourage the efforts of the students in the long of all the topics , allowing monitor on its degree of monitoring and understanding of the subject .

Theory

Individual evaluation through :

- Two partial tests with multiple-choice questions. There are no conditions to take any of the scheduled tests. If a minimum score of 3.5 is not achieved in the partial tests, the student must attend the makeup exam.
- A final problem-solving test that will evaluate all the problems worked on throughout the course. It will take place on the same day as the exam for the second partial theory test. If a minimum score of 3.5 is not achieved, the student must attend the makeup exam.

- A final makeup test for the two partial exams, in multiple-choice format, aimed at those students who either could not attend or did not obtain a score higher than 3.5 in one or both of the partial exams. This test is optional for those who wish to improve their partial exam grades. Anyone who takes this makeup test waives the grade previously obtained in the corresponding partial exam. If a minimum score of 3.5 is not achieved in the makeup test for the partial exams, the course is failed.

- A final makeup problem-solving test, aimed at those students who either could not attend or did not obtain a score higher than 3.5 on the problem-solving exam. This test is optional for those who wish to improve their problem-solving exam grade. Anyone who takes this makeup test waives the grade previously obtained. There is no minimum passing grade in the problem-solving makeup test to pass the course.

To participate in the recovery, the student must have been previously evaluated in a set of activities the weight of which is equivalent to a minimum of two third parts of the qualification total of course.

Scientic seminars:

Group evaluation.

- Presentation on group theme scientific interest and related to the relationship structure- function in disease .
- If it is done in English, a multiplier factor will be applied, that can mean a maximum of 0.5 additional points.
- The mark obtained in this seminar, initially the same for all the members of the group , can be weighted based on data from a questionnaire assessment that each student will do on the work of his group and his own.

The weight of the evaluation of seminars will be 10% of the total.

Problems

Group assessment with an additional individual assessment component:

- Group resolution of problems proposed in the classroom.

Individual assessment through:

- A final problem-solving test in which the overall problems worked on throughout the entire course will be evaluated, and which will take place on the date set for the second partial theory exam.

- A makeup test aimed at those students who either could not attend or did not achieve a score higher than 3.5 on the final problem-solving test. This test is optional for those who wish to improve their problem-solving grade. Anyone who takes this test waives the grade previously obtained on the final problem-solving test.

- There is no minimum passing grade in the makeup test to pass the subject.

The weight of the evaluation of problems will be 20% of the total: 0,5% corresponding to the evaluation group and 15% corresponding to the test end.

Practices

Group evaluation:

Presentation of the results obtained during the practices and resolution of the proposed questionnaire. Also take into account the attitude and behavior in the laboratory .

Attendance to the practices of the laboratory is mandatory. Only accepted changes of grupde exceptionally and always with justification documents. In case of not attending justified on any of the sessions of practices and there is no option to be assigned to a different group a group this session will not be considered in the calculation of the grade of practices.

The weight of the evaluation of practices will be 15% of the total.

Qualifications

The four sections are inseparable, so the student must participate, and be evaluated , in all of them in order to pass the subject. The rating end is calculated according to the parameters listed in the table below is presented so that the section of theory has generally 50% of the grade, Section of seminars 10%, the section of problems 20% and the internship the remaining 15% . To pass the course is requirement essential to have achieved a grade equal to or higher than 3.5 in each of the exams partial of theory. Once this requirement is met, the subject will be considered passed when the final grade is equal to or greater than 50 out of a maximum of 100.

Single assessment mode

- Students who have opted for the single assessment mode must take a final test consisting of an exam of the entire theoretical and problem syllabus of the subject. This test will take place on the same day that the students of the continuous evaluation take the exam of the second partial.

- The practical classes are of compulsory attendance and the students of the single assessment must take the exam and/or questionnaire on the same day as the students of the continuous assessment.

- The student's grade will be:

Subject grade = (Final exam grade - 85% + Laboratory grade - 15%)/100.

- Recovery: The same recovery system as for continuous assessment will be applied. If the final grade does not reach 5, the student has another opportunity to pass the course through the recovery exam to be held on the date set by the coordinationofthe degree. In this test 85% of the grade corresponding to the theory part can be recovered. The practical part is not recoverable.

- Not Assessable: The same criteria for being marked as "Not Assessable" as in continuous assessment will be applied.

Bibliography

Basic bibliography

- Mathews, C.K., Van Holde, K.E., Appling, D.R., Anthony-Cahill, S.J. "Biochemistry" (2013) 4ª ed. Pearson Education

- McKee, T i McKee, J.R. "Bioquímica. La base molecular de la vida" (2009). 4ª edició. McGraw-Hill-Interamericana.

- Murray, R.K.i col. "Harper. Bioquímica ilustrada" (2013). 29ª edició. McGraw-Hill-Interamericana.

- Nelson, D.L. and Cox, M.M. "Lehninger-Principios de Bioquímica". (2018) 7ª. ed. Ed. Omega.

- Nelson, D.L. and Cox, M.M. "Lehninger-Principles of Biochemistry". (2017) 7ª. ed. Freeman, W. H. & Company

- Berg, J.M., Tymoczko,J.L., Stryer, L "Bioquímica" (2013). 7ªed. Ed. Reverté, Barcelona.

- Berg, J.M., Tymoczko,J.L., Stryer, L "Biochemistry" (2015) 8th ed. Macmillan

- Tymoczko,J.L., Berg, J.M.,, Stryer, L "Bioquímica. Curso básico". (2014). Reverté

- Horton, H.R., Moran, L.A. Scrimgeour, K.G. Perry M.D., Rawn J.D. "Principios de Bioquímica". 2008. 4ª ed. Prentice-Hall. Pearson Educación. México

- Voet, D., Voet, J.G. "Biochemistry" (2010), 4rta ed. Wiley

- Voet, D., Voet, J.G, Pratt, C.W. "Fundamentos de Bioquímica". (2016), 4ª ed. Ed.Médica Panamericana. Barcelona

Exercises

- Textos com Lehninger, Mathews, Stryer contenen problemes al final de cada capítol.

- Stephenson F.H. (2012) Cáculo en Biología molecular y Biotecnología. 2ª ed. Ed. Elsevier España

Bibliography available in electronic format in the UAB catalog:

Bioquímica : con aplicaciones clínicas / Lubert Stryer, Jeremy M. Berg, John L. Tymoczko ; con la colaboración de Gregory J. Gatto, Jr. ; versión española por Miguel Ángel Trueba

https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjcib/alma991009089459706709

Bioquímica : curso básico / John L. Tymoczko, Jeremy M. Berg, Lubert Stryer ; [versión española traducida por: Juan Manuel González Mañas]

https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_digitalia_books_DIGRVRT0433

Calculations for molecular biology and biotechnology / Frank H. Stephenson

https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_scopus_primary_2_s2_0_84882176946

Fundamentos de bioquímica [Recurs electrònic] : la vida a nivel molecular : 4a edición / Donald Voet, Judith G. Voet, Charlotte W. Pratt
Voet, Donald

https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991007007959706709

Software

The use of the software detailed below is recommended for the preparation of scientific seminars:

- PyMol: https://pymol.org/2/

- Expasy: https://www.expasy.org/

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	511	Catalan/Spanish	first semester	morning-mixed

(PLAB) Practical laboratories	512	Catalan/Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	513	Catalan/Spanish	first semester	morning-mixed
(SEM) Seminars	511	Catalan/Spanish	first semester	afternoon
(SEM) Seminars	512	Catalan/Spanish	first semester	afternoon
(TE) Theory	51	Catalan	first semester	morning-mixed