



Teaching Guide

Teaching Guide				
Identifying Data				2022/23
Subject (*)	Structural Biochemistry		Code	610G04019
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Second	Obligatory	6
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Bioloxía			
Coordinador	Vizoso Vázquez, Ángel José	E-mail	a.vizoso@udc.es	
Lecturers	Saavedra Bouza, Almudena	E-mail	almudena.saavedra@udc.es	
	Vizoso Vázquez, Ángel José		a.vizoso@udc.es	
Web	https://campusvirtual.udc.gal			
General description	The Structural Biochemistry course is fundamental, from a basic point of view, to understand the main chemical, biophysical and structural properties of biological macromolecules and the relationship between these properties and the different functions they perform. The knowledge acquired will be essential for other subjects of the Degree in Nanoscience in Nanotechnology.			

Study programme competences

Code	Study programme competences
A3	CE3 - Reconocer y analizar problemas físicos, químicos, matemáticos, biológicos en el ámbito de la Nanociencia y Nanotecnología, así como plantear respuestas o trabajos adecuados para su resolución, incluyendo el uso de fuentes bibliográficas.
A6	CE6 - Manipular instrumentación y material propios de laboratorios para ensayos físicos, químicos y biológicos en el estudio y análisis de fenómenos en la nanoescala.
A7	CE7 - Interpretar los datos obtenidos mediante medidas experimentales y simulaciones, incluyendo el uso de herramientas informáticas, identificar su significado y relacionarlos con las teorías químicas, físicas o biológicas apropiadas.
A8	CE8 - Aplicar las normas generales de seguridad y funcionamiento de un laboratorio y las normativas específicas para la manipulación de la instrumentación y de los productos y nanomateriales.
B3	CB3 - Que los estudiantes tengan la capacidad de reunir e interpretar datos relevantes (normalmente dentro de su área de estudio) para emitir juicios que incluyan una reflexión sobre temas relevantes de índole social, científica o ética
B4	CB4 - Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado
B6	CG1 - Aprender a aprender
B7	CG2 - Resolver problemas de forma efectiva.
B8	CG3 - Aplicar un pensamiento crítico, lógico y creativo.
C3	CT3 - Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida
C6	CT6 - Adquirir habilidades para la vida y hábitos, rutinas y estilos de vida saludables
C7	CT7 - Desarrollar la capacidad de trabajar en equipos interdisciplinarios o transdisciplinarios, para ofrecer propuestas que contribuyan a un desarrollo sostenible ambiental, económico, político y social.
C8	CT8 - Valorar la importancia que tiene la investigación, la innovación y el desarrollo tecnológico en el avance socioeconómico y cultural de la sociedad

Learning outcomes

Learning outcomes	Study programme competences
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Identify the main biomolecules, their structure and function.	A3	B3 B4 B7	
Recognize the principles of enzymology.	A3 A7	B3 B4 B7	C3
Solve basic structural biochemistry problems.	A3 A6 A7	B3 B4 B6 B7 B8	C3 C7 C8
Apply the main biochemical techniques for the isolation, purification and characterization of biomolecules.	A6 A8	B3 B4 B8	C6 C7 C8

Contents	
Topic	Sub-topic
Module 1. Introduction to Biochemistry	Concept, origins and evolution of Biomolecules. Functional groups, chemical bonds and stereochemistry. Biomolecules in polar solvents: ionization of water, ionic balance and buffer systems. Thermodynamic processes in biochemistry.
Module 2. Structure and function of biomolecules: carbohydrates, lipids, nucleic acids, amino acids and proteins.	<p>2.1. Structure and function of amino acids and proteins: Type of proteins and functions. Structure and properties of two amino acids. Classification. Protein structuring levels. peptide bond. Primary structure and amino acid sequence of proteins. Protein secondary structure: description and prediction. Concept of protein domain and folding. Tertiary and quaternary structure of proteins: characteristics and classification. Dynamics and folding of proteins. Relationship between structure and function in proteins.</p> <p>2.2. Structure and function of carbohydrates: Classification. Monosaccharides: description, structure and physical and chemical properties. O-glycosidic bond. Oligosaccharides: nomenclature, description, structure and properties. polysaccharides. Glycoconjugates: proteoglycans, glycoproteins and glycolipids. Formation and functionalization of nanostructures based on carbohydrates.</p> <p>2.3. Structure and function of lipids: Type of lipids and functions. Classification, physical-chemical properties, structure and biological importance of fatty acids, cerides, glycerides, phosphoglycerides. sphingolipids, terpenes and steroids. pyrrolic lipids. Cholesterol and derivatives. Lipoproteins. Fat-soluble vitamins. Formation and functionalization of lipid-based nanostructures.</p> <p>2.4. Structure and function of nucleic acids: nature and function. Nucleotides, structure and properties. Phosphodiester bond and primary structure of nucleic acids. Watson and Crick model and alternative structures of deoxyribonucleic acids. Types and structure of ribonucleic acids. Formation and functionalization of nanocomplexes based on nucleic acids.</p>



Module 3. Enzymology: Enzymes, enzyme kinetics and enzyme regulation.	General properties. Classification and nomenclature of enzymes. Effects of catalysts on chemical reactions. Activation energy and transition state. Enzyme cofactors, coenzymes and the role of vitamins. The active site: three-dimensional structure and enzyme-substrate coupling. Enzyme mechanisms. Acid-base, covalent, electrostatic and metal ion catalysis. Proximity and orientation effects. Reaction speed and activation energy: concepts, calculations and units. Units of enzymatic activity. Effect of enzyme concentration. Enzymes used in clinical analysis, in the diagnosis of diseases or as therapeutic agents.
Module 4. Biochemical techniques for the isolation and characterization of biomolecules.	General aspects of the methodology in biochemistry. The biological material used in biochemistry. Fractional precipitation and centrifugation. Chromatographic, electrophoretic and spectroscopic techniques. Dialysis and ultrafiltration. Radioactivity and isotopic techniques in biochemistry.
Lab work	1- Affinity chromatography 2- SDS-PAGE electrophoresis + protein quantification 3- Measurements of enzymatic activity 4- Protein crystallography + Work with molecular models: monosaccharides and peptides.
Use of bioinformatic tools	1- Databases 2- Multiple Sequence Alignment 3- Modeling of structures 4- Docking

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A3 A8 B3 B6 C8	28	70	98
Laboratory practice	A6 B3 B4 C3	15	5	20
ICT practicals	A3 A7 B3 B4 B7 B8 C3 C6 C7	8	8	16
Mixed objective/subjective test	B3 B4 C6	0	10	10
Personalized attention		6	0	6
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	The subjects of the subject will be taught by the professors and all the presentations or other documentation will be made available to the students on the Virtual Campus.
Laboratory practice	A series of activities will be carried out in the practice laboratory, so that students learn to handle scientific instruments and basic procedures in Biochemistry and Molecular Biology. A brief memory will be delivered at the end of them.
ICT practicals	A series of activities will be carried out in the computer room, so that students learn to handle different databases and computer tools in the field of protein structural biology. A practical group work will be proposed once the necessary knowledge has been acquired.
Mixed objective/subjective test	Written test used to evaluate learning, and that can combine different types of questions: multiple choice, association, explanatory or calculation questions and problem solving.

Personalized attention	
Methodologies	Description



Laboratory practice ICT practicals	The schedule of tutorials will be specified at the beginning of the course. Students will also be able to request tutorials and answer specific questions by email.
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Assessment			
Methodologies	Competencies	Description	Qualification
Laboratory practice	A6 B3 B4 C3	Laboratory practices are considered a COMPULSARY activity to pass the course. The evaluation will consist of the preparation of an internship report where the quality of the work, the adequacy in the graphical representation of data, interpretation of results, as well as the ability to discuss these will be considered, for which the following will be considered a necessary condition: use of scientific language and correct and contrasted bibliographic information.	10
Mixed objective/subjective test	B3 B4 C6	Evaluation of the Theoretical knowledge (test, definitions, problems).	70
ICT practicals	A3 A7 B3 B4 B7 B8 C3 C6 C7	Attendance at the training sessions is considered a COMPULSARY and PRESENTIAL activity to pass the subject. The evaluation will consist of the group elaboration of a text analyzing an amino acid sequence selected by the teacher. The quality of the work, the adequacy in the graphic representation of data, interpretation of results, as well as the ability to discuss them, will be evaluated, for which the use of scientific language and correct and contrasted bibliographic information will be considered a necessary condition.	20

Assessment comments
<p>-LABORATORY PRACTICES are compulsory. Students who do not complete ALL the practices without a duly justified reason prevent them from passing the subject. OFFICIAL CHANCE FOR JUNE A.-To pass the subject it will be necessary to reach 45% of the points, in each of the Evaluable Parts: Objective Test, Laboratory Practices and ICT Practices. B.-HONOURS ENROLLMENT: Those students who take the first opportunity (official exam in June) will have priority to apply for MH. JULY OFFICIAL OPPORTUNITY A.-To pass the subject it will be necessary to reach 45% of the points, in each one of the Evaluable Parts: Objective Test, Problem Solving and Laboratory Practices. Final Qualification, in the Minutes: In any of the 2 Options: June or July, ONLY the qualifications of all the Parties (Objective Test, Laboratory Practices and ICT Practices) will be added if they all reach 45% of their value. If this percentage is not reached in any of them, only the note of 4 will appear in the Minutes. CONSIDERATION OF NOT PRESENTED (NP): 1st Opportunity in June: The student who does not appear for the objective test on the official date. 2nd Opportunity of July: A NOT PRESENTED will apply when the student does not appear for any of the evaluable parts. Exceptional cases: Exceptionally, in the event that the student, for duly justified reasons, has not been able to take all the continuous assessment tests, the teacher(s) will take the measures that he/she deems appropriate for this purpose. -For students with partial dedication or exemption from attendance, a specific global assessment exam will be held in the June and July sessions.</p>

Sources of information	
Basic	<ul style="list-style-type: none"> - Mathews CK, Van Holde KE, Appling DR y Anthony-Cahill SJ (2013). Bioquímica, 4ª ed.. Ed. Pearson - David L. Nelson, Michael M. Cox. (2018). Lehninger Principios de Bioquímica. 7a ed.. Ed. Omega - Feduchi, E., Romero, C.S., Yáñez, E., García-Hoz Jiménez, C (2021). Bioquímica. Conceptos esenciales. 3a ed... Editorial Médica Panamericana - Stryer, L., Berg, J.M. y Tymoczko, J.L. (2015). Bioquímica, 7ª ed.. Ed. Reverté



Complementary	<ul style="list-style-type: none">- Bernhard Rupp (2009). Biomolecular Crystallography: Principles, Practice, and Application to Structural Biology 1a ed.. Garland Science- Smith, C. A. y Wood, E. J. (1997). Moléculas biológicas. . Ed. Addison-Wesley Iberoamericana.- Voet, D., Voet, J.G, Pratt, C.W. (2016). Fundamentos de Bioquímica. 4a Ed.. Médica Panamericana- Stephenson F.H. (2012). Cálculo en Biología molecular y Biotecnología. 2a ed. Ed. . Elsevier España.- TERESE M. BERGFORS (2009). PROTEIN CRYSTALLIZATION 2a ed.. International University Line <p>Cibertexto de Biomoléculas: http://www.ehu.es/biomoleculas/Base de datos Lípidos:http://lipidbank.jp Base de datos Ácidos Nucleicos:http://ndbserver.rutgers.edu Base de datos Proteínas:https://www.rcsb.org Curso cristalografía Proteínas: https://www.xtal.iqfr.csic.es/Cristalografia/index-en.html</p>
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Recommendations

Subjects that it is recommended to have taken before

Chemistry: Equilibrium and Change/610G04008
Fundamentals of Mathematics/610G04001
Cell Biology/610G04003
Chemistry: Structure and Bonding/610G04005
Integrated Basic Laboratory/610G04004

Subjects that are recommended to be taken simultaneously

Thermodynamics: Equilibrium and Phases/610G04018
Instrumental Analysis/610G04014
Spectroscopy/610G04017

Subjects that continue the syllabus

Kinetic and Catalysis/610G04026
Fundamentals of Biotechnology/610G04029
Molecular and Metabolic Biochemistry/610G04023

Other comments

Program of the Faculty of Sciences Green Campus: To contribute to achieving an immediate sustainable environment and comply with point 6 of the "Environmental Declaration of the Faculty of Sciences (2020)", the documentary work carried out in this area will be requested in virtual format and computer support.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.