UNIVERSIDADE DA CORUÑA

Teaching Guide					
Identifying Data					2019/20
Subject (*)	Biochemistry I			Code	610G02011
Study programme	Grao en Bioloxía				
Descriptors					
Cycle	Period	Year		Type	Credits
Graduate	2nd four-month period	First		Basic training	6
Language	Spanish				
Teaching method	Face-to-face				
Prerequisites					
Department	Bioloxía				
Coordinador	Rodriguez Torres, Ana Maria		E-mail	ana.rodriguez.torres@udc.es	
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Web	ciencias.udc.es/bcm				
General description	A Bioquímica I é unha das principais, e máis dinámicas, ramas da Bioloxía, que á súa vez se sitúa como ponte entre esta última e a Química. Como disciplina básica, o estudo da Bioquímica I resulta imprescindible para entender as principais propiedades, químicas e estruturais, das macromoléculas biolóxicas e a relación existente entre estas propiedades e as diversas funcións que desempeñan. Constitúe o punto de partida para o estudo posterior doutras materias relacionadas.				

Study programme competences / results	
Code	Study programme competences / results
A8	Illar, analizar e identificar biomoléculas.
A30	Manexar adecuadamente instrumentación científica.
A31	Desenvolverse con seguridade nun laboratorio.
B1	Aprender a aprender.
B2	Resolver problemas de forma efectiva.
B3	Aplicar un pensamento crítico, lóxico e creativo.
B4	Traballar de forma autónoma con iniciativa.
B5	Traballar en colaboración.
B6	Organizar e planificar o traballo.
B7	Comunicarse de maneira efectiva nunha contorna de traballo.
B8	Sintetizar a información.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Develop their ability to formulate and solve biochemical basic problems, relating the chemical and structural properties of biological molecules with their functionality.	A8	B2 B3	
Know the main bibliographical sources in the field of biochemistry, that allows the student to find, select and understand information.	A8	B1 B8	
Know the main characteristics of living matter from a molecular point of view: the main properties, chemical and structural of the biological macromolecules and the relationship between their properties and their functions. Also know the basic principles of bioenergetics and enzymology.	A8	B1 B2 B3 B8	

Know the main techniques for the isolation, purification and characterization of the biomolecules.	A8 A30 A31	B2 B4 B5 B6 B7	

Contents	
Topic	**Sub-topic**
SECTION 1. INTRODUCTION TO BIOCHEMISTRY	1. Biochemistry, origins and evolution until the present 2. Biomolecules and Bioelements:Concept. Origins and Evolution of Biomolecules 3. Review of functional groups, chemical bonds and stereochemistry 4. Biomolecules in its aqueous environment
SECTIION 2. BIOCHEMISTRY METHODOLOGY	1. General aspects of biochemistry methodology 2. Biological material used in biochemistry 3. Techniques tissue homogenate. Fractionation of cellular organelles 4. Fractional precipitation and centrifugation 5. Chromatographic techniques 6. Electrophoretic techniques 7. Dialysis and ultrafiltration 8. Radioactivity and isotopic techniques in biochemistry 9. Spectroscopic techniques
SECTION 3. CARBOHYDRATES	Monosaccharides 1. Concept, classification and biological importance of carbohydrates 2. Configuration, conformation and cyclic structure of monosaccharides 3. Physical and chemical properties 4. Most important derivatives: structure and function Oligosaccharides and polysaccharides 1. Properties of the O-glycosidic bond 2. Nomenclature, classification, structure, properties and biological significance of most important oligosaccharides 3. Analysis and identification techniques 4. Polysaccharides: concept and classification 5. Most important glucans: structure and biological function

SECTION 4. LIPIDS	Fatty acids, glycerides and glycerides 1. Concepts, classification and biological importance 2. Fatty Acids. General characteristics. Classification and nomenclature. Physical and chemical properties 3. Isolation and identification techniques 4. Fatty acid derivatives: Prostaglandins, thromboxanes and leukotrienes 5. Waxes. Definition, structure and biological function 6. Glycerides. Definition, structure and nomenclature. Properties and structural analysis Phosphoglycerides and sphingolipids. Terpenes and steroids 1. Phosphoglycerides. Structure and classification. Properties and biological function 2. Sphingolipids: Phosphosphingolipids and glycosphingolipids. Structural analysis. Phospholipids and biological membranes 3. Terpenes. Structure, classification and nomenclature. Biological functions 4. Steroids. Structure, classification and nomenclature. Sterols, bile salts and steroid hormones: biological functions Pyrrolic lipids 1. The pyrrole ring 2. Pirrolinic compounds: linear and cyclic pyrroles 3. Pyrrole compounds as members of conjugated proteins 4. Porphyrias and other pathologies

SECTION 5. AMINOACIDS, PEPTIDES AND PROTEINS	Amino acids: properties and purification 1. Structure, stereochemistry and classification of amino acid building blocks of proteins 2. Other amino acids 3. Physical and chemical properties of amino acids 4. Chemical reactivity of the amino acids 5. Purification and identification of amino acids Primary structure of peptides and proteins 1. The peptide bond and its features. The amide bond. Physical and chemical properties of the peptides. 2. Nomenclature of peptides. Peptides of biological interest 3. Proteins: general characteristics. Concept. Classification criteria. Physical and chemical general properties 4. Structure levels of proteins 5. Primary structure of proteins. Concept of primary structure. Types of proteins according to their primary sequence Secondary structure of proteins 1. Linus Pauling and Robert Corey. Concept of secondary structure 2. Alpha helix, beta sheets, and beta turns. Regions without secondary structure: Structural Features. 3. Prediction of secondary structures: Statistical methods 4. Stabilization of secondary structures Spatial conformation of proteins 1. Concept of tertiary structure, supersecondary structure and domain 2. Stability of the three dimensional structure of proteins 3. Fibrous and globular proteins: characteristics and content in secondary and supersecondary structures and domains 4. Characteristics of protein folding 5. Quaternary structure of proteins Protein properties. Extraction, purification and characterization 1. Physical properties. Denaturation and renaturation concepts: causes and effects. Protein absorbance at 280 nm 2. Chemical properties. Amphoteric character of proteins. Reactivity of the side chains of amino acids 3. Methods for determining protein concentrations 4. Methods of extraction, separation, purification and concentration of proteins 5. Methods for protein characterization: molecular weight, pI and number of monomers Structural analysis of the proteins 1. Analysis of the primary structure. Analysis of amino acid composition and identification of the amino terminal residue 2. Automated sequencing of a short polypeptide: Edman degradation 3. Sequencing and automated protein synthesis 4. Localization of modified amino acid by mass spectrometry 5. Analysis of the secondary structures: circular dichroism 6. Analysis of the tertiary structure: X-ray diffraction and nuclear magnetic resonance

Conjugated proteins

1. Concept and types
2. Collagen
3. Hemeproteins: Types and structural and functional characteristics
4. Myoglobin and hemoglobin

Motor proteins and antibodies

1. Actin and myosin. General and structural characteristics
2. The Muscle contraction
3. General structure of immunoglobulins

SECTION 6. NUCLEOTIDES AND NUCLEIC ACIDS	Nucleotides 1. Nucleotides: definition, composition and general structure 2. Physical and chemical properties of bases 3. Important functional groups of the bases 4. Nucleotides as structural components of nucleic acids: phosphodiester bond 5. Nucleotides with other biological functions 6. Natural modifications and mutation of the bases Deoxyribonucleic and ribonucleic acids 1. Definition and general characteristics of nucleic acids 2. Compositional and structural differences between DNA and RNA 3. Deoxyribonucleic acids: The DNA double helix and the tertiary structures of DNA. Structural characteristics of the different types of genomes 4. DNA sequencing techniques: The Sanger method 5. Ribonucleic Acids: François Jacob and Jacques Monod: theory of the information transport from DNA to protein. Types of RNA: function and structure Properties and characterization of DNA and RNA 1. Denaturing agents: related to the temperature and pH 2. Loss of secondary and tertiary structure of nucleic acids: consequences 3. The Tm (melting temperature) and its relation to the length and nucleotide composition of the nucleic acids 4. Kinetics and monitorization of the denaturation-renaturation process: the hyperchromic effect of the denaturation 5. Hybridization concept: formation of pure and hybrid duplexes. Techniques: Southern and Northern blot
SECTION 7. PRINCIPLES OF BIOENERGETICS	1. Review of the thermodynamics principles applied to biological systems 2. Concept of coupled reaction and ATP cycle 3. Energy carrier molecules 4. Electron transporter molecules 5. Acetyl groups transporter molecules

SECTION 8. ENZYMOLOGY	Enzymes as biological catalysts 1. General characteristics and biological function 2. Advantages of enzymes over chemical catalysts 3. Classification of enzymes 4. Reactions catalyzed by different classes of enzymes 5. Cofactors, coenzymes and role of vitamins 6. Principal reactions where the coenzymes are involved Action mechanisms of the enzymes 1. Role of enzymes in biological reactions and metabolism 2. Speed of reactions and activation energy 3. Enzymes from the structural viewpoint. The active site: three dimensional structure and substrate recognition capability. Side chains of amino acids and catalysis 4. Models that explain the activation energy decrease in the enzymatic reaction 5. Review of heterolithic and homolithic reactions. Nucleophilic and electrophilic reagents 6. Other molecules as biological catalysts: Antibodies as catalysts (abzymes), ribozymes, DNAzymes and Sinzymes 7. Enzymes used in clinical analysis, in the diagnostic of diseases, or as therapeutic agents

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	B1 B3 B4 B6 B8	28	70	98
Laboratory practice	A8 A30 A31 B2 B5 B7	15	3.75	18.75
Problem solving	B1 B2 B4 B7	8	6	14
Workbook	B1 B6 B8	0.25	1	1.25
Mixed objective/subjective test	A8 B2 B3 B7 B8	2	10	12
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 topics of the course will be taught by teachers and all presentations or other documentation will be made available to students on the Moodle platform.
Laboratory practice	A serie of activities will be conducted in the practical laboratory, so the students will learn how to handle basic scientific instrumental in Biochemistry and Molecular Biology.
Problem solving	In Moodle, the students will have a serie of questionnaires, tests practical problems to be solve individually as part of the continuous evaluation. Previously some of them will be solved in the seminar classes that will help the students to understand them.
Workbook	In each subject and/or thematic block the students will be recommended with a series of basic bibliographic readings, which they must consult previously of the Master Class, in order to encourage an active participation of the student.
Mixed objective/subjective test	Written test used for the assessment of learning, whose distinctive trait is the ability to determine whether the answers are correct or not. It is a measuring instrument rigorously developed, designed to measure knowledge, skills, abilities, performance, skills, attitudes, intelligence, etc. It applies to both the diagnostic, formative and summative assessment. The objective test can combine different types of questions: multiple choice questions, ordering, short answer, discrimination, complete and/or association. It can also contain a single type of any of these questions.

Personalized attention	
Methodologies	**Description**
Problem solving Laboratory practice	All the students would be orientated to resolve the problems and the practical cases. The schedule for the Tutoring hours would be specificated at the begining of the course. The students can also solicitated a previous appointment to answer any question by e-mail.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Mixed objective/subjective test	A8 B2 B3 B7 B8	Evaluation of the Theoretical knowledge (test, definitions, related issues).	40
Problem solving	B1 B2 B4 B7	Evaluation of the resolution of practical cases.	40
Laboratory practice	A8 A30 A31 B2 B5 B7	The practical classes at the laboratory will be considered as an MANDATORY assistance for passing the subject. The evaluation will consist of an objective test which will be included: specific practical cases related to the tests with Biomolecules, the use of different techniques and methods to quantify and identify these, as well as the management of the equipment used during the various practical clases. They will be evaluated also the ability to graph data, interpretation of results, also their discussion, which will be the necessary condition to use a correct scientific language.	20

Assessment comments

1st OPPORTUNITY QUALIFICATION (JUNE)

A.-To overcome this subject it will be necessary to achieve, at least, 45 out of 100 of the points in each of the assessable activities: Objective Test, Problem solving and Laboratory practice. Otherwise the three activities cannot be compensated among them.

B.-HONOURS (Matrícula de Honor): The highest mark available and awarded will be only for those students who have demonstrated an excellent performance in the 1st Opportunity (June)

2nd OPPORTUNITY QUALIFICATION (JULY)

A.- Again, the students are required to obtain a final grade of at least 45 out of 100 in each of the three activities to pass this subject.

B.- Laboratory practical classes are compulsory. Those students who do not carry out ALL laboratory practices, and do not present a proper justification, will not overcome the subject.

Final Qualification Records (QRs)

QRs will be the sum of the points achieved in the three assessable activities in both (June and July) opportunities. In those cases in which any of the three activities, the 45% of the points are not achieved, the Final QRs will be the score of 4.

Consideration of Not Presented (NP) or ?No Show?:
.-1st Opportunity (June): Those students that do not take the objective test in the official exam will be considered as NP.

.-2nd Opportunity (July): NP will be applicable to those students that do not take ANY of the parts in the official exam.

Exceptional cases: Exceptionally, in the case of a student that for duly justified reasons cannot take any of the tests of continuous assessment, the Professor will adopt the appropriate decisions for this purpose.

For students with part-time dedication or waiver assistance, in June and July there will be a specific exam for overall assessment.

Sources of information	
Basic	- Feduchi, E., Blasco, I., Romero, C.S. y Yáñez, E. (2010). Bioquímica. Conceptos esenciales. 1ª ed.. Editorial Médica Panamericana - Albert L. Lehninger, David L. Nelson, Michael M. Cox. (2001). Lehninger Principios de Bioquímica. 3ª ed. . Ed. Omega - Stryer, L., Berg, J.M. y Tymoczko, J.L. (2013). Bioquímica, 7ª ed.. Ed. Reverté - Mathews CK, Van Holde KE, Appling DR y Anthony-Cahill SJ (2013). Bioquímica, 4ª ed.. Ed. Pearson
Complementary	- Schmid, G.H. (1988). Química Biológica. Las bases químicas de la vida.. Ed. Interamericana/McGraw-Hill - Segel, I.H. (1982). Cálculos de Bioquímica. 2ª ed.. Ed. Acribia. - Smith, C. A. y Wood, E. J. (1997). Moléculas biológicas. . Ed. Addison-Wesley Iberoamericana. - Voet, D. y Voet, J.G. (1992). Bioquímica.. Ed. Omega

Recommendations
Subjects that it is recommended to have taken before
Chemistry/610G02001 Mathematics/610G02003 Biology: Basic Levels of Organisation of Life I (Cells)/610G02007
Subjects that are recommended to be taken simultaneously

Physics/610G02002
Statistics/610G02005
Biology: Basic Levels of Organisation of Life II (Tissues)/610G02008
Subjects that continue the syllabus
Biochemistry II/610G02012
Biochemistry and Molecular Biology/610G02013
Biochemical Foundations of Biotechnology/610G02014
Other comments

(*)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.