



Teaching Guide

Identifying Data					2015/16
Subject (*)	Bioquímica: Bioquímica I	Code	610G02011		
Study programme	Grao en Bioloxía				
Descriptors					
Cycle	Period	Year	Type	Credits	
Graduate	2nd four-month period	First	FB	6	
Language	Spanish				
Teaching method	Face-to-face				
Prerequisites					
Department	Bioloxía Celular e Molecular				
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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

Code	Study programme competences
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		
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	B2
	A30	B4
	A31	B5
		B6
		B7

Contents	
Topic	Sub-topic
SECTION 1. INTRODUCTION TO BIOCHEMISTRY	<ol style="list-style-type: none"> Biochemistry, origins and evolution until the present Biomolecules and Bioelements: Concept. Origins and Evolution of Biomolecules Review of functional groups, chemical bonds and stereochemistry Biomolecules in its aqueous environment
SECTION 2. BIOCHEMISTRY METHODOLOGY	<ol style="list-style-type: none"> General aspects of biochemistry methodology Biological material used in biochemistry Techniques tissue homogenate. Fractionation of cellular organelles Fractional precipitation and centrifugation Chromatographic techniques Electrophoretic techniques Dialysis and ultrafiltration Radioactivity and isotopic techniques in biochemistry Spectroscopic techniques
SECTION 3. CARBOHYDRATES	<p>Monosaccharides</p> <ol style="list-style-type: none"> Concept, classification and biological importance of carbohydrates Configuration, conformation and cyclic structure of monosaccharides Physical and chemical properties Most important derivatives: structure and function <p>Oligosaccharides and polysaccharides</p> <ol style="list-style-type: none"> Properties of the O-glycosidic bond Nomenclature, classification, structure, properties and biological significance of most important oligosaccharides Analysis and identification techniques Polysaccharides: concept and classification 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. Porphyrins 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. PRINCIPLES OF BIOENERGETICS	<ol style="list-style-type: none">1. Review of the thermodynamics principles applied to biological systems2. Concept of coupled reaction and ATP cycle3. Energy carrier molecules4. Electron transporter molecules5. Acetyl groups transporter molecules
SECTION 7. ENZYMOLOGY	<p>Enzymes as biological catalysts</p> <ol style="list-style-type: none">1. General characteristics and biological function2. Advantages of enzymes over chemical catalysts3. Classification of enzymes4. Reactions catalyzed by different classes of enzymes5. Cofactors, coenzymes and role of vitamins6. Principal reactions where the coenzymes are involved <p>Action mechanisms of the enzymes</p> <ol style="list-style-type: none">1. Role of enzymes in biological reactions and metabolism2. Speed of reactions and activation energy3. Enzymes from the structural viewpoint. The active site: three dimensional structure and substrate recognition capability. Side chains of amino acids and catalysis4. Models that explain the activation energy decrease in the enzymatic reaction5. Review of heterolithic and homolithic reactions. Nucleophilic and electrophilic reagents6. Other molecules as biological catalysts: Antibodies as catalysts (abzymes), ribozymes, DNAzymes and Sinzymes7. Enzymes used in clinical analysis, in the diagnostic of diseases, or as therapeutic agents



SECTION 8. NUCLEOTIDES AND NUCLEIC ACIDS	<p>Nucleotides</p> <ol style="list-style-type: none"> 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 <p>Deoxyribonucleic and ribonucleic acids</p> <ol style="list-style-type: none"> 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 <p>Properties and characterization of DNA and RNA</p> <ol style="list-style-type: none"> 1. Denaturing agents: related to the temperature and pH 2. Loss of secondary and tertiary structure of nucleic acids: consequences 3. The T_m (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
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Planning				
Methodologies / tests	Competencies	Ordinary class hours	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
Objective 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 serie of basic bibliographic readings, which they must consult previously of the Master Class, in order to encourage an active participation of the student.



Objective test	<p>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.</p> <p>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.</p>
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Personalized attention

Methodologies	Description
Problem solving Laboratory practice	<p>The student would be orientated to resolve the problems and the practical cases.</p> <p>The schedule for the Tutoring hours would be specified at the beginning of the course. The students can also solicit a previous appointment to answer any question by e-mail.</p>

Assessment

Methodologies	Competencies	Description	Qualification
Objective test	A8 B2 B3 B7 B8	<p>This objective test will consist of two parts, depending on the characteristics of the various topics, as well as group dynamics.</p> <ul style="list-style-type: none">- Theoretical knowledge (test, definitions, related issues)- Problems (resolution of practical cases) <p>In both the two parts will be necessary to reach 50% of the mark to pass the objective test.</p>	80
Laboratory practice	A8 A30 A31 B2 B5 B7	<p>The practical classes at the laboratory will be considered as an MANDATORY assistance for passing the subject.</p> <p>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 practices.</p> <p>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.</p>	20

Assessment comments



1st OPTION QUALIFICATION (JUNE)

A.- To pass the subject will be necessary to achieve the 50% of the points in each of the evaluable activities: Theory, Problems and Practices.

B.- HONOURS VALUE: It will be given to the students at the first option (official exam in June).

2nd OPTION QUALIFICATION (JULY)

A.- To pass the subject will be necessary to achieve the 50% of the points in each of the evaluable activities: Theory, Problems and Practices.

B.- Those students who not be carried out all the practical classes (without justification), they have a SUSPENSE in the global rating.

.- In the Final Qualification (either of 2 options: June or July), if the sum of the notes is greater than 5 but one part is suspended, it will appear 4.9 points in the Acts.

.- In the 2 Options (June and July) a NP: Not Presented, will be aplicable when the student DON'T DO any of the exams of the evaluables activities.

Sources of information

Basic	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - 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 <p>Recursos web: Biomodel: Modelos moleculares en movimiento e interactivos que, junto con texto explicativo, ilustran la estructura tridimensional de las biomoléculas. Autor: Ángel Herráez Sánchez Estructura de macromoléculas: Modelo interactivo para profundizar en las estructuras macromoleculares: desde un enlace peptídico hasta una membrana biológica. Autor: Jesús M. Sanz Aula Virtual de Biomoléculas: Herramientas para conocer mejor las biomoléculas. Autor: José Luis Urdiales Ruiz Cibertexto de Biomoléculas: Un curso completo de la estructura de las biomoléculas (glúcidos, lípidos, proteínas y ácidos nucleicos) con la posibilidad de autoevaluarse. Autor: Juan Manuel González Mañas MATERIALES MULTIMEDIA Y BIOMOLÉCULAS: Material docente para el primer, segundo y tercer ciclo Autores: Pilar Roca, Jordi Oliver y Sergio Rodríguez Enlaces: Colección de enlaces sobre Bioquímica y Biología Molecular en español y otros idiomas en el mundo. Recopilador: Ángel Herráez Sánchez Otros materiais de apoio: Materiales disponibles en la página web de la asignatura. CD-Rom: BioROM 2011 Ayudas al aprendizaje de la Bioquímica, Biotecnología y Biología Molecular</p>

Recommendations

Subjects that it is recommended to have taken before



Química/610G02001

Matemáticas/610G02003

Citloxía/610G02007

Subjects that are recommended to be taken simultaneously

Física/610G02002

Estatística/610G02005

Histoloxía/610G02008

Subjects that continue the syllabus

Bioquímica: Bioquímica II/610G02012

Bioquímica e Bioloxía Molecular/610G02013

Fundamentos bioquímicos de biotecnoloxía/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.