| Teaching Guide | | | | |
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| Identifying Data | | | | 2018/19 |
| Subject (*) | Biochemistry II | | Code | 610G02012 |
| Study programme | Grao en Bioloxía | | | |
| Descriptors | | | | |
| Cycle | Period | Year | Type | Credits |
| Graduate | 1st four-month period | Second | Basic training | 6 |
| Language | Spanish | | | |
| Teaching method | Face-to-face | | | |
| Prerequisites | | | | |
| Department | Bioloxía | | | |
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| Lecturers | Barreiro Alonso, Aida Inés<br>Cerdan Villanueva, Maria Esperanza<br>Freire Picos, María Ángeles<br>Gonzalez Siso, Maria Isabel | | E-mail | aida.barreiro@udc.es<br>esper.cerdan@udc.es<br>maria.freirep@udc.es<br>isabel.gsiso@udc.es |
| Web | ciencias.udc.es/bcm | | | |
| General description | The subject contents provide to the student the basic information for knowing and understanding the biochemical reactions,enzyme catalysis and metabolism. Studying in the second year of Biology degree will allow the student to achieve the basic knowledge to understand the molecular mechanisms governing many responses in the live organisms. | | | |

| Study programme competences | |
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| Code | Study programme competences |
| A8 | Illar, analizar e identificar biomoléculas. |
| A10 | Avaliar actividades metabólicas. |
| A26 | Deseñar experimentos, obter información e interpretar os resultados. |
| A29 | Impartir coñecementos de Bioloxía. |
| 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. |
| B7 | Comunicarse de maneira efectiva nunha contorna de traballo. |
| B10 | Exercer a crítica científica. |
| B11 | Debater en público. |
| B13 | Comportarse con ética e responsabilidade social como cidadán e como profesional. |

| Learning outcomes | |
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| Learning outcomes | Study programme competences |

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| Understand and describe the mechanisms by which the Enzymes act in biological catalysis. To design, combining and using the methodology of the practical course and theoretical classes, systems to purify and analyse enzymes. To know the importance of the pathways to obtain energy in the biological systems to maintain life. To know the main metabolic pathways in the cell and its regulation. Develop the capability to relate the different metabolic pathways. | A8<br>A10<br>A26<br>A29<br>A30<br>A31 | B1<br>B2<br>B3<br>B4<br>B5<br>B7<br>B10<br>B11<br>B13 | |

| Contents | |
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| **Topic** | **Sub-topic** |
| 1. Biological Enzymes as catalysts. | Structural features that give them advantages over chemical catalysts. Reaction mechanisms. Antibodies as catalysts. Ribozymes. |
| 2. Kinetics of chemical reactions. | Monosubstrate reactions and Michaelis-Menten kinetics Transformation of the Michaelis- Menten equation. Bisubstrate reaction kinetics. Irreversible inhibitors; binding, examples and applications. Reversible Inhibition: types of inhibition. Kinetics in the presence of inhibitors. |
| 3. Regulation of enzymatic activity. | Importance of regulation in metabolism. Allosteric enzymes. Covalent modification. Isoenzymes. Zymogens or proenzymes. |
| 4. Methodology for determination of enzyme activities. | Direct and indirect assays. Purification of enzymes: specific activity, yield and purification factor. Importance and current applications of enzymology. |
| 5. Introduction to Metabolism. | Anabolic and catabolic pathways. Compartmentalization. Need for coordination and interaction between the different routes, and variability among species. Levels of obtaining energy. Methodology for the study of metabolic pathways. Levels of study. |
| 6. Transport of metabolites across cell membranes. | Types of transport depending on the energy sources. Structural data. Examples with specific metabolites |
| 7. Obtaining chemical energy. | Oxidation reduction in energy production. Coenzymes involved. Generation of ATP: substrate-level phosphorylation, oxidative phosphorylation and photosynthetic phosphorylation and energy production systems. Detailed study of oxidative phosphorylation and photosynthetic phosphorylation. |
| 8: Glycolysis and catabolism of hexoses. | Location of the routes. Stages and pathway regulation. Fermentations. Relationship with the pentose phosphate pathway. |
| 9: TCA cycle | Location of the route. Conversion of pyruvate to acetyl-CoA. Study of the pyruvate dehydrogenase complex and interaction with other routes. Anaplerotic routes, importance of mitochondrial shuttles and balances. |
| 10. Gluconeogenesis. | Definition and localization, metabolic need for this route. Gluconeogenesis from: pyruvate, lactate, amino acids and triglycerides. Glyoxylate cycle. |
| 11. "Dark Phase" of photosynthesis. Relationship with gluconeogenesis. | The Calvin cycle. Photorespiration. Regulation. The C4 pathway of tropical plants. The crassulacean acid metabolism. Sucrose metabolism and starch. |
| 12. Glycogen metabolism. | The reserve polysaccharide glycogen. Biosynthesis and degradation of muscle and liver glycogen. Regulation. The role of the liver in the maintenance of blood glucose. Congenital anomalies of glycogen metabolism |
| 13. Lipid Metabolism. | Lipid catabolism: lipolysis, beta-oxidation. Biosynthesis of fatty acids, triglycerides, membrane lipids and steroids. Regulation of lipid metabolism. Metabolism of ketone bodies. |

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| 14. Metabolism of amino acids. | Digestion and degradation of intracellular proteins. Nitrogen removal of amino acids: transamination, deamination. Urea cycle. Ammonia transport to the liver. Fate of the carbon skeleton of amino acids. Amino acid biosynthesis: origin of nitrogen and carbon skeleton. regulation |
| 15. Derivatives of amino acids. | Amino acid precursor functions: Amines with biological activity, glutathione, porphyrins. Metabolism of purine and pyrimidine nucleotides. regulation |
| 16. Integration of metabolism. | Metabolic profiling of major organs. Key connections between routes: glucose-6-phosphate, pyruvate and acetyl CoA. Metabolic adaptations to stress. Fasting, exercise. |
| 17. Hormonal regulation of metabolism. | Hormones as chemical messengers. Second messengers. Metabolic targets of hormone action. Hormone receptors. Adenylate cyclase system. Phospholipase system. Receptor dimerization |

| Planning | | | | |
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| Methodologies / tests | Competencies | Ordinary class hours | Student?s personal work hours | Total hours |
| Guest lecture / keynote speech | A10 B1 B3 B4 B7 B10 B11 B13 | 24 | 60 | 84 |
| Problem solving | A10 A29 B1 B2 B3 B4 B5 B7 B10 B11 B13 | 8 | 16 | 24 |
| Laboratory practice | A8 A26 A30 A31 B1 B2 B3 B4 B5 B7 B10 B13 | 15 | 22.5 | 37.5 |
| Mixed objective/subjective test | A8 A10 A26 B2 B3 B7 B13 | 2 | 0 | 2 |
| Personalized attention | | 2.5 | 0 | 2.5 |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. | | | | |

| Methodologies | |
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| Methodologies | Description |
| Guest lecture / keynote speech | Oral presentation supplemented with the use of media and the introduction of some questions to the students, in order to impart knowledge and facilitate learning. The master class is also known as "conference" , " expository method " or " maxistral lesson." The latter method is usually reserved for a special kind of lesson taught by a teacher in special occasions, containing original preparation involved and based on the use of the word and images as a means of transmission of information to the audience. |
| Problem solving | Technique by which you have to solve a specific problem situation, from the previous theoretical resources, and may have more than one possible solution. |
| Laboratory practice | Methodology that allows students actually learn -as through conducting practical activities, such as demonstrations exercises, experiments and research. |
| Mixed objective/subjective test | Exam that integrates objective test, short questions and resolution of cases and issues. |

| Personalized attention | |
|---|---|
| Methodologies | Description |

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| Guest lecture / keynote speech<br>Problem solving<br>Laboratory practice<br>Mixed objective/subjective test | The personalized attention will be just along the course and at the request of the student.<br>The way of working to acquire skills and prepare the exams, the orientation of problem solving and interpretation of results of practical work, as well as any other questions that arise from the student shall be guided by this personal attention.<br>Students with part-time dedication or waiver of assistance should contact the teachers of the subject in the early going to establish a schedule of activities to acquire and conveniently evaluate the skills of matter. |

| Assessment | | | |
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| Methodologies | Competencies | Description | Qualification |
| Problem solving | A10 A29 B1 B2 B3 B4 B5 B7 B10 B11 B13 | Student´s work in reduced groups and controls. | 20 |
| Laboratory practice | A8 A26 A30 A31 B1 B2 B3 B4 B5 B7 B10 B13 | Participation in the clases and exam. | 15 |
| Mixed objective/subjective test | A8 A10 A26 B2 B3 B7 B13 | The knowledgements aquired by the students in both, the master clases and the problem solving will be evaluated. | 65 |

| Assessment comments |
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| Attendance at the laboratory practice is mandatory to pass the subject. Assistance may be validated, upon request, by the already completed in the immediately preceding year. If the student does not attend to laboratory work, the student must pass a test to demonstrate the practical training. In addition to attending practices, the skills acquired will be evaluated through a exam.<br>Attendance and participation of students in small groups (problem solving) are<br>evaluated by their work in groups, preparation of schemes and controls. To be able to pass the subject, the students must get at least the 35% of the points in the global exam (mixed test). Above this qualification, the qualifications of the rest of activities are summed up. Below this qualification, the maximum total qualification (after adding those of the activities) cannot surpass 4. To be qualified as Not Presented the students cannot attend more than 10% of evaluable activities.For the July rating, the students may kept approved parts in<br>January and pass only the remaining parts. Alternatively, in July the students can recover 100% of the grade for the course through a practice exam (15%) and a mixed test (85%). For students with part-time dedication or waiver assistance, in January and July there will be a specific exam for overall assessment. |

| Sources of information | |
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| Basic | - Feduchi, Blasco, Romero y Yáñez (2011). Bioquímica, conceptos esenciales. Panamericana<br>- Lehninger, Nelson y Cox (2006). Principios de Bioquímica. Omega<br>- Stryer, Berg y Tymoczko (2009). Bioquímica 6ª Edn. Reverte<br>- Tymoczko, Berg, Stryer (2014). Bioquímica curso básico. Reverté<br>No moodle da asignatura incluiranse e actualizaranse ligazóns a páxinas web e outras fontes bibliográficas. |
| Complementary | - Melo y Cuamatzi (2004). Bioquímica de los procesos metabólicos. Reverté-UAM Xochimilco<br><br> |

| Recommendations |
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| Subjects that it is recommended to have taken before |
| Chemistry/610G02001<br>Biochemistry I/610G02011 |
| Subjects that are recommended to be taken simultaneously |
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| Subjects that continue the syllabus |
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| Biochemistry and Molecular Biology/610G02013<br>Biochemical Foundations of Biotechnology/610G02014 |
| **Other comments** |
| We inform that to be honored with "matrícula" the best qualifyed students in the first oportunity (January) will have preference.<br><br>Drinks or food are not allowed in the classroom. We recommend the assistence to the reduced groups and the personal tutorials to increase the student´s succes. |

**(*)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.**