

COURSE DESCRIPTION

COURSE DETAILS

Title (of the course): **TOXICOLOGÍA MOLECULAR Y CELULAR**

Code: 101859

Degree/Master: **GRADO DE BIOQUÍMICA**

Year: 3

Name of the module to which it belongs: **INTEGRACIÓN FISIOLÓGICA Y APLICACIONES DE LA BIOQUÍMICA Y BIOLOGÍA MOLECULAR**

Field: **TOXICOLOGÍA MOLECULAR Y CELULAR**

Character: **OBLIGATORIA**

Duration: **SECOND TERM**

ECTS Credits: 6

Classroom hours: 60

Face-to-face classroom percentage: 40%

Study hours: 90

Online platform: <http://www3.uco.es/moodlemap/>

LECTURER INFORMATION

Name: ALHAMA CARMONA, JOSÉ (Coordinator)

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Department: **BIOQUÍMICA Y BIOLOGÍA MOLECULAR**

Area: **BIOQUÍMICA Y BIOLOGÍA MOLECULAR**

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Name: MICHÁN DOÑA, CARMEN MARÍA

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PREREQUISITES AND RECOMMENDATIONS

Prerequisites established in the study plan

None

Recommendations

It is recommended to have the level B1 of English (this requirement is mandatory for the recognition of having taken the course in English according to the "Plan de Plurilingüismo de la Facultad de Ciencias").

INTENDED LEARNING OUTCOMES

- | | |
|-----|--|
| CB1 | Ability to reason critically and self critically. |
| CB4 | Having the ability to work and study independently. |
| CB6 | To know how to recognise and analyse a problem, identifying its main characteristics, and design a scientific resolve. |

COURSE DESCRIPTION

CB7	TO know how to use basic computing tools to communicate, find information and processing data in a professional setting.
CB8	To know how to read scientific texts in English.
CE3	To understand the basic principles of molecular structure and chemical reactions of simple biomolecules.
CE5	To understand the chemical and thermodynamic principles of molecular recognition and biocatalysis, as well as the role of enzymes and other proteins in determining the functions of cells and organisms.
CE7	To understand the structure, organisation, expression, regulation and evolution of genes in living organisms, as well as the molecular background of genetic and epigenetic variations among individuals.
CE8	To understand the biochemical and molecular bases of folding, post translational modification, intercellular trafficking, sub-cellular localisation and turnover of cell proteins.
CE9	To understand the main physiological processes of multicell organisms as well as understanding the molecular bases of them.
CE10	To understand the essential aspects of metabolic processes and their control, and to have a well rounded view of the regulations and adaptations of a metabolism in different physiological states.
CE11	To have a well rounded view of cellular operations (including the metabolism and gene expression) regarding their regulation and relationships with different parts of cells.
CE12	To have an well rounded view of intercellular communication systems and intercellular signaling which standardise proliferation, differentiation, development and the function of tissues and organs in order to understand the complexity of the interactions.
CE24	To have the mathematical, statistical, and computing skills to obtain, analyse and interpret data. In order to understand simple models of biological systems and processes on cell and molecular levels
CE25	To know how to search for, and find and interpret information from the main biological databases (genomic, transcriptomic, proteomic, metabolomic, and similar derivatives from other forms of bulk analysis.) and bibliographic data and to use the bio tools.
CE28	The ability to communicate information relating to Biochemistry and Molecular Biology, including planning, writing and presenting a scientific report.

OBJECTIVES

To prepare the student in the biochemical and cellular aspects of Toxicology, with special emphasis on the Environmental Toxicology and Drug Development

CONTENT

1. Theory contents

1 INTRODUCTION. Xenobiotics: organic compounds (air and working contaminants, food additives, abuse drugs, pesticides, solvents, polycyclic aromatic hydrocarbons), toxins (micotoxins, from plants), inorganic pollutants. 1

2 BASIC CONCEPTS AND TOXICITY MECHANISMS. Disposition of xenobiotics. Absorption (membranes structure, ionization, partition coefficient, absorption: mechanisms and pathways (via skin, lungs, digestive tract). Distribution (compartments, barriers, plasma proteins -types, consequences of binding-). Accumulation. Excretion. Effect of xenobiotics in human organs. Hepatic, renal and lung toxicology. 4

3 OXIDATIVE STRESS. Oxygen biology and oxidative stress. Oxygen chemistry and reactive oxygen species (O_2^- , H_2O_2 , $HO\cdot$, $1O_2$). Reactive nitrogen species. Organic oxygen radicals. Lipid peroxidation. Thiols redox state. Redox cycling, anti-oxidants, antioxidative enzymes. 3

4 GENETIC TOXICOLOGY. Types of mutations and DNA repair mechanisms. Mutagenic, carcinogenic and teratogenic agents. Assays to determine genetic alterations. General aspects of cancer. Human carcinogens. Teratogenicity. 4.5

5 BIOTRANSFORMATION. Biotransformation: effects, microsomes, mixed function oxidases. Phase I reactions. Cytochrome P450 system (components, structure, mechanism, isoenzymes, activities). Flavin monooxygenase and cytochrome b5. Non-microsomal oxidations.

Cooxidations. Reduction. Hydrolytic reactions. Phase II reactions: scheme and types (glycosylation, sulfate conjugation, methylation, acetylation, conjugation with amino acids). Glutathione. GSH-transferases (types, structure, reactions, specificity). Glutathion-conjugates fate. 6

6 MODIFICATIONS OF BIOTRANSFORMATION. Differences between species, strains and individuals. Nutritional and physiological factors.

Induction (receptors, ligands). Nuclear hormone receptors (structures, mechanisms). Ah battery (AhR, Arnt, mechanism, physiological inducers). CAR/RXR receptor. PXR receptor (CYP3A substrates/inducers, structure, function). PPARs receptors (microsomal beta-oxidation, peroxisome proliferators, mechanisms). GSTs regulation. Interaction. Inhibition (pesticides and acetylcholinesterase, stages of poisoning, nerve agents). Chronic exposure. 4.

7 ENVIRONMENTAL TOXICOLOGY APPLICATIONS. Bioindicators, biomarkers and their types. Biological effects of metals. Conventional biomarkers. Studies on fish and bivalve from the Andalusian South Atlantic coast. Omics approaches. Aznalcóllar accident. The "Estero de Domingo Rubio". Environmental quality at Doñana National Park and surroundings. 3.5

8 CELL TOXICITY. Concept of programmed cell death. Apoptosis, necrosis and autophagy. Apoptosis signaling pathways. Methods for studying in vitro and in vivo cytotoxicity. Drug toxicology. Therapeutic index for drugs. Drug interactions. 5



COURSE DESCRIPTION

2. Practical contents

The practical contents are divided into 3 sessions of laboratory practice (LP) and 7 sessions of classroom practice (CP).

Laboratory Practices:

LP1: Evaluation of oxidative stress using conventional biochemical biomarkers.

LP2: Evaluation of the redox state in proteins by electrophoretic separation and fluorescent detection.

LP3: Evaluation of the cytotoxicity of compounds by microbial lethality assays.

Classroom Practices:

The results obtained in the laboratory practices will be analyzed and discussed in CP1, CP2, CP3 y CP4. In CP5, students will learn how to obtain scientific information to prepare a report on various case studies related to the subject. To do this, students will be divided into teams of 2-4 people. These reports shall be discussed and orally exposed in the corresponding Medium Group evaluation session (CP6).

The last classroom practice (CP7) session will focus on the development of new drugs, including Regulatory

Preclinical trials before approval.

METHODOLOGY

General clarifications on the methodology. (optional)

Case study includes preparation of reports and seminars, analysis of documents, discussions and team-work.

Methodological adaptations for part-time students and students with disabilities and special educational needs

Adaptations of the teaching methodology for part-time students will be made according to the rules of the University and based on the characteristics of each individual case.

The methodological strategies and evaluation system contemplated in this Teaching Guide will be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required

Face-to-face activities

Activity	Large group	Medium group	Total
Assessment activities	3	6	9
Case study	-	12	12
Lab practice	-	9	9
Lectures	30	-	30
Total hours:	33	27	60

Off-site activities

Activity	Total
Exercises	10
Group work	15
Information search	5
Reference search	5
Self-study	55
Total hours:	90

WORK MATERIALS FOR STUDENTS

Case studies - <http://www3.uco.es/moodlemap/>

Placement booklet - <http://www3.uco.es/moodlemap/>

Coursebook - <http://www3.uco.es/moodlemap/>

Oral presentations - <http://www3.uco.es/moodlemap/>

References - <http://www3.uco.es/moodlemap/>

COURSE DESCRIPTION

EVALUATION

Intended learnig outcomes	Tools		
	Objective tests	Placement reports	Short answer tests
CB1		X	
CB4	X	X	X
CB6	X	X	
CB7		X	
CB8		X	
CE10	X	X	X
CE11	X	X	X
CE12	X	X	X
CE24		X	X
CE25		X	X
CE28	X	X	X
CE3	X	X	X
CE5	X	X	X
CE7	X	X	X
CE8	X	X	X
CE9	X	X	X
Total (100%)	55%	30%	15%
Minimum grade.(*)	3	3	3

(*) Minimum grade necessary to pass the course

Method of assessment of attendance:

La asistencia a las sesiones de prácticas de laboratorio es obligatoria. La asistencia a las otras sesiones se evaluará en el apartado "pruebas de respuesta corta".

General clarifications on instruments for evaluation:

Attendance at laboratory practice sessions is mandatory. Attendance at the other sessions will be evaluated in the section "short answer tests". The course has no mandatory activities and to pass the course a student must achieve 50 points out of 100. The final grade will consist of the following addends:

- Final exam: up to 55 points
- Attendance to the lectures and participation, and responses to short questions: up to 15 points. In this section, activities of the "Complementa" Program (Faculty of Science), whose contents are relevant to the subject, may be included at the discretion of teachers.
- Evaluation of laboratory practice sessions. Elaboration and discussion of reports: up to 30 points.

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:

Adaptations of the evaluation for PART TIME STUDENTS will be made according to the rules of the University and based on the characteristics of each individual case.

Qualifying criteria for obtaining honors: *Según el artículo 30.3 del Reglamento de Régimen Académico.*

BIBLIOGRAPHY



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INFORMACIÓN SOBRE TITULACIONES DE LA UNIVERSIDAD DE CÓRDOBA

uco.es/grados

COURSE DESCRIPTION

1. Basic Bibliography:

- Klaassen, C.D., Watkins III, J.B. (2010) Casarett & Doull's Essentials of Toxicology, 2^a ed, McGraw Hill.
- Hodgson, E. (2010) A Textbook of Modern Toxicology, 4^a ed, Wiley.
- Timbrell, J.A. (2009) Principles of Biochemical Toxicology, 4^a ed, Informa Healthcare.
- Lu, F.C., Kacew, C. (2009) Lu's Basic Toxicology: Fundamentals, Targets Organs and Risk Assessment. Informa Healthacare.

2. Further reading:

- Newman, M.C. (2009) Fundamentals of Ecotoxicology, 3^a ed, CRC Press.
- Repetto Jiménez, M., Repetto Kuhn, G (2009) Toxicología Fundamental, 4^a ed, Diaz de Santos.
- Smart, R.C., Hodgson, E. (2008) Molecular and Biochemical Toxicology, 4^a ed, Wiley.

COORDINATION CRITERIA

- Tasks performance

Clarifications:

The contents of the subject "TOXICOLOGÍA MOLECULAR Y CELULAR" have been coordinated with those of the subjects "FUNDAMENTOS DE BIOQUÍMICA" and FUNDAMENTOS DE GENÉTICA (first year), and the subject "BIOQUÍMICA AMBIENTAL Y BIOTECNOLOGÍA" (third year of the Degree of Biochesmisty).

SCHEDULE

Period	Activity			
	Assessment activities	Case study	Lab practice	Lectures
1# Week	0	0	0	2
2# Week	0	0	3	2
3# Week	0	2	0	2
4# Week	0	0	3	2
5# Week	0	2	0	2
6# Week	0	0	3	2
7# Week	0	2	0	2
8# Week	3	0	0	2
9# Week	0	3	0	2
10# Week	0	0	0	2
11# Week	0	0	0	2
12# Week	3	0	0	3
13# Week	0	0	0	3
14# Week	0	3	0	2
15# Week	3	0	0	0
Total hours:	9	12	9	30

The methodological strategies and the evaluation system contemplated in this Course Description will be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required.