

Toxicology

Code: 101910
ECTS Credits: 3

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OB	3	2

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Other comments on languages

Catalan 90%, English 10%

Prerequisites

It is advisable to have a good knowledge of physics, chemistry, biochemistry, cell biology and physiology. A good level of English and a critical reading ability of toxicological information (books, review articles, original articles) is also recommended. In order to be able to attend the sessions of laboratory practices, the student must justify having passed the biosafety and security tests that he/she will find in the Virtual Campus and accept the operation regulations of the laboratories of the Faculty of Biosciences.

Objectives and Contextualisation

Toxicology is a fundamental subject of the second semester of the 3rd year of the Degree in Biomedical Sciences. Its objective is to provide the basic knowledge of what is currently the science of toxicology, paying special attention to the fundamental principles and the areas of experimental, analytical and regulatory toxicology, ecotoxicology (= pollutants) and medical toxicology (= diagnosis and treatment, including the use of antidotes). The specific study of the main toxic agents that affect or can affect humans and animals, and in particular gaseous and volatile agents, metals and non-metals, ionizing radiation, pesticides, domestic and industrial chemicals, and toxins, is also carried out.

Competences

- Display theoretical and practical knowledge of the major molecular and cellular bases of human and animal pathologies.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Describe the branches of ecotoxicology (environmental contaminants) and the elements for diagnosing and treating the main conditions.
2. Describe the principles of experimental and analytical toxicology.
3. Understand and critique scientific articles on pharmacology.
4. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

THEORY*

SECTION A: GENERAL TOXICOLOGY

UNIT 1.- INTRODUCTION TO TOXICOLOGY. Definition and current concept of Toxicology. Historical perspective. Main toxic disasters. Toxicological terminology. Genotoxic agents. Carcinogenesis. Teratogeny and allergy. Toxicology branches: medical, analytical, experimental, environmental and regulatory. Classification of poisons.

UNIT 2.- EXPERIMENTAL TOXICOLOGY. General principles. Toxicity evaluation. QSAR and retrospective studies. Acute and chronic toxicity tests. Laboratory animals. GLP and GMP. Special tests: reproduction, teratogenicity, mutagenicity, carcinogenesis. Toxicity *in vitro*. Safety factors. Dose-response. Lethal dose and lethal concentration. Pictograms. Hazard and precautionary statements. NOEL and NOAEL, NOEC and NOAEC. ADI and TLV.

UNIT 3.- TOXICOKINETICS AND METABOLISM. Exposure and absorption pathways of the poisons. Distribution. Metabolism of xenobiotics. Lethal synthesis. Elimination.

UNIT 4.- ENVIRONMENTAL TOXICOLOGY AND ECOTOXICOLOGY. Contamination and pollution. Sentinel species. Biomarkers. Bioaccumulation, bioconcentration and biomagnification.

UNIT 5.- DIAGNOSIS OF POISONINGS. Common causes of poisoning. Frequency of poisonings: toxicoepidemiological data. Generalities of the diagnostic protocol. Clinical history. Symptoms and clinical signs. Post-mortem examinations.

UNIT 6.- ANALYTICAL TOXICOLOGY. Chromatographic techniques: gas chromatography. The flame ionization (FID) and the electron capture (ECD) detectors. Mass spectrometry (MS).

UNIT 7.- TREATMENT OF POISONINGS. General guidelines for the treatment of a poisoned patient. Elimination of the source of the poison. Measures to prevent the absorption. Symptomatic treatment.

UNIT 8.- ANTIDOTES. Introduction to antidotes. Main antidotes and their mechanism of action.

SECTION B: POISONS

TOPIC 9.- TOXIC GASES. Simple asphyxiating gases. Oxygen and ozone. CFC. Fluorine. Chlorine. Hydrogen sulphide. Carbon monoxide. Carbon dioxide. Nitrogen and sulfur oxides. Acid rain. Hydrogen cyanide and cyanide.

UNIT 10.- NON METALS AND METALS. The Periodic Table of the elements. Fluorides. White phosphorus. Trivalent and pentavalent arsenic. Aluminum and acid waters. Chrome. Zinc. Cadmium and Itai-Itai syndrome. Tin. Tributyltin (TBT). Mercury. Methylmercury and Minamata. Thallium. Lead. Tetraethyl lead.

UNIT 11.- IONIZING RADIATIONS. Introduction. X-ray and gamma ray. Alpha and beta rays. Radon. Chernobyl and Fukushima. A and H bombs. Strontium-90, cesium-137 and iodine-131.

UNIT 12.- PESTICIDES. Introduction to the world of pesticides. Fungicides: derivatives of dithiocarbamic acid, pentachlorophenol, hexachlorobenzene. Herbicides: phenoxy acids and derivatives, paraquat, glyphosate.

Insecticides: nicotine, pyrethrins and pyrethroids, organochlorine insecticides, organophosphorus and carbamic insecticides. Delayed neurotoxicity (OPIDN). Rodenticides: strychnine, warfarin and other anticoagulants, fluoroacetate.

UNIT 13.- TOXICS RELATED TO FOOD. Nitrates and nitrites. Nitrosamines. Heterocyclic aromatic amines. The Toxic Oil Syndrome (TOS). Polycyclic aromatic hydrocarbons. Ethanol. Methanol. Drug residues in food. Food additives.

UNIT 14.- MISCELLANEOUS POISONS. Solvents: hexane; benzene; halogenated solvents. The VOCs. Ethylene glycol and diethylene glycol. Detergents. Drugs of abuse.

UNIT 15.- TOXINS. Toxins classes. Role in diseases. Cholera. Botulism. Tetanus. Mycotoxins and mycotoxicosis. Poisonous mushrooms. Poisons in the Plant Kingdom. Insect toxins. Toxins of arachnids. Reptile toxins. Marine animal toxins.

SEMINARS*

SEMINAR 1.- The case of p,p'-DDT: Rachel Carson and SilentSpring.

SEMINAR2.- Polychlorinated and polybrominated biphenyls. Dibenzo-p-dioxins and polychlorinated dibenzofurans. Polybrominated diphenyl ethers. TEF and TEQ.

SEMINAR 3.- Unspecific treatment of the poisoned patient.

SEMINAR 4.- Classification of antidotes according to their mechanism of action.

SEMINAR 5.- Radioactivity.

SEMINAR 6.- Lead in sports and lead poisoning: a practical case of an unresolved toxicological problem.

SEMINAR 7.- Oil and oil spills: a practical case of an environmental problem.

PRACTICES*

- Determination of cerebral acetylcholinesterase activity by spectrophotometric methods.

- Recognition of poisonous plants.

Methodology

Theory*. The teacher will explain much of the contents of the syllabus with the support of visual material that will be available to students in the Campus Virtual (CV) in advance. In order to follow the explanations, students must bring this material to class as a script. These lectures will deal with the main parts of the subject, which will have to be extended and confronted autonomously by the students as personal work. The teaching material that will be used in these cases will basically consist of books and review articles. Parts of the theory program (specific and well-defined topics) will be explained, by their own entity and interest, in the section of seminars.

Seminars*. Complementary to the theory classes, seminars will address (with use of ICT) specific topics related to poisons and contaminants. The active participation of all students will be promoted during the resolution/discussion of the issues/situations/problems/cases that may arise.

Laboratory practices*. Practical sessions for the observation and execution of procedures, methodologies and techniques that are used in the study of poisons. Group work and active self-learning are promoted.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory work	3	0.12	2, 4
Lectures	16	0.64	2, 1
Seminars and problems	7	0.28	3, 2, 1
Type: Supervised			
Face-to-face and virtual tutoring	2	0.08	3, 4
Type: Autonomous			
Individual work	25	1	4
Preparation and elaboration of a work with scientific format in groups	18.6	0.74	3, 4
Resolution of cases and problems	2	0.08	3, 2, 1

Assessment

The competences of this subject will be evaluated by:

- A first mid-term partial exam, where the theory program and the seminars carried out to date will be evaluated. Worth 35% of the final grade.
- A second exam (2nd partial exam) at the end of the course, where all the content of theory, seminars and laboratory practices will be evaluated. Worth 45% of the final grade.
- Preparation of a scientific poster, a written summary of $\approx 1,000$ words (references not included) that will be prepared in groups throughout the semester on a topic of toxicology. Worth 20% of the final grade

To pass the subject, the weighted average grade of the two exams and the overall grade of the subject (calculated from the weighted average for all activities) must be equal to or greater than 5.0. Therefore, the subject will be considered 'failed' when:

- The weighted average grade of the two exams does not reach a minimum of 5.0. In this case, the final grade will be listed as 'failed' regardless of the grade for the other activities
- The weighted average grade of the two exams is equal to or greater than 5.0 but the overall average of the subject is less than 5.0

When the student does not carry out any of the activities of evaluation these will score 0. The no attendance by unjustified reasons to a laboratory practice or seminar will subtract 0,25 points to the final grade. A student will be considered non-assessable when his/her participation in assessment activities represents $\leq 15\%$ of the final grade. In order to take the reevaluation exam, the student must have previously been assessed in a set of activities that represent a minimum of two thirds of the final grade of the subject. The mark of the reevaluation exam will replace the weighted average mark of the midterm exams.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
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First partial test	35 %	0.6	0.02	3, 2, 1
Preparation and elaboration of a scientific work	20 %	0	0	3, 2, 1, 4
Second partial test (cumulative)	45 %	0.8	0.03	3, 2, 1

Bibliography

AMIARD-TRIQUET C, AMIARD JC, RAINBOW PS (eds.). Ecological Biomarkers: Indicators of Ecotoxicological Effects. CRC Press, 2016.

[https://catalegclassic-uab-cat.aren.uab.cat/record=b1982195~S1*cat]

BARCELOUX DG (ed.). Medical Toxicology of Natural Substances. Wiley, 2008.

[https://catalegclassic-uab-cat.aren.uab.cat/record=b1956412~S1*cat]

BARILE FA. Principles of Toxicology Testing. CRC Press, 2007.

BOELSTERLI A. Mechanistic Toxicology. CRC Press, 2007.

DART RC. The 5 Minute Toxicology Consult. Lippincott, Williams and Wilkins, 1999.

[https://catalegclassic-uab-cat.aren.uab.cat/record=b2095560~S1*cat]

DESHPANDE SS. Handbook of Food Toxicology. Marcel Dekker, 2002.

ELLENHORN MJ (ed.). Ellenhorn's Medical Toxicology. Williams & Wilkins, 1997.

EMSLEY J. The Elements of Murder: A History of Poison. Oxford University Press, 2006.

[https://catalegclassic-uab-cat.aren.uab.cat/record=b2092544~S1*cat]

FROHNE D, PFÄNDER HJ. Poisonous Plants. Manson Publishing, 2005.

GREIM H, SNYDER R (eds.). Toxicology and Risk Assessment: A Comprehensive Introduction. Wiley Blackwell, 2008.

GUIART R. Tòxics, Verins, Drogues i Contaminants, Volums I, II i III. Servei Publicacions UAB, 2008-2009.

GUIART R. Tóxicos: Los Enemigos de la Vida. Edicions UAB, 2014.

GUPTA R (ed.). Veterinary Toxicology: Basic and Clinical Principles. Academic Press, 2018.

[https://catalegclassic-uab-cat.aren.uab.cat/record=b1728237~S1*cat ;
<https://www-sciencedirect-com.aren.uab.cat/book/9780128114100/veterinary-toxicology?via=ihub=>]

GUPTA R (ed.). Biomarkers in Toxicology. Academic Press, 2014.

[https://catalegclassic-uab-cat.aren.uab.cat/record=b2092371~S1*cat]

HARRIS CR. Manual de Toxicología para Médicos. Elsevier-Masson, 2008.

HAYES AW, KRUGER C (eds.). Hayes' Principles and Methods of Toxicology. CRC Press, 2014.

HODGSON E. A Textbook of Modern Toxicology. Wiley, 2010.

HODGSON E, SMART RC. Introduction to Biochemical Toxicology. John Wiley & Sons, 2001.

HONG H (ed.). Advances in Computational Toxicology: Methodologies and Applications in Regulatory Science. Springer, 2019.

HOVDA L, BRUTLAG A, POPPENGA R, PETERSON K (eds.). Small Animal Toxicology. Wiley-Blackwell, 2016. [https://catalegclassic-uab-cat.aren.uab.cat/record=b2095561~S1*cat]

- KLAASSEN CD (ed.). Casarett & Doull's Toxicology: The Basic Science of Poisons. McGraw-Hill, 2018.
- KRIEGER R (ed.). Hayes' Handbook of Pesticide Toxicology. Elsevier Science & Technology, 2010.
[<https://ebookcentral-proquest-com.are.uab.cat/lib/uab/detail.action?docID=625355>]
- MARQUARDT H (ed.). Toxicology. Academic Press, 1999.
[https://catalegclassic-uab-cat.are.uab.cat/record=b1728215~S1*cat]
- MERCURIO SD. Biological Toxicology. Jones and Barlett, 2015.
- MURRAY L, LITTLE M, PASCU O, HOGGETT K. Toxicology Handbook. Elsevier Australia, 2015.
- NORDBERG G (ed.). Handbook on the Toxicology of Metals. Academic Press, 2007.
[https://catalegclassic-uab-cat.are.uab.cat/record=b1732255~S1*cat]
- RATHORE HS, NOLLET LML (eds.). Pesticides: Evaluation of Environmental Pollution. CRC Press, 2012.
[https://catalegclassic-uab-cat.are.uab.cat/record=b2092316~S1*cat]
- REPETTO M, REPETTO G. Toxicología Fundamental. Díaz de Santos, 2009.
[https://catalegclassic-uab-cat.are.uab.cat/record=b2094439~S1*cat]
- STINE KE, BROWN TM. Principles of Toxicology. CRC Press, 2015.
- TIMBRELL J. Introduction to Toxicology. Taylor & Francis, 2001.
- TIMBRELL J. Principles of Biochemical Toxicology. CRC Press, 2008.
[https://catalegclassic-uab-cat.are.uab.cat/record=b2092203~S1*cat]
- TIMBRELL J. The Poison Paradox. Oxford University Press, 2005.
- WALKER CH, SIBLY RM, HOPKIN SP, PEAKALL DB. Principles of Ecotoxicology. CRC Press, 2012.
- WORLD HEALTH ORGANIZATION. Diversos volums de la sèrie "Environmental Health Criteria", WHO.
[<https://apps.who.int/iris/handle/10665/26724/browse?type=title> ;
https://catalegclassic-uab-cat.are.uab.cat/record=b1872000~S1*cat]

Software

None.