Universitat Autònoma de Barcelona

2020/2021

Toxicology

Code: 101910
ECTS Credits: 3

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OB	3	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

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

For those students who request it by email in advance, there will be a Spanish version of the exams

Teachers

Núria Giménez Gómez

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 important 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.

* Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

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.

* The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

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, in groups of 4, of a work with scientific format	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 means of:

a) A first partial exam in the middle of the course, where the block A of theory and the seminars until then given will be evaluated. The exam will consist of 60 T/F questions, and 36 minutes of time to do it. Worth 35 % of the final grade.

b) A second partial exam at the end of the course, where the theory block B, seminars and practices will be evaluated with approximately 50 T/F questions, plus approximately 20 questions from the first partial (continuous and cumulative evaluation), and approximately 10 from the students scientific work (which will be posted on Virtual Campus), with a total of 80 questions and 48 minutes of time to do it. Worth 45 % of the final grade.

c) Preparation of a scientific poster and a written summary of ≈1,000 words (references not included) that will be prepared in groups of four students throughout the semester, on a toxicological theme to choose by them, and which will be send to the teaching staff at the end of the course for evaluation. During the preparation of this work, it will be possible to have individual or group tutorials, face-to-face or virtual, whose objective will be to solve doubts and guide on its elaboration. Worth 20 % of the final grade. The teaching staff will evaluate the quality of the work with a collective note to the members of each group, unless in writing any of them indicates that not all of them have done comparable work and/or there has not been a good capacity to collaborate as a team.

A student will be considered as "failing grade" when the final marks does not allow him/her to reach a global grade equal to or greater than 5.00. If a student does not show up for any of the evaluation activities, this will score as zero (0.00). The non-attendance for non-justified reasons to a PLAB subtract 0.25 points to the final grade. In this subject a final second chance exam will be held for students with a final grade of <5.00, with the

requirement thatthey must have attended all the lab practices and have presented, defended and approved the work (poster + summary). This exam is only for failing grade students and cannot be used to improve a grade that is already >5.00. In this exam the whole course will be evaluated (theory + PAUL/seminars + PLAB) through 80 T/F test questions, and the resulting final grade will be 80 % of the score obtained in it and 20 % of that achieved in the work. It should be noted that the second chance exam will have a degree of difficulty equal to or greater than that of the partial exams. The students will only be considered as "not gradable" in the case that they do not appear in two or more of the three evaluations.

* Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
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

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