Universitat Autònoma de Barcelona

2023/2024

Toxicology

Code: 101910
ECTS Credits: 3

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OB	3	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Angel Bistue Rovira

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*

BLOCK A. INTRODUCTION TO TOXICOLOGY

- Introduction to toxicology, basic principles of toxicology. (TE) Concept of toxicity. Factors that determine toxicity: substance, organism and environment. Fundamental concepts. Epidemiology of poisoning. (Relationship between pharmacotic and toxic)

BLOCK B. TOXIC SUBSTANCES

- Industrial pollutants (TE). Introduction to pollution. Historical perspective. Classification of pollutants. Metals. Dioxins. Acute and chronic effects.
- pesticides (TE). Pesticides. Radioactivity. Microplastics. PBT and vPvB concept
- Toxins present in vegetables, animals and fungi (TE). General introduction to toxins. Phytotoxin poisoning: control and prevention. Variability in the production of phytotoxins. Main groups of phytotoxins. Fungal poisoning. Poisoning from ingestion of mushrooms. Marine toxins. Bivalve poisoning. Poisonings from fish consumption. Toxins as drugs (Atropine) and drug modifications.

BLOCK C. PHASES OF TOXICITY: FROM EXPOSURE TO EFFECTS

- Environmental toxicology (TE). The compartments of the earth: atmosphere, hydrosphere, lithosphere and biosphere. Mobility of pollutants through the environment. Transport in fluids. Bioaccessibility. Partition coefficients H', Koc and Kow. Bioaccumulation. Biomagnification.
- Toxicokinetics (TE). Dose and internal exposure. Absorption. Types of cell transport. Routes of exposure. Absorption rates. Distribution. Pre-systemic elimination. Plasma proteins. Accumulation and remobilization. Metabolism. Phases I and II of metabolism. Characteristics of metabolism: specificity, induction and inhibition. Detoxification and metabolic activation. Excretion. Relationship between metabolism and excretion.
- Toxicodynamics I (TE). Types of toxic effects. Toxicity at the molecular level. Toxicity in organs and systems. Toxicity on the digestive system and hepatotoxicity, Nephrotoxicity, Toxicity on the respiratory system, Neurotoxicity, Toxicity on the cardiovascular system and blood. Drugs and Drugs (TE). Introduction. Definitions and basic concepts. Factors involved in the process of drug addiction. Ability of different drugs to produce drug addiction. Toxicokinetics and addictive capacity. Classification. Effects of drugs of abuse: Acute toxicity (overdoses), Medium and long-term effects, Addiction.
- Toxicodynamics II (TE) Genotoxicity. Carcinogenesis. Teratogenesis. Endocrine disruptors.

BLOCK D. EVALUATION OF TOXICITY

- Analytical toxicology I (TE). Chromatographic techniques: gas chromatography. The flame ionization detector (FID) and the electron capture detector (ECD). Mass spectrometry (MS).

- Analytical toxicology II (TE) Biological monitoring.
- Analytical toxicology III (TE) Phases of chemical monitoring: pre-analytical, analytical and post-analytical. Extraction, purification and determination of an analyte. Chromatography. Calculation of concentrations. Interpretation of toxicological analysis.
- Experimental toxicology: methods for determining toxicity (TE). Models for assessing toxicity. Theoretical estimates. In vitro studies. In vivo studies. Epidemiological studies. Toxicological risk communication. Globally Harmonized System (GHS). Labelling of chemical products and safety data sheets.
- Toxicological risk assessment. Quantitative toxicology.Dose-response (TE). Dose and concentration concept. Type of response. Acute toxicity index (LD50, CL50). Subchronic toxicity index (NOAEL and LOAEL). Maximum exposure limits (ADI, TDI, RfD). Uncertainty factors. Maximum permissible concentrations (MRL). Characterization of toxicological risk. Experimental evaluation of toxicity: for what? Such as? When? Methodologies useful in the screening phase. Valid methods in the registration phase (preclinical).
- Food toxicology. Toxins present in food and food safety. RASFF alert system.

BLOCK E. MEDICAL TOXICOLOGY

- Diagnosis (TE).Identify causes, biomarkers, medical history, symptoms.
- Treatment of poisonings (TE). Approaches to the diagnosis of poisonings. General aspects and antidotes. General guidelines for the treatment of an intoxicated patient. Local treatment. General treatment. Measures to prevent the absorption of the toxic substance. Main treatment methods: evacuating, neutralizing, antidotic and eliminating. Fundamental and applications. Elimination of the source of the toxic. Activated carbon mechanisms, favoring the elimination or excretion of the substance.
- Antidotes (TE). Introduction the antidotes. Main antidotes and the mechanism of action.

SEMINARS

- S1. Clinical cases (database).
- S2. Experimental toxicokinetics: case of alcohol.
- S3. Zebrafish embryotoxicity test.
- S4. Example of interpretation of a toxicological report.
- S5. Poster
- S6. Identification of suspicious products. Cannabis and cocaine by colorimetry, UV spectrophotometry and thin-film chromatography
- S7. Poster

LABORATORY PRACTICES (PLAB)*

- Determination of acetylcholinesterase activity in pesticide poisoning

- Identification of toxic plants and rapid determinations of phytotoxins

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) A first mid-term partial exam, where the theory program and the seminars carried out to date will be evaluated. Worth 25% of the final grade.

b) 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 50% of the final grade.

c) Preparation of a scientific poster that will be prepared in groups throughout the semester on a topic of toxicology. Worth 15% of the final grade

d) Class activities and case resolution. Worth 10% 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.

This course does not use the one-time evaluation system.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Cases and class activities	10%	0	0	3, 4
Final test (cumulative)	50 %	0.8	0.03	3, 2, 1
First partial test	25 %	0.6	0.02	3, 2, 1
Preparation and elaboration of a scientific work	15 %	0	0	3, 2, 1, 4

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Software

None.