

**COURSE DATA****Data Subject**

<b>Code</b>	43058
<b>Name</b>	Biomarkers of pollution
<b>Cycle</b>	Master's degree
<b>ECTS Credits</b>	3.0
<b>Academic year</b>	2021 - 2022

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
2139 - Master's Degree in Environmental Pollution, Toxicology and Health	Faculty of Biological Sciences	1	Second term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
2139 - Master's Degree in Environmental Pollution, Toxicology and Health	3 - Environmental toxicology	Optional

**Coordination**

<b>Name</b>	<b>Department</b>
TORREBLANCA TAMARIT, AMPARO	357 - Cellular Biology, Functional Biology and Physical Anthropol.

**SUMMARY**

Environmental toxicology needs to relate the presence of a pollutant in the environment to a valid prediction of the risk it poses to living beings. Biomarkers provide a measure of the exposure or effect of the contaminant on organisms. Their use in bio-monitoring campaigns for ecosystems is constantly increasing since they allow us to know the general "health" of the organisms that inhabit the contaminated ecosystems and are indicative of the nature of the polluting substances to which they are exposed.

The study of this matter is basic to know one of the most powerful tools available to evaluate the impact of pollutants on living things in different ecosystems, in addition to predicting the risk associated with their presence.



It is a subject with 3 ECTS credits, which is located in the second semester of the master. It has an applied character, oriented to the evaluation of specific situations that occur in the environment.

## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

## COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

### 2139 - Master's Degree in Environmental Pollution, Toxicology and Health

- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Capacidad de utilizar las nuevas tecnologías de la información y la comunicación.
- Capacidad de análisis, síntesis y razonamiento crítico en la aplicación del método científico.
- Capacidad para el aprendizaje autónomo y organizado y para la adaptación a nuevas situaciones.
- Comprensión del mundo natural como producto de la evolución y de su vulnerabilidad frente a la influencia humana.
- Desarrollo de un compromiso ético y capacidad de participación en el debate social.
- Comprender los mecanismos de toxicidad de contaminantes.
- Diseñar y ejecutar programas para la prevenir la contaminación del medio acuático continental y del litoral.
- Valorar integralmente del estado de salud del medio ambiente.
- Realizar ensayos del ciclo de vida.
- Realizar diagnóstico de problemas ambientales.
- Diseñar los indicadores específicos para un riesgo ambiental concreto.



## **LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)**

### **SKILLS TO ACQUIRE.**

- To handle scientific terminology properly and become familiar with their sources.
- To get an integrated view of the defense mechanisms of adaptation to the environment of animals. Make sense of foreground, interrelate and apply.
- Ability to analyze data, choosing the right method, critical evaluation and interpretation of experimental results in various forms of expression (tables, graphs ...).
- Acquire synthesis capacity to collect, coherently and in an organized way, information or data of different origins.
- Meet the management of basic scientific instrumentation typical of Biomarkers determination.

### **SOCIAL SKILLS**

- Develop capacity for critical thinking, fostering communication and discussion with a view to stimulating individual creative ability.
- Ability to work in groups when dealing with problematic situations collectively.
- Ability to build a comprehensive text written and organized.
- Ability to speaking to a public audience, such as the class itself, by exposure or intervention in a debate on a topic or controversial issue.
- Ability to interact with both the teacher and with peers.
- Interest in social and economic application of science and in particular the Environmental Toxicology.
- Interest in popular science and the impact of science on culture and consciousness of society.
- Professional training. Acquisition of scientific and technical knowledge related to resistance to xenobiotics that will facilitate the work in Environmental Toxicology in a society in continuous technological progress.

## **DESCRIPTION OF CONTENTS**

### **1. Biomarcadores de contaminación**

- Biomarkers: Concept, classification and specificity.
- Relationship between the adverse effects of contamination and biomarkers.
- Scientific basis for the use of biomarkers in monitoring pollution and its effects.
- Physiological variables as a biomarker. Physiological status. Scope for growth. Caloric content. Hematology. Metabolites present in plasma.
- Esterases: general and classification. Characterization of the enzymatic activity of B-esterases.
- Cholinesterases in vertebrates and invertebrates and their use as biomarkers of exposure and effect to organophosphate and carbamate pesticides. Determination of cholinesterase activity
- Use of the enzymes involved in the biotransformation processes as biomarkers. Phase I enzymes: cytochrome P450 CYP1A. Phase II enzymes: glutathione transferase, UDP-glucuronyl transferase.
- Metallothioneins. Biochemical characteristics and mechanisms of induction of its synthesis. Quantification methods. Examples of use in real situations Porphyrins and synthesis of the heme group. Inhibition of delta-amino levulinic acid dehydratase (ALA-D) activity as an indicator of lead exposure. Blood carboxylated porphyrin levels as indicators of exposure to organochlorine compounds. Hemoglobin adducts.



- Biomarkers related to oxidative stress: oxidative status of glutathione, glutathione reductase activity, catalase activity, peroxidase activity, superoxide dismutase activity. Protein carbonylation. Lipid peroxidation.
- Biomarkers of genetic damage. Alkaline elution test for DNA strand break. Comet test for DNA strand break. Test for chemical adducts in DNA. Detection of micronuclei.
- Genomics and proteomics in the development of new biomarkers.

## WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	21,00	100
Development of group work	7,00	0
Study and independent work	12,00	0
Preparation of evaluation activities	16,00	0
Preparing lectures	10,00	0
<b>TOTAL</b>	<b>66,00</b>	

## TEACHING METHODOLOGY

- Master class for acquiring the fundamental knowledge, including methodological aspects.
- Practice class on the evaluation of pollution effects.
- A tutorship of 1.5 hours will be carry out in the class. On the other hand, other tutored sessions will be available by e-mail or using the “aula virtual” tool.
- All activities and master classes are reinforced with documentation and information exchanges between lecturers and students using the “aula virtual” tool of the Universitat de València webpage.

## EVALUATION

- SE1 - Continuous evaluation of the student in theory classes, laboratory and seminars: participatory assistance, manipulation of material and equipment, organization of work, understanding and use of the practical script, calculation, teamwork, etc.
- SE2 - Evaluation of non-contact activities related to laboratory classes: reports and / or reports of the practices delivered.
- SE3 - Written exams about the theoretical and / or practical classes: based on the learning results and the specific objectives of each subject.



- SE4 - Attendance to tutorials for the accomplishment of the work and / or participative assistance to programmed course / s for the promotion of transversal competences.
- SE5 - Preparation of a report on the activities carried out to promote transversal competences.

Final Exam 55 points

Continuous assessment 10 points

Conferences 10 points

TOTAL 75 points

Participation, presentation of a report and questionnaire (compulsory attendance) 25 points

TOTAL 25 points

## REFERENCES

### Basic

- Blasco, Julián. Marine ecotoxicology : current knowledge and future issues. London, United Kingdom: Academic Press Elsevier, 2016. Print.  
Fowler, Bruce A. Molecular biological markers for toxicology and risk assessment. London, UK: Academic Press is an imprint of Elsevier, 2016. Print.  
Gagne, Francois. Biochemical ecotoxicology : principles and methods. Amsterdam: Academic Press, 2014. Print.  
Gross, Elisabeth M., and Jeanne Garric. Ecotoxicology : new challenges and new approaches. London Kidlington, Oxford: ISTE Press Ltd Elsevier Ltd, 2019. Print.



Gupta, Ramesh C. Biomarkers in toxicology. Amsterdam: Academic Press, 2019. Print.

Muttin, Frédéric. Oil spill studies : healing the ocean, biomarking and the law. London, UK Oxford, UK: Elsevier Ltd. ISTE Press, 2018. Print.

Pope, Carey N., and Jing Liu. An introduction to interdisciplinary toxicology from molecules to man. London: Academic Press, 2020. Print.

Triquet, C, J. C. Amiard, and Catherine Mouneyrac. Aquatic ecotoxicology : advancing tools for dealing with emerging risks. London: Academic Press is an imprint of Elsevier, 2015. Print.

## **ADDENDUM COVID-19**

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

### **3. Teaching methodology**

In-person seminars are replaced by a non-face-to-face activity such as the commentary of a scientific article individually through a Virtual Classroom activity.

### **4. Evaluation**

The weighting of the continuous evaluation that was already under way before the entry into force of the "alarm state" is maintained.

The theory test will be through online testing. The "online" evaluation tests will be of type tests with alternative answers and will be carried out through the "questionnaires" tool available through Virtual Classroom. If, for technical reasons, duly justified, a student is unable to take any examination, the possibility of taking an alternative test that, in any case, will be ORAL type will be considered.