

## Microbial Ecology

Code: 100825  
 ECTS Credits: 4

Degree	Type	Year	Semester
2500251 Environmental Biology	OB	3	1

### 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

### Teachers

Olga Sánchez Martínez

### Prerequisites

Although no official prerequisite exists, students are advised to review concepts that refer to the microbial world, previously studied.

In order to take this course it is necessary that the student has passed the tests of Safety and Biosafety that he/she will find in the corresponding Moodle space. It is necessary to present, the first day of class, the printed pdf documents generated when passing the tests. Also, it is necessary to know and accept the operating rules of the laboratories of the Faculty of Biosciences. In addition, it is imperative that the student follows the rules of work indicated by the teaching staff. For safety reasons, if the two tests have not been passed, or the student does not wear a lab coat and safety glasses, access to the lab will not be allowed.

### Objectives and Contextualisation

It is a mandatory, nuclear course of the degree of Environmental Biology, which introduces the student in the principles and terminology, as well as in the methods of study of Microbial Ecology.

The objectives of the course are:

1. Acquire the basic concepts and methods of study of Microbial Ecology.
2. Display knowledge of the microorganisms in their natural habitats and the environmental factors that affect their distribution.
3. Recognize the main relationships that microorganisms establish between them and with other living things, such as plants and animals.
4. Understand the role of microorganisms in biogeochemical cycles

## **Skills**

- Communicate efficiently, orally and in writing.
- Identify and interpret the diversity of species in the environment.
- Integrate knowledge of different organisational levels of organisms in their functioning.
- Know a foreign language (English).
- Sample, characterise and manipulate populations and communities.
- Understand the bases of regulation of vital functions of organisms through internal and external factors, and identify environmental adaptation mechanisms.

## **Learning outcomes**

1. Communicate efficiently, orally and in writing.
2. Interpret the distribution, requirements and biological interactions in the environment of microorganisms, principally bacteria.
3. Interpret the role of microorganisms, principally bacteria, in the functioning of biological systems.
4. Isolate, culture and identify microorganisms in the laboratory, principally bacteria.
5. Know a foreign language (English).
6. Recognise the biochemical bases and their relation to the metabolic processes that determine the functioning of microorganisms, principally bacteria.
7. Recognise the functional processes that determine the adaptation of microorganisms, principally bacteria, to the medium.

## **Content**

### **THEORY**

#### **I. INTRODUCTION AND METHODS**

##### **1. Microbial Ecology: concept and historical development**

Historical development. Microbial Ecology today. Concepts of microbial ecology.

##### **2. Methods of study of Microbial Ecology (I)**

Characteristics and objectives of the Microbial Ecology sampling. Sampling devices in different habitats. Preservation of samples.

##### **3. Methods of study (II)**

Quantification of microorganisms in the natural environment. Estimation of biomass. Estimation of microbial biodiversity with molecular techniques.

##### **4. Methods of study (III)**

Detection and measurement of microbial activity.

#### **II. INTERACTIONS BETWEEN POPULATIONS**

##### **5. Interactions between microbial populations**

Interactions within the same population. Transmission of chemical signals between microorganisms: quorum sensing. Neutralism. Positive interactions: commensalism, synergism and mutualism. Negative interactions: competition, amensalism, predation and parasitism.

##### **6. Interactions between plants and microorganisms**

Rhizosphere. Mycorrhizae. Fixation of nitrogen in the radical nodules. Phillosphere.

##### **7. Interactions between microorganisms and animals**

Contribution of microorganisms to animal nutrition. Predation of animals by fungi. Other symbiotic relationships.

### **III. MICROORGANISMS IN THEIR NATURAL HABITATS**

#### **8. Microbial communities and ecosystems**

Structure and dynamics of microbial communities. Effect of environmental factors on the distribution of microorganisms.

#### **9. Marine and freshwater environments**

Water as a microbial habitat. Lotic and lentic ecosystems. Coastal marine ecosystems. Open sea.

#### **10. Terrestrial ecosystems**

Edaphic microbiomes: soil and rhizosphere. Microbiology of sediments.

#### **11. Extreme environments**

What is an extreme environment? Examples: Terrestrial hot springs and deep-sea hydrothermal vents. Deep ocean. Warm and cold deserts. Acidic and alkaline environments. The subsoil.

#### **12. Microorganisms in nutrient cycles**

Carbon cycle: Carbon transfer through trophic networks. Cycle of nitrogen, sulfur and other elements. Interrelations between cycles.

## **LABORATORY PRACTICES**

### **Characterization of experimental models:**

**Practice 1.** Macro and microscopic observation

**Practice 2.** Determination of physical and chemical parameters

**Practice 3.** Microorganisms count

**Practice 4.** Determination of total biomass

**Practice 5.** Metabolic characterization of the ecosystem: enzymatic activity

**Practice 6.** Metabolic characterization of the ecosystem: use of carbon sources

**Practice 7.** The nitrogen cycle

**Practice 8.** Enrichment and isolation of different microbial physiological groups

**Practice 9.** Determination of the optimum temperature of growth from one of the isolated bacteria

### **Methodology**

The course of Microbial Ecology consists of two modules, which have been programmed in an integrated way so that the student will have to relate throughout the course the content and activities scheduled to achieve the skills indicated in this guide.

The two modules are:

**Theoretical lectures.** Within this module, master or expository lectures represent the main activity to be carried out in the classroom and allow basic concepts to be transmitted to a large number of students in a relatively short time. They will be complemented with Power Point presentations and diverse didactic material

that will be delivered to the students at the beginning of the course.

**Practical laboratory classes.** At the beginning of the course the student will receive a Handbook with the practical work to be developed during the course. The objectives of these activities are: a) facilitate the understanding of the knowledge presented in the theoretical lectures, b) acquire manual skills, c) interpret results, and d) integrate theoretical and practical knowledge.

#### **Additional Information:**

In order to support the above mentioned training activities, individual tutorials can be carried out at the request of the students by the teachers Olga Sánchez (C3-335) and Maira Martínez-Alonso (C3-329).

The student will have at the Moodle space all the documentation delivered by the teacher for the good monitoring of the course. He / she will also be able to consult the teaching space of the Degree Coordination to obtain updated information.

## **Activities**

Title	Hours	ECTS	Learning outcomes
<b>Type: Directed</b>			
Laboratory practices	12	0.48	4, 1, 5, 3, 2, 7, 6
Theoretical lectures	24	0.96	1, 5, 3, 2, 7, 6
<b>Type: Supervised</b>			
Individual/group tutorials	2	0.08	3, 2, 7, 6
<b>Type: Autonomous</b>			
Bibliography search	5	0.2	5
Preparation and writing of works	10	0.4	1, 5, 3, 2, 7, 6
Study	35	1.4	5, 3, 2, 7, 6
Text reading	7	0.28	5

## **Evaluation**

The valuation of the course will be individual and continuous through the following tests:

**Assessment of the theoretical lectures module** (80% of the overall mark): During the course two written exams of this module will be scheduled, which are eliminatory. Each test will have a weight of 50% of the mark of the module and it will be necessary to obtain a score equal or superior to 5 to average them; otherwise, the student will have to take a final second-chance exam that will include the theoretical contents of the whole course. Each test will consist of multiple choice and / or true / false test questions, which will allow to assess a large part of the contents, and / or short answer questions aimed at assessing whether the key conceptual objectives have been achieved.

**Assessment of the laboratory work module** (20% of the overall grade): The evaluation will include the preparation of a questionnaire and a written test with multiple choice and / or true / false test questions. Each

of the two tests will have a weight of 50% of the mark of the module and it will be necessary to obtain a score equal to or higher than 5 to average them; otherwise, the student will have to take a final second-chance exam with all the contents of the module.

#### **Final considerations:**

To pass the course the student must obtain a score of 5 or higher in each module. Students who do not pass any of the two modules will have to retake them in a second-chance exam where the whole theory and / or laboratory work content will be included on the date scheduled for the final evaluation of the course.

The presentation of the student to raise the mark involves the renunciation to that obtained with the partial exams and he / she will have to perform the re-assessment of all contents of the course on the day scheduled for that purpose.

From the second registration, those students repeating the course will not have to carry out the teaching activities, nor the assessment of those skills passed in the laboratory work module. That is, the mark obtained in the lab work module will be saved, as long as it has been passed.

A student will be considered as Not Assessable if he / she does less than 50% of the assessment activities.

### **Evaluation activities**

Title	Weighting	Hours	ECTS	Learning outcomes
Assessment of laboratory work	20	1	0.04	4, 1, 5, 3, 2, 7, 6
Theory assessment	80	4	0.16	1, 3, 2, 7, 6

### **Bibliography**

#### **Text books:**

Atlas RM, Bartha R (2002). Ecología microbiana y microbiología ambiental. 4<sup>a</sup> ed., Pearson Educación SA.

Kirchman DL (2012). Processes in microbial ecology. Oxford University Press.

Madigan M, Martinko JM, Bender KS, Buckley DH, Stahl DA (2015). Brock, biología de los microorganismos, 14<sup>a</sup> ed., Pearson Educación SA.

Madigan M, Martinko JM, Bender KS, Buckley DH, Stahl DA (2014). Brock Biology of Microorganisms. 14<sup>a</sup> ed. Pearson SA.

Wiley J, Sherwood LM, Woolverton CJ (2008). Microbiología de Prescott, Harley y Klein, 7<sup>a</sup> ed., MacGraw-Hill.

Willey J, Sherwood LM, Woolverton CJ (2013). Prescott's Microbiology. 9<sup>a</sup> ed. MacGraw-Hill.