Universitat Autònoma de Barcelona

2019/2020

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

Competences

- 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.

Laboratory practices. This subject will be taught in small groups with a maximum of 24 students per laboratory session. Each student is assigned to a group of practices and can not change groups without the permission of the teacher responsiblefor the subject.

Attendance at all practices is mandatory and it is necessary to be very punctual. Once the teacher has begun the explanation of the practice, students will not be allowed to enter in the classroom. If a student, with a justified cause, has not been able to attend a practice session, he/she will have to contact the teacher responsible for the subject and present the corresponding proof. In this case he/she will be assigned a new day to do the practice. If the practice has already been done and the student can not retake it, it will not be considered as a lack of attendance.

At the beginning of the course the student will receive a Handbook with the practices 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 practice knowledge.

It is mandatory to wear a labcoat in all practices sessions that take place in the laboratory and also the use of protection glasses in those sessions indicated by the teacher. In addition, each student will have to bring the corresponding Practices Handbook and a notebook to record the results of the work.

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).

Students will have at the Moodle space all the documentation delivered by the teachers 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
Type: Directed			
Laboratory practices	12	0.48	4, 1, 5, 3, 2, 7, 6
Theoretical lectures	24	0.96	1, 5, 3, 2, 7, 6
Type: Supervised			
Individual/group tutorials	2	0.08	3, 2, 7, 6
Type: Autonomous			
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

Assessment

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

Assessment of the theoretical lectures module (65% 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. Each test will consist of multiple choice 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 a written test with multiple choice questions and problems (20%), an oral presentation of the practical results (5%), and the individual daily monitoring of the practical skills acquired by the students (10%).

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 examon the scheduled date for the final evaluation of the subject, where the whole theory and / or laboratory work content will be included. Practical skills can not be retaken.

To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course. Thus, the student will be graded as Non-evaluable if the weighing of all conducted evaluation activities is less than 67% of the final score.

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.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assessment of laboratory work	35	1	0.04	4, 1, 5, 3, 2, 7, 6
Theory assessment, part 1	32,5	2	0.08	1, 3, 2, 7, 6
Theory assessment, part 2	32,5	2	0.08	1, 3, 2, 7, 6

Bibliography

Text books:

Atlas RM, Bartha R (2002). Ecología microbiana y microbiologia ambiental. 4ª ed., Pearson Educación SA.

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

Madigan MT, Martinko JM, Bender KS, Buckley DH, Stahl DA. 2014. Brock Biología de los Microorganismos. 14ª ed. Pearson Education.

Madigan MT, Bender KS, Buckley DH, Sattley WM, Stahl DA. 2017. Brock Biology of Microorganisms. 15th ed. Pearson SA.

Martín A, Béjar V, Gutiérrez JC, Llagostera M, Quesada E. 2019. Microbiología Esencial. 1ª ed. Editorial Médica Panamericana.

Willey J, Sherwood LM, Woolverton CJ. 2008. Microbiología de Prescott, Harley y Klein. 7ª ed. MacGraw-Hill.

Willey JM, Sherwood LM, Woolverton CJ. 2017. Prescott's Microbiology. 10th ed. MacGraw-Hill.