

**Prokaryote Diversity**

Code: 101027  
ECTS Credits: 3

Degree	Type	Year	Semester
2500502 Microbiology	OB	2	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.

## Prerequisites

There are no official prerequisites; however, it is advisable for students to review the concepts that refer to the microbial world, studied previously.

## Objectives and Contextualisation

This is a compulsory course of the second year of the Degree in Microbiology, which introduces students to the basic knowledge of prokaryotic diversity, with special emphasis on the structural and ecophysiological characteristics of the large prokaryotic groups we know, and their importance .

The main objective of the course is to provide basic training for the study of the microbial diversity, physiology and metabolism of the main prokaryotic groups.

The specific objectives of the course are the following:

- Recognize the diversity of prokaryotic microorganisms
- Understand the principles of classical and molecular taxonomy.
- Know how to distinguish the characteristics that define the different taxonomic groups, their structural particularities, their ecophysiological characteristics and their importance.
- Learn how to apply the knowledge studied to carry out the identification and characterization of the main prokaryotic groups.

## Competences

- Apply knowledge of theory to practice

- Communicate orally and in writing.
- Develop critical reasoning skills in the field of study and in relation to the social context.
- Know and interpret microbial diversity, the physiology and metabolism of microorganisms and the genetic bases that govern their vital functions.
- Obtain, select and manage information.
- Use bibliography or internet tools, specific to microbiology or other related disciplines, both in English and in the first language.
- Work individually or in groups, in multidisciplinary teams and in an international context.

## Learning Outcomes

1. Apply knowledge of theory to practice
2. Communicate orally and in writing.
3. Develop critical reasoning skills in the field of study and in relation to the social context.
4. Evaluate the role of microorganisms in important industrial processes and as producers of key compounds for the development of our societies and the improvement of quality of life
5. Identify metabolic diversity in microbes and relate it to the different groups of microorganisms.
6. Identify the role of the different microbial groups in the environment and in the cycles of the elements, and their environmental implications
7. Obtain, select and manage information.
8. Recognise and consult microbial collections of model cultures.
9. Recognise the diversity of the microbial world and identify the different groups it is composed of.
10. Recognise the role of microorganisms as agents of disease or toxicological problems in human beings, animals and plants.
11. Use bibliography or internet tools, specific to microbiology or other related disciplines, both in English and in the first language.
12. Work individually or in groups, in multidisciplinary teams and in an international context.

## Content

### THEORY

#### Unit 1. Introduction to prokaryotic diversity

What do we mean by prokaryotic diversity? Phylogeny and implications in taxonomy.

#### Unit 2. Microbial systematics

Classification, nomenclature and identification. Classification systems. Polyphasic taxonomy: phenotypic, genotypic and phylogenetic methods. Classification units. The species concept for prokaryotes. Bergey's Manual of Systematic Bacteriology. Culture collections.

#### Unit 3. Archaea domain

Structural particularities of archaea. Phylogeny and metabolism. Euryarchaeota. Crenarchaeota. New archaeal phyla.

#### Unit 4. The deep-branching bacterial groups

Adaptations to life at high temperatures, and high radiation. Ecophysiological characteristics of the different groups and key genera.

#### Unit 5. Gram-Negative Bacteria I

Characteristics of the main groups of green phototrophic bacteria. General characteristics, ecological relevance and key genera. Main chemotrophic groups: Structure, classification and ecophysiology.

## Unit 6. Gram-negative bacteria II

Proteobacteria. Morphological, physiological and metabolic diversity. Phylogenetic divisions. Main members of the group and their significance.

## Unit 7. Gram-positive bacteria and mycoplasma

Morphological and ecophysiological characteristics, main phylogenetic groups and applied importance.

## Unit 8. Extension of prokaryotic diversity

What do we know about the diversity of prokaryotes? Current tools available to assess the hidden diversity of bacteria and archaea. Phylogenetic groups dominated by sequences of uncultivated microorganisms. Distribution and characterization.

## SEMINARS

Introduction to identification techniques through the resolution of 6 practical cases:

- Methods of isolation of microorganisms
- Techniques of microscopic observation
- Methods for identification and characterization of microorganisms

## Methodology

The Diversity of Prokaryotes course 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 programmed in order to achieve the indicated skills in the section of the same name of this guide.

Several learning strategies will be combined:

**Theory classes.** These master or expository classes represent the main activity to be performed in the classroom, and allow the acquisition of basic concepts by a large number of students, in relatively little time, attending these classes, which will have to be complemented with the study of the topics explained. For the teaching of each subject, presentations like PowerPoint and diverse teaching material will be used and delivered to the students.

**Case-resolution Seminars.** These are sessions of work for groups with a small number of students, based on working methodological aspects, through the study of practical cases. For the resolution of the practical cases, groups of 5 students will work on a specific case, which will be presented orally and, later, will be discussed in the classroom collectively. In this methodology, the teacher has a conductive role, through questions that encourage reflection and debate among students. Attendance at the seminar sessions is mandatory. In case of absence for unjustified reasons, there will be a penalty in the seminar module grade.

**Tutorials.** Tutorials can be done in groups or individually. The first ones will be programmed at the request of the students. The objective of these sessions is to resolve doubts, clarify concepts, establish the knowledge acquired and facilitate the study of the students. They can also be used to solve doubts that students have about the preparation of practical cases. The sessions of tutorials will not be master classes. Likewise, the students will be able to perform individual tutorials in the office of the professor (C3-329).

**Additional information:** Students 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.

**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			
Theory lectures	18	0.72	6, 5, 10, 8, 9, 4
case-resolution seminars	6	0.24	1, 3, 6, 7, 10, 8, 2, 12, 11, 4
Type: Supervised			
Individual/group tutorials	2	0.08	1, 3, 6, 5, 7, 10, 8, 9, 2, 12, 11, 4
Type: Autonomous			
Bibliography search	5	0.2	1, 3, 7, 11
Learning consolidation: study	20	0.8	3, 6, 5, 7, 10, 8, 9, 12, 11, 4
Preparation of oral presentation	9	0.36	3, 7, 2, 12, 11
Text reading	10	0.4	3, 7, 11

## Assessment

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

Assessment of the theory lectures module (70% of the overall grade). Throughout the course two written tests will be scheduled, which will be cumulative; That is to say, the second test will include all the theoretical contents of the subject. The first test will have a weight of 40% and the second of 60%. If the student obtains in the second test a note superior to the first one, the final note of this module will be the one of the second test. Each test will include short answer questions and multiple-choice and/or true/false test questions.

Assessment of case-resolution seminars module (30% of the overall grade). The evaluation of this activity will consist of the following tests: a) Oral presentation of the practical case, in the class seminars, for each group of work, and b) Written tests consisting of multiple choice questions that will include the different aspects treated in the classes of seminars. These tests will have a weight of 6 and 4 points, over 10, respectively. Only the average will be considered if the score of a) and b) is equal or superior to 4.

Final Considerations:

- To pass the subject, you must obtain a qualification of 5 or higher in each module. Students who do not pass any of the modules will be able to retake them on the scheduled date for the final evaluation of the subject. The re-assessment of the theory module will consist of an overall examination of the subject matter that will include short answer questions and multiple-choice and/or true/false test questions. The re-assessment examination of the seminar module will involve a multiple-choice question test on the presentations of all practical cases worked in the seminar sessions.
- 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.
- Students who can not attend an individual assessment test for a justified cause and provide the corresponding documentation will be entitled to take the test in question on another date.

- Students wishing to improve the final grade of the course will waive the qualification previously obtained, and all the written tests, corresponding to the different modules of the subject, will have to be examined, on the day set for the final evaluation.
- From the second enrolment, the repeating students will not have to carry out the activities, nor the evaluations of those skills that have been passed, corresponding to the case-resolution seminars module. That is, the mark obtained in this module will be saved, as long as they have been passed.

### Single evaluation

This subject considers the single assessment system that consists of a single summary test in which the contents of the entire theory program of the subject will be assessed. The test will consist of short-answer questions aimed at assessing whether the key conceptual objectives of the subject have been achieved, as well as multiple-choice and/or true/false test-type questions, which will allow a large part of the content to be assessed. The grade obtained in this synthesis test will account for 70% of the final grade for the subject and must be equal to or greater than 5 to average with the seminars module. The single assessment will be done on the same day as the subject's assessment 2.

The evaluation of the seminar module will follow the same process as the continuous evaluation. The grade obtained will account for 30% of the final grade of the subject. The seminar module is compulsory attendance for all sessions. It is required to have passed the seminar module (grade of 5 or higher) in order to pass the subject.

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Cas-resolution seminars assessment	30	1.5	0.06	1, 3, 7, 2, 12, 11
Final exam	42	2	0.08	6, 5, 10, 8, 9, 2, 4
Midterm exam	28	1.5	0.06	6, 5, 10, 8, 9, 2, 4

## Bibliography

Recommended books:

- Brown JW. 2015. Principles of microbial diversity. 1st ed. ASM Press.
- Madigan MT, Martinko JM, Bender KS, Buckley DH, Stahl DA. 2015. Brock Biología de los Microorganismos. 14<sup>a</sup> ed. Pearson Education. Electronic resource.
- Madigan MT, Bender KS, Buckley DH, Sattley WM, Stahl DA. 2021. Brock Biology of Microorganisms. 16th ed. Pearson SA.
- Martín A, Béjar V, Gutiérrez JC, Llagostera M, Quesada E. 2019. Microbiología Esencial. 1<sup>a</sup> ed. Editorial Médica Panamericana. Electronic resource.
- Ogunseitan O. 2008. Microbial diversity. Form and function in Prokaryotes. Blackwell Publishing. Electronic resource.
- Staley JT, Reysenbach AL. 2002. Biodiversity of microbial life: foundation of earth's biosphere. Wiley-Liss, Inc, New York.

- Willey J, Sherwood LM, Woolverton CJ. 2009. Microbiología de Prescott, Harley y Klein. 7th ed. MacGraw-Hill.
- Willey JM, Sandman KM, Wood DH. 2020. Prescott's Microbiology. 11th ed. MacGraw-Hill.
- Willey JM, Sandman KM. 2021. Prescott's Principles of Microbiology. 2nd ed. MacGraw-Hill. Electronic resource.

Other useful reference books:

- The Prokaryotes.

Rosenberg E, DeLong EF, Lory S, Stackebrandt E, Thompson F (Editors). 2013-14. The Prokaryotes. Fourth Edition. 11 vol. Springer, New York. Electronic resource.

- Volume 1: The Prokaryotes: Prokaryotic Biology and Symbiotic Associations
- Volume 2: The Prokaryotes: Applied Bacteriology and Biotechnology
- Volume 3: The Prokaryotes: Prokaryotic Physiology and Biochemistry
- Volume 4: The Prokaryotes: Prokaryotic Communities and Ecophysiology
- Volume 5: The Prokaryotes: Human Microbiology
- Volume 6: The Prokaryotes: Alphaproteobacteria and Betaproteobacteria
- Volume 7: The Prokaryotes: Firmicutes and Tenericutes
- Volume 8: The Prokaryotes: Actinobacteria
- Volume 9: The Prokaryotes: Gammaproteobacteria
- Volume 10: The Prokaryotes: Deltaproteobacteria and Epsilonproteobacteria
- Volume 11: The Prokaryotes: Other Major Lineages of Bacteria and the Archaea

- The Prokaryotes: a handbook on the Biology of Bacteria

Dworkin M, Falkow S, Rosenberg E, Schleifer KH, Stackebrandt E (Editors). 2006. Third Edition. 7 vol. Springer, New York. Electronic resource.

- Volume 1: Symbiotic Associations, Biotechnology, Applied Microbiology
- Volume 2: Ecophysiology and Biochemistry
- Volume 3: Archaea. Bacteria: Firmicutes, Actinomycetes
- Volume 4: Bacteria: Firmicutes, Cyanobacteria
- Volume 5: Proteobacteria: Alpha and Beta Subclasses
- Volume 6: Proteobacteria: Gamma Subclass
- Volume 7: Proteobacteria: Delta and Epsilon Subclasses. Deeply Rooting Bacteria

- Bergey's Manual® of Systematic Bacteriology

Garrity G (Ed.) 2001-2012. Bergey's Manual of Systematic Bacteriology. Second Edition. 5 vol. Springer, New York.

Volume package:

- Volume 1: Boone DR, Castenholz RW (Eds.). 2001. Bergey's Manual of Systematic Bacteriology, Second Edition. Volume One: The Archaea and the Deeply Branching and Phototrophic Bacteria. Springer, New York.
- Volume 2: Brenner DJ, Krieg NR, Staley JT (Eds.). 2005. Bergey's Manual of Systematic Bacteriology, Second Edition, Volume Two: The Proteobacteria. Springer, New York.
- Volume 3: De Vos P, Garrity G, Jones D, Krieg NR, Ludwig W, Rainey FA, Schleifer K-H, Whitman WB (Eds.). 2009. Bergey's Manual of Systematic Bacteriology: Volume 3: The Firmicutes. Springer, New York.
- Volume 4: Krieg NR, Ludwig W, Whitman WB, Hedlund BP, Paster BJ, Staley JT, Ward N, Brown D (Eds.). 2010. Bergey's Manual of Systematic Bacteriology, Second Edition. Volume 4: The

Bacteroidetes, Spirochaetes, Tenericutes (Mollicutes), Acidobacteria, Fibrobacteres, Fusobacteria, Dictyoglomi, Gemmatimonadetes, Lentisphaerae, Verrucomicrobia, Chlamydiae, and Planctomycetes. Springer, New York.

- Volume 5: Goodfellow M, Kämpfer P, Busse H-J, Trujillo M, Suzuki K-I, Ludwig W, Whitman WB (Eds.). 2012. Volume 5: The Actinobacteria. Springer, New York.

- Bergey's Manual® of Systematics of Archaea and Bacteria

Whitman WB (Ed.). 2015. Bergey's Manual of Systematics of Archaea and Bacteria (digital Ed.). First Edition. John Wiley & Sons, Inc. <http://wileyonlinelibrary.com/ref/bergeysmanual>

In this link, it can be found an infographic prepared by the Library Service to facilitate the location of electronic books:

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Webs of interest:

<http://www.microbelibrary.org>

<http://microbewiki.kenyon.edu>

## Software

No specific software is needed in this subject.