Universitat Autònoma de Barcelona

2023/2024

Microbiology

Code: 100852
ECTS Credits: 6

Degree	Type	Year	Semester
2500251 Environmental Biology	FB	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.

Teachers

Olga Sanchez Martinez

Nuria Vigues Frantzen

Prerequisites

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

Objectives and Contextualisation

It is a mandatory subject, nuclear in the degree of Environmental Biology, that introduces students to the microbial world, giving an overview of the microorganisms, in connection with the rest of living beings and with the different environments in which they live.
This subject, given its introductory nature, offers the most basic concepts and competences referred to Microbiology, so that students can deepen in the following courses in other more specialized subjects of Microbiology.

Objectives of the subject:

1. To broadly recognize microbial diversity and to know how to distinguish the characteristics that define the different microbial groups.

2. To identify the different structures, as well as the composition of the prokaryotic cell.

3. To know the metabolic versatility of the different microbial groups, particularly that of prokaryotes.

4. To know the genomic variability of the microorganisms and the main mechanisms of exchange of genetic information in prokaryotes.

5. To recognize the main relationships of microorganisms with living organisms and with the physical environment they inhabit.

6. To know the role of microorganisms in the development of human societies, as well as their future applications.

7. To know how to perform basic calculations to determine microbiological parameters.

8. To understand and apply basic laboratory techniques to work experimentally with microorganisms.

Competences

- Apply ICT resources pertaining to this field of study.
- Communicate efficiently, orally and in writing.
- Identify and interpret the diversity of species in the environment.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Manage, conserve and restore populations and ecosystems.
- Obtain, observe, handle, cultivate and conserve specimens.
- Sample, characterise and manipulate populations and communities.
- Solve problems.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.

Learning Outcomes

1. Apply ICT resources pertaining to this field of study.
2. Communicate efficiently, orally and in writing.
3. Identify the role of microorganisms in the environment.
4. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
5. Recognise the different microbial groups.
6. Recognise the role of microorganisms in diseases and in industrial processes.
7. Solve problems.
8. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
9. Use basic laboratory equipment and employ techniques for working with microorganisms.

Content

THEORETICAL CONTENT (3,6 ECTS)

Unit 1. The microbial world
History and human societies and microorganisms. Discovering microorganisms. Levels of organization. Main differences between viruses and cellular organisms. Prokaryotic and eukaryotic organization. Groups and names of microorganisms.

Unit 2. Morphology, structure and chemical composition of viruses

Concept of virus. Morphology of viral particles: icosahedral, helical and complex symmetries. Structure of the viral envelope. The viral genome. Enzymes.

Unit 3. Virus-host cell relationships
Viral cycle: one-step growth. Adsorption and penetration. Genome replication. Assembly and release of the virions. Possible effects of viral multiplication on the host.

Unit 4. Classification and diversity of viruses
Criteria for Classification of Viruses (ICVT). Nomenclature. Classification of Baltimore. Prokaryotic and eukaryotic viruses. Other subcellular infectious agents.

Unit 5. Structure and function of the prokaryotic cell
Size and morphology. Cytoplasmic membrane. Structure and function of the cell wall. Capsules and slime layers. The cytoplasm. The nuclear region. Functional and storage inclusions. Appendages. Main mechanisms of motility. Microbial taxisms. Endospores.

Unit 6. The genome of prokaryotes
Structure of the genome. Size, topology and number of chromosomes. Extrachromosomal genetic material: plasmids. Transposable elements. Microbial genomics.

Unit 7. Mutagenesis
Types of mutations. Effects. Causes. DNA repair. Selection of mutants.

Unit 8. Genetic transfer mechanisms
Recombination. Transformation, transduction and conjugation.

Unit 9. The cell cycle of prokaryotes
Binary division. Cell division and control. Diversity of the prokaryotic cell cycle.

Unit 10. Microbial growth. Influence of environmental factors on growth
Exponential growth. Growth cycle in populations. Environmental factors affecting growth: temperature, pH, water availability, oxygen and pressure.

Unit 11. Control of microbial growth
Chemical methods: heat sterilization, radiation and filtration. Antimicrobial agents. Measurement of antimicrobial activity. Resistance to antimicrobials.

Unit 12. Metabolism: global scheme
Sources of energy, carbon and reducing power. Metabolic classes. Processes to obtain energy. Biosynthetic strategy.

Unit 13. Metabolic diversity I
Phototrophy, autotrophs, chemolitotrophy and nitrogen fixation.

Unit 14. Metabolic diversity II
Fermentations. Anerobic respiration. Aerobic chemoorganotrophy.

Unit 15. Diversity of prokaryotes
The origin of life and biological diversification. Microbial systematics: taxonomy and phylogeny. Taxonomic ranges. Species concept in prokaryotes. Techniques to determine taxonomy and phylogeny.

Unit 16. The archaea
Differential characteristics: Euryarchaeota and Crenarchaeota. Phylum Euryarchaeota: methanogens, extreme halophiles. Thermoplasmatales, Thermococales and *Methanopyrus*, Archaeoglobals and *Nanoarchaeum*. Phylum Crenarchaeota: hyperthermophiles and others. New phyla of archaea.

Unit 17. Gram negative proteobacteria
Subdivisions within the proteobacteria. Photosynthetic, chemolitotrophic and methanotrophic proteins. Aerobic

or facultative chemoorganotrophic proteobacteria. Proteobacteria with unusual morphologies: spirals, prosthecates, stalks, buds and sheaths. Delta and Epsilon proteobacteria.

Unit 18. Non proteobacteria Gram negative bacteria
Cyanobacteria. Green bacteria: Chlorobi and Chloroflexus. Chlamydia. Planctomyces. Spirochetes. Deinococcus and Thermus. Hyperthermophilic bacteria. Other Gram negative phyla.

Unit 19. Non endospore-forming Gram positive bacteria and mycoplasma
Non endospore-forming Gram positive bacteria. Endospore-forming Gram positive bacteria. Mycoplasma. Actinobacteria: Gram positive bacteria withhigh G + C content.

Unit 20. Microorganisms in their environment
Concept of microenvironment. Colonization of surfaces. Aerial, terrestrial and aquatic environments, main characteristics. Trophic relationships in microorganisms.

Unit 21. Biogeochemical cycles
Microorganisms as agents of geochemical change. Carbon cycle. Nitrogen cycle.

PROBLEMS AND TECHNIQUES CONTENT (1 ECTS)

Module 1. Microscopic technique.
Module 2. Spread and isolation technique.
Module 3. Microscopic observations.
Module 4. Problems on basic microbiology.
Module 5. Problems on growth and microbial control.

LABORATORY PRACTICES CONTENT (1,4 ECTS)

Module 1. Microbial count.
Module 2. Isolation of microorganisms
Module 3. Observation of microorganisms.
Module 4. Identification of microorganisms.
Module 5. Microbial diversity and ubiquity.

Methodology

TEACHING METHODOLOGY AND TRAINING ACTIVITIES

The subject of Microbiology consists of three modules of supervised activities, which have been programmed in an integrated way so that the student must relate throughout the course the content and activities programmed to reach the skills indicated in this guide.

The three modules are as follows:

Participatory theoretical lectures: The student must acquire the scientific-technical knowledge of this subject by attending these classes and complementing them with the personal study of the topics explained. At the beginning of the course, the student will be given a detailed schedule of the topics to be discussed throughout the course, as well as the bibliography that should be consulted to prepare each theoretical class and for the personal study of the theoretical contents of the subject. The teaching of each subject will be based on a theoretical exposition.

Classes on methodology and problems: These classes are sessions with a reduced number of students with the aim of: a) working methodological aspects, b) facilitating the understanding of the knowledge presented in

the theoretical lectures and c) bridging the theoretical lectures and practical laboratory work, with the objective of integrating theoretical and practical knowledge.At the beginning of the course the student will receive a detailed schedule of the contents of each session, which will indicate the bibliography to be consulted and the relationship of each session with the topics covered in the theoretical lectures and in the laboratory practices. A dossier will also be given with a proposal of problems that must be developed during the course. The sessions will be held in the classroom, where different methodological issues and basic microbiology problems will be discussed. Each student will explain the steps he has followed to solve the problems.

Practical laboratory classes: Previous to the practical lab classes the student will receive a Handbook with the practical work to be developed during the course. The objectives of these activities are: a) to facilitate the understanding of the knowledge presented in the theoretical lectures, b) to practice the experimental designs developed in the problem sessions, c) to acquire manual skills, d) to interpret the results, and e) to integrate theoretical and practical knowledge. The attendance to the practical classes is mandatory in order to acquire the competences of the subject. For attending the laboratory classes it is necessary the student to pass the biosafety and safety tests that will be find in the Moodle space and to know and accept the working rules of the laboratories of the Faculty of Biosciences. In addition, he must comply with the regulations of work in a laboratory of Microbiology that he will find indicated in the Handbook. In order to achieve a good performance and to acquire the competences corresponding to thisactivity it is essential that the student makes a comprehensive reading of the practices proposed before their completion.

As supervised activities of the subject, the students will be able to carry out tutorials in the teachers' office and / or through TICs. At the beginning of the course the procedure for conducting tutorials will be communicated.

The autonomous activities of this subject are: study, reading of texts and resolution of problems.

Additional information: For a good follow-up of the subject, the student will have in the Moodle space all the documentation indicated in the previous points.

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			
Practical laboratory classes	12	0.48	3, 4, 5, 7
Problem classes	8	0.32	2, 5, 7
Theoretical lectures	30	1.2	8, 1, 3, 6, 5
Type: Supervised			
Group and individual tutorials	4	0.16	2, 3, 6, 5, 7
Type: Autonomous			
Problem resolution	20	0.8	7
Study	50	2	3, 6, 5
Text reading	20	0.8	1

Assessment

Continuous evaluation

The assessment of the subject will be individual and continuous through the following tests:

Module of evaluation of theoretical classes (60% of the overall mark). During the course two written tests of this module will be programmed, which are cumulative; i.e. the second test will include all the theoretical contents of the subject.

- The first test will have a weight of 24% and the second one of 36% of the overall mark.

- If the student obtains in the second test a higher mark than in the first one, the final mark of this module will be that of the second test.

- Each test will include one or two short answer questions (with a maximum of 2 points out of 10) and a maximum of 60 multiple choice and / or true / false test questions (with a maximum value of 9 out of 10).

Module of evaluation of the classes on methodology and problems (20% of the overall mark). The evaluation of this activity will consist of the following tests:

A) Resolution of problems in the classroom

B) A written test at the end of the course that will consist of the resolution of a maximum of six problems and some test questions.

- These tests will have a weight of 3 and 7 points, out of 10, respectively. To pass this module you must obtain at least a 5 in the written test.

Module of assessment of the practical laboratory classes (20% of the overall mark). The evaluation of this activity will consist of two tests:

A) Practical skill, which will consist of the delivery of different practical results to the teacher during each laboratory session

B) Written test at the end of the practical laboratory classes consisting of a maximum of 20 test questions about the work done in the laboratory.

- These tests will havea weight of 4 and 6 points, out of 10, respectively. To pass this module the student must obtain at least 5 points in the written test.

To pass the subject the student must obtain a grade of 5 or higher in each module. Students who do not pass any of the written tests of the practical and methodology and problems modules will be able to retake them in the scheduled date for the assessment of the subject at the end of the semester. The re-assessment of the theory module will be done in a single written global test.

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 scoreof the course or module. Thus, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score.

Students wishing to improve their mark may present to an overall examination of the subject, which will include questions from all three modules. In this case, the presentation of the student in the re-assessment examination involves the renunciation of the qualification previously obtained. The date of the exam will be the same for the retake process.

From the second registration ofthe subject on, it will not be necessary for the student to carryout the laboratory practices module if he / she has achieved the competences of thispart of the subject in the previous course. This exemption will be maintained for a period of three additional registrations.

Single assessment

The single assessment 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 and 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 60% of the final grade of the subject and must be equal to or greater than 5. The single assessment will be done on the same day as the 2nd part of the subject.

The assessment of the laboratory practices and techniques and problems modules will follow the same process as the continuous assessment. The grade obtained will account for 20% of the final grade of the subject for each of the modules. The laboratory practices attendance is compulsory at all sessions. It is a requirement to have passed the laboratory practices and techniques and problems modules (grade 5 or higher) to take the single assessment test.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assessment of laboratory practices	20%	1	0.04	2, 4, 7, 9
Techniques and problems assessment	20%	1	0.04	2, 7
Theory assessment: Part 1	24%	2	0.08	8, 1, 2, 3, 6, 5
Theory assessment: Part 2	36%	2	0.08	8, 1, 2, 3, 6, 5

Bibliography

Text books:

Madigan, M.T., J.M. Martinko, K.S. Bender, D.H. Buckely, D.A. Stahl. 2015. Brock Biología de los Microorganismos. 14ª ed. Pearson Educación, S.A. ISBN:9788490352793.

Madigan MT, Bender KS Buckley DH, Sattley WM, Stahl DA (2021). Brock. Biology of microorganisms, 16ª ed., Pearson SA.

Martín A, Bejar V, Guitiérrez JC, Llagostera M, Quesada E. 2018. Microbiología Esencial. Panamericana. ISBN 9788498357868

Willey J., L. Sherwood, C.J. Woolverton. 2017. Prescott's Microbiology, 10th ed. McGraw-Hill Education. ISBN: 9781259669934.

Willey, J, LM Sherwood, CJ Woolverton. 2009. Microbiología de Prescott, Harley y Klein. 7ª ed. MacGraw-Hill-Interamericana de España.ISBN: 978-84-481-6827-8.

https://bibcercador.uab.cat/discovery/search?search_scope=CourseReserves&vid=34CSUC_UAB:VU1&query=c

Blogs:

Esos pequeños bichitos
http://weblogs.madrimasd.org/microbiologia/

Blog Small things considered
http://schaechter.asmblog.org/schaechter/

Webs:

http://www.microbeworld.org/
http://weblogs.madrimasd.org/microbiologia/archive/2007/12/23/81281.aspx
http://microbewiki.kenyon.edu/index.php/MicrobeWiki
http://serc.carleton.edu/microbelife/
http://web.mst.edu/~microbio/Bio221.html
http://curiosidadesdelamicrobiologia.blogspot.com/
http://weblogs.madrimasd.org/microbiologia/
http://www.topix.com/science/microbiology
http://microbiologybytes.wordpress.com/
http://www.cellsalive.com/
http://commtechlab.msu.edu/sites/dlc-me/
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Software

No specific software is needed in this subject