Microbiology

Code: 100875
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500252 Biochemistry	OB	1

Contact

Name: Jose Luis Corchero Nieto

Email: joseluis.corchero@uab.cat

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Although there is no official prerequisites, students are advised and encouraged to review the scientific-theoretical contents related to the concepts of the microbial world, studied beforehand and on which this subject is based.

It is convenient to have a good knowledge of the subjects already studied during the first semester of the first course of the Biochemistry degree, as well as of the subjects simultaneous studied during the second semester of the course.

Objectives and Contextualisation

Microbiology is a compulsory course/subject of the Biochemistry degree, which introduces students to the microbial world, giving a general view of the microorganisms, in connection with other organisms, and with the different environments in which microorganisms live.

This subject gives basic concepts and skills in Microbiology, so that the students can dig deeper in the following courses that form part of the nucleus of the Biochemistry degree.

Detailed objectives of the course

1 Recognize the huge microbial biodiversity and know how to distinguish the characteristics that define different microbial groups.

2 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 the prokaryote.

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

5 Recognize the main relationships of microorganisms with the other 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 current and future applications.

7 Know how to perform basic calculations to determine microbiological parameters.

8 Understand basic laboratory techniques to work with microorganisms.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Apply general laboratory security and operational standards and specific regulations for the manipulation of different biological systems.
- Be able to self-evaluate.
- Collaborate with other work colleagues.
- Describe the structural, physiological and biochemical characteristics of the different types of cells and explain how their properties fit in with their biological function.
- Integrate knowledge of biochemistry and molecular biology with that of microbiology and biochemical engineering, especially in their application to biotechnological processes.
- Integrate scientific and technological knowledge.
- Interpret experimental results and identify consistent and inconsistent elements.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Manage bibliographies and interpret the information in the main biological databases, and also know how to use basic ICT tools.
- Manage information and the organisation and planning of work.
- Read specialised texts both in English and one's own language.
- Stay abreast of new knowledge of the structure, organisation, expression, regulation and evolution of genes in living beings.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take responsibility for one's own learning after receiving general instructions.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Think in an integrated manner and approach problems from different perspectives.
- Use ICT for communication, information searching, data processing and calculations.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Be able to self-evaluate.
3. Collaborate with other work colleagues.
4. Define rules for the safe handling of microorganisms.
5. Describe the molecular, cellular and physiological bases of the organisation, functioning and integration of microorganisms.
6. Describe the principal techniques for using microorganisms and their structures and molecules in biotechnological processes.
7. Identify the genetic properties of microorganisms.
8. Identify the genetic, physiological and metabolic properties of microorganisms that can potentially be used in biotechnological processes.
9. Identify the physiological and metabolic characteristics of microorganisms.
10. Interpret experimental results and identify consistent and inconsistent elements.
11. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
12. Manage information and the organisation and planning of work.
13. Master the nomenclature of microorganisms.
14. Read specialised texts both in English and one's own language.

15. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
16. Take responsibility for one's own learning after receiving general instructions.
17. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
18. Think in an integrated manner and approach problems from different perspectives.
19. Use ICT for communication, information searching, data processing and calculations.

Content

I Theoretical topics

INTRODUCTION

Topic 1. The world of microorganisms.

The history of human societies and the microorganisms. Discover microorganisms. Cell organization levels. Main differences between viruses and cellular organisms. Prokaryotic and eukaryotic organization. Groups and names of microorganisms.

STRUCTURE AND FUNCTION OF THE PROKARYOTES

Topic 2. The prokaryotic cell. Size and morphology. The cytoplasm. The nuclear region. Cytoplasmic membrane.

Topic 3. Envelopes of the prokaryotic cell and motility. Structure and function of the cell wall. Capsules and mucosal capes. Main motility mechanisms.

Topic 4. Intracellular inclusion and forms of differentiation. Functional and storage inclusions. Endospores.

MICROBIAL GROWTH AND ITS CONTROL

Topic 5. The cellular cycle of the prokaryotes. Binary Fission. Cellular division and control. Diversity of prokaryotic cell cycle.

Topic 6. Microbial growth and continuous culture of microorganisms. Cellular growth and population growth. Influence of environmental factors on cell growth. Concepts of continuous culture of microorganisms.

Topic 7. Control of microbial growth by chemical agents. Antimicrobial agents. Differences between antiseptics, disinfectants and chemotherapeutic agents. Resistance to antimicrobial agents.

PHYSIOLOGY AND BACTERIAL METABOLISM

Topic 8. Global metabolic scheme. Sources of energy, carbon and reducing power. Biosynthetic strategy. Processes for obtaining energy. Types of microorganisms according to their nutrition. Lithotrophy, organotrophy and phototrophy. Autotrophy and heterotrophy.

Topic 9. Fermentation. General characteristics of a fermentation process. Final products and classification of fermentations. Fermentations without phosphorylation at substrate level.

Topic 10. Respiration. Respiratory chains. Aerobic respiration. Respiration of inorganic and organic compounds. Anaerobic respiration.

Topic 11. Photosynthesis. Pigments photosynthetic and organization of the photosynthetic apparatus. Photophosphorilation. Differences between oxygenic and anoxygenic photosynthesis.

BACTERIAL GENETICS

Topic 12. The prokaryote genome. Structure of the genome. Measure, topology and number of chromosomes. Extracromosomal genetic material: plasmids. Mobile elements: insertion sequences, transposons and integrons.

Topic 13. Genetic transfer mechanisms. Bacterial plasmids. Conjugation, transformation and transduction.

Topic 14. Mutagenesis. Spontaneous and induced mutations. Selection of mutants and phenotypic expression. DNA repair.

MICROBIAL DIVERSITY

Topic 15. Diversity of prokaryotes. Taxonomy of prokaryotes. Classical and molecular taxonomy. Concept of prokaryote species. Other taxonomic levels. Basis of phylogenetic organization. The origin of life and biological diversification. The big bacterial groups.

THE VIRUSES

Topic 16. Introductory view and general characteristics of the virus. Concept of virus. Structure of the virus. Viral replication. Principles of taxonomy and viral diversity.

EPIDEMIOLOGY AND MICROBIAL DISEASES

Topic 17. Relationship Host - Pathogen. Normal microbiota. Distribution of the microbiota. Mechanisms of microbial pathogenicity. Mechanisms of host defense. Adaptive or specific immunity mechanisms. Acquired active or passive immunity.

Topic 18. Microbial diseases. Epidemiology of microbial diseases. Human diseases caused by microorganisms. Chemotherapy and antimicrobials.

APPLIED MICROBIOLOGY

Topic 19. Microbiology for the food industry. Growth of microorganisms in food and its control. Diseases transmitted by food. Detection of pathogens transmitted by food.

Topic 20. Microbiology for the health industry. Industrial microorganisms and their products. Primary and secondary metabolites. Vitamin production, amino acids and antibiotics. Microbial biotransformations. Microbialenzymes as industrial products.

Topic 21. Biotechnology. Basic principles of biotechnology. Expressing cloned genes. Production of proteins in bacteria. Production of proteins in yeasts. Obtaining of vaccines by means of genetic engineering. Microbial biopolymers. Gene therapy in humans. Transgenic organisms.

II- Seminars and problems.

Topic 1. Microscopic techniques. Optical and electronic microscopy applied to microorganisms. Examination of microorganisms in vivo. Fixation and staining. Simple, differential and specific stains.

Topic 2. Microscopic observations. Analysis of microscopic images. Identification of morphologies and microbial structures.

Topic 3. Techniques of sterilization of microorganisms. Basic principles and different sterilization techniques.

Topic 4. Seeding and isolation techniques. Nutritional requirements of microorganisms. Composition of the culture media. Types of culture measures. Isolation of microorganisms. Seeding methods. Methods for the identification of microorganisms.

Topic 5. Basic microbiology problems. Experimental design. Concentrations calculation. Concepts of viable and total cells counting. Concept of viable but not cultivable microorganisms.

Topic 6. Problems related to growth and microbial control. Experimental design. Growth curve. Calculation of parameters. Survival rates to different treatments.

Topic 7. Basic virology problems. Virus counting. Virulent bacteria and temperature-regulated bacteria.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problems in class	15	0.6	19, 3, 4, 6, 12, 10, 14, 18, 16, 2
Theoretical classes	30	1.2	4, 5, 6, 13, 12, 9, 7, 8, 18
Type: Supervised			
Tutorial classes (individual or in groups)	4	0.16	19, 3, 12, 14, 18, 16
Type: Autonomous			
Individual study	60	2.4	19, 5, 6, 13, 12, 9, 7, 8, 14, 18, 16
Problems resolution	20	0.8	19, 3, 4, 6, 12, 10, 14, 18, 16, 2
Text reading	15	0.6	19, 3, 12, 10, 14, 18, 16, 2

The subject of Microbiology consists of two modules, which have been programmed in an integrated way so that the student will have to relate, throughout the whole course, the contents and the activities programmed for the course, and to achieve the skills indicated in section 5 of this guide.

The modules are as follows:

Theory classes: The student has to acquire the scientific-technical knowledge of this subject attending these classes and complementing them with personal study of the subjects.

At the beginning of the course, the student will be given a detailed calendar of the subjects to be dealt with throughout the course, as well as the bibliography that must be consulted to prepare each theoretical class and for personal study. Each topic will be based on a theoretical exposition and a short discussion of the material.

Problems and seminars: These classes are clearly active and participative sessions, with the

goal of: a) working on methodological aspects, b) enabling the student to design basic experiments of Microbiology and proposing experimental protocols, c) designing strategies to solve and interpret problems, d) to acquire the necessary skills to carry out bibliographic research, reading texts and public presentations, e) to facilitate the understanding of the knowledge exposed to the theoretical classes and f) to bridge the gap between the theoretical classes and practical laboratory work. The student will come up with proposals for problems and/or scientific cases that need to be analyzed and developed during the course both individually and in group. It is possible to program some oral and/or written presentation/exhibition.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evaluation of problems and seminars: Writen exam with 2 parts (seminars/presentations and problems)	30 % of final grade	1	0.04	19, 3, 4, 12, 10, 14, 18, 16, 2
Evaluation of seminar and problems. Oral exposition	10 % of final grade	1	0.04	1, 17, 15, 19, 3, 10, 11, 18, 16, 2
Evaluation of theoretical classes (questions multiple choice and/or shorts): 2 examns, 30% of final grade each.	60 % of final grade	4	0.16	1, 17, 15, 3, 5, 6, 13, 12, 9, 7, 8, 11, 14, 18

This course does not follow the "single evaluation" model. The assessment of the subject will be individual and continuous through the following tests:

Theoretical classes (60% of the overall grade).

During the course two partial written tests will be programmed. Each partial test will have a weight of 30% of the final grade of the course. The final note of this module will be the mean of the two proves. The student must achieve a minimum qualification of 5 in each test.

Those students who do not pass one or both of the written partial tests, or those students who wants to improve their grade, will have to attend to a final exam. The qualification obtained in this final exam will be used for the calculation of the final grade of this module.

Problem and seminar classes (40% of the overall grade).

The evaluation of this activity will be done separately:

- Resolution of questions related to seminars held in class, by means of a written test at the end of the course. Students who do not pass this seminar/problem assessment test may do so by attending a remedial test in the data programmed. This part will correspond to 15% of the overall grade. The student must achieve a minimum qualification of 5 in this test.

- Resolution of problems similar to those held in class, by means of a written test at the end of the course. Students who do not pass this seminar/problem assessment test may do so by attending a remedial test in the data programmed. This part will correspond to 15% of the overall grade. The student must achieve a minimum qualification of 5 in this test.

- Oral presentations of the group work. . Oral presentations will be evaluated with respect to the contents and organization of the presentation. This part will correspond to 10% of the overall grade. This activity is mandatory and will not have remedial test.

All the evaluation activities will be in Spanish. However, foreign students (eg. Erasmus students) can ask for English transllation.

To exceed the whole course, student must achieve a qualification of 5 or higher in EVERY module. To participate in the remedial tests, the student must have been previously assessed in a set of activities, the weight of which is equivalent to a minimum of two thirdparts of the total qualification of the course. If not, the student will obtain the qualification of "Not Appraisable"

Bibliography

Recomended bibliography

Madigan, M, JM Martinko, PV Dunlap, DP Clark. 2009. Brock Biología de los Microorganismos. 12ª ed. Prentice Hall.

Wiley, J, LM Sherwood, CJ Woolverton. 2008. Microbiología de Prescott, Harley y Klein. 7ª ed. MacGraw-Hill.ISBN: 978-8448168278.

Glazer, AN, H Nikaido. 2007. Microbial Biotechnology: Fundamentals of Applied Microbiology. 2ond edition. Cambridge University Press

Lee Yuan Kun. 2006. Microbial Biotechnology: Principles and Applications. 2ond edition. New Jersey. World Scientific

Jennifer Louten. 2016. Essential human virology. Elsevier Ed. ISBN: 978-0-12-800947-5

Other readings

De Kruif, P. 1926. Los cazadores de microbios. Ediciones Nueva Fénix

Blogs recomended

Esos pequeños bichitos

http://weblogs.madrimasd.org/microbiologia/

Blog *Small things considered*

http://schaechter.asmblog.org/schaechter/

Webs recomended

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/

http://commtechlab.msu.edu/sites/dlc-me/zoo/

http://www.microbiologia.com.ar/

Software

No especial software will be needed

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	311	Spanish	second semester	afternoon
(TE) Theory	31	Spanish	second semester	afternoon