

Microbiology

Code: 101953
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	FB	1	1

Contact

Name: José Antonio Domínguez Benítez
Email: JoseAntonio.Dominguez@uab.cat

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

Isidre Gibert González

Prerequisites

Although there are no official prerequisites, it would be better for students to be familiar with microbiology concepts and have a good knowledge of the other subjects that are studied simultaneously during the first semester.

Objectives and Contextualisation

The course is mandatory and core of the Degree of Genetics. It introduces the student into the microbial world, giving a general vision of the microorganisms, in connection with other higher organisms, including plants and animals, and also with the different environments where they live, including the relations established between microorganisms and humans.

This course offers the basic concepts and competencies in Microbiology so that the student can go more into depth in the Microbiology field in the following years.

Objectives of the Course:

1. To identify the different structures, and the composition of the prokaryotic cells.
2. To learn the metabolic versatility of the different groups of microorganisms.
3. To understand the microbial population growth, and how to control it by chemical and physical methods, including antimicrobials.
4. To learn about viruses: their main characteristics, their life cycle, their relation with the host and their diversity.
5. To study the genomic variability of the microorganisms, the main mechanism of exchange of genetic information between prokaryotes.

6. To identify the microbial diversity and to distinguish the main characteristics that defines each microbial group.

7. To study the relations between the microorganisms with other organisms, including plants and animals, and with the environment where they live, including the interaction with humans.

Skills

- Apply scientific method to problem solving.
- Be able to analyse and synthesise.
- Be able to communicate effectively, orally and in writing.
- Be sensitive to environmental, health and social matters.
- Develop self-directed learning.
- Reason critically.
- Recognise and structurally and functionally describe the different levels of biological organisation, from macromolecules to ecosystems.
- Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Learning outcomes

1. Apply scientific method to problem solving.
2. Be able to analyse and synthesise.
3. Be able to communicate effectively, orally and in writing.
4. Be sensitive to environmental, health and social matters.
5. Describe microbial populational dynamics and the physical and chemical processes that control them.
6. Develop self-directed learning.
7. Identify microbial metabolic diversity and its relationship with different groups of microorganisms.
8. Reason critically.
9. Recognise the diversity of the world of microbes and identify the main groups that it is composed of.
10. Relate the components and basic structures of microorganisms with their functions.
11. Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Content

THEORY CONTENTS

INTRODUCTION

Chapter 1. The microbial world.

The history and scope of microbiology. Discovering the microorganisms. Levels of organization. Differences between viruses and cellular organisms. Prokaryotic and eukaryotic organization. Groups and taxonomy of microorganisms.

PROKARYOTIC CELL: STRUCTURE AND FUNCTION

Chapter 2. The prokaryote cell.

Size and morphology. Cytoplasm. Nucleus. Cytoplasm membrane.

Chapter 3. Envelops of the prokaryotes and motility.

Structure and function of the cell wall. Capsule and mucous envelops. Main motility mechanisms.

Chapter 4. Intracellular inclusions and differentiation forms.

Functional inclusions and storage. Endospores. Filamentous and mycelium. Spores and cists. Fructiferous bodies.

FISIOLOGY AND BACTERIAL METABOLISM

Chapter 5. Metabolism.

Energy, Carbon and reduction power sources. Biosynthetic strategies. Energy caption. Groups of microorganisms according to their nutrition. Lithotrophy, organotrophy and Phototrophy. Autotrophy and heterotrophy.

Chapter 6. Respiration

Respiratory chains. Aerobic respiration. Inorganic, and facultative organic respiration. Anaerobic respiration.

Chapter 7. Fermentation.

General characteristics of fermentation. Final products and fermentation classification. Non-phosphorylation at substrate level fermentations. Syntrophism.

Chapter 8. Photosynthesis.

Photosynthetic pigments and photosynthetic systems organization. Photophosphorylation. Differences between anoxygenic and oxygenic photosynthesis.

MICROBIOAL GROWTH AND CONTROL

Chapter 9. The life cycle of prokaryotes.

Binary fission. Cellular division and control. Diversity in the cellular cycle in prokaryotes.

Chapter 10. Microbial growth and continuous culture of microorganisms.

Cellular growth and population growth. Interaction of the environmental factors in the growth. Microbial continuous culture concepts.

Chapter 11. Control of microbial growth by means of chemical agents.

Antimicrobials agents. Differences between antiseptics, disinfectants and chemotherapeutics agents. Antimicrobial resistance.

VIROLOGY

Chapter 12. Virus's morphology, structure and chemical composition.

Concept of viruses. Viral components: nucleic acids, enzymes and others. Envelope structure. Morphology: icosahedral, helix, mixed and complex symmetry. Techniques for viruses study.

Chapter 13. Relationship between viruses and the host cell.

Viral cycle: step growth. Adsorption and penetration. Replication of the genome. Replication. Assembly and release of the viruses. Potential effects of the viruses' multiplication in the host.

Chapter 14. Classification and viruses diversity.

Classification criteria. Nomenclature. Baltimore classification. Bacteriophages, animal and plant viruses. Other subcellular infectious agents.

BACTERIAL GENETICS

Chapter 15. The prokaryotes genome.

Genes structure. Size, topology and number of chromosomes. Extra-chromosomal material: plasmids. Transposable elements: insertion sequence, transposons and integrons.

Chapter 16. Mutagenic.

Spontaneous and induced mutations. Selection of mutants and phenotypic expression. DNA repairs.

Chapter 17. Conjugation.

Plasmid conjugation. The plasmid F. Hfr y F' Strains. Genome transference by means of the F plasmid. Construction of genetics maps by conjugation.

Chapter 18. Transformation.

Natural transformation. Status of competence and DNA incorporation. Plasmid transformation and transfection. Artificial transformation.

Chapter 19. Transduction and lysogeny.

Virulent and attenuated bacteriophages. Lytic and lysogenic cycles: regulation. General and specialized transduction.

DIVERSITY AND MICROBIAL ECOLOGY

Chapter 20. Prokaryote diversity.

Introduction to the prokaryote taxonomy. Classic and molecular taxonomy. Concept of prokaryote species. Other taxonomic levels. Phylogenetic organization. The life origin and the biological diversification. Archaea vs Eubacteria

Chapter 21. The microorganisms in the environment.

Extreme environments. The main extremophile microorganisms. Air, terrestrial and aquatic environment: main characteristics. Microambient concept. Surface colonization. Main groups of environmental microorganisms. Photosynthetic microorganisms.

Chapter 22. Trophic relations between microorganisms.

Intra and inter-population interactions. Competence and amensalism. Parasitism and predation. Commensalisms and mutualism. Microbial associations. Interactions with plants and animals. Main groups involved.

Chapter 23. Biogeochemical cycles.

The microorganisms as agents of geochemical changes. Main microorganisms involved in the biogeochemical cycles.

Chapter 24. Host-pathogen interaction.

Normal microbiome. Distribution of the microbiome. Microbial mechanism of pathogenicity. Main pathogens groups of microorganisms. Host defence mechanisms. Adaptive and specific immunity. Active and passive immunity.

PROBLEMS CONTENTS

Session 1. Techniques of microscopy. *In vivo* microorganism examination. Fixation and stain. Microscopic images analysis. Morphologies and microbial structures identification.

Session 2. Culture and isolation of bacteria. Nutritional requirements. Culture media composition. Types of culture media. Isolation and identification of bacteria.

Session 3. Bacterial Genetics problems resolution.

Session 4. Applied Microbiology problems resolution

Methodology

Methodology and learning activities

Two modules constitute the subject. The students will have to combine the learning activities scheduled in order to achieve the previous competences mentioned.

The two modules are the following:

Participative theory sessions: The students have to acquire the scientific and technological knowledge of the subject following the lectures, and expanding and confronting the main ideas of the topics autonomously as a personal work. At the beginning of the course the student will receive the calendar with the topics that we will be discussed, and also the references. The student should use this material to prepare the theory sessions. The professor using visual material will explain the content of different topics. An active participation of all students in the discussion of different topics will be promoted.

Problems sessions: These sessions will be conducted with a reduced number of students. The objectives are: a) to work methodological aspects; b) to facilitate the understanding of the knowledge explained in the theory sessions; c) to teach student how to integrate the knowledge and how to solve microbiological basic problems. We will do activities of learning based in projects. During the course the student will receive material with problems to solve, that will be solved during the course, both autonomously and in-group.

To follow adequately the course, the student will have access to the materials used in the sessions via Moodle.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Participative Theory Sessions	30	1.2	1, 5, 7, 8, 9, 10, 3, 2, 11
Problems Sessions	14	0.56	1, 5, 7, 8, 9, 10, 3, 2, 11
Type: Autonomous			
Individual study	50	2	1, 4, 5, 6, 7, 8, 9, 10, 2, 11
Reference search and individual reading	15	0.6	1, 6, 8, 2, 11
Solving problems	31	1.24	1, 4, 5, 6, 7, 8, 9, 10, 2, 11

Evaluation

The assessment of the subject will be individual and continuous, and done through different tests:

- Assessment of the theory and problems contents (50% and 20%, respectively, of the overall grade) by means a written test.

- Assessment of the individual and in-group activities (30% of the overall grade). The assessment of this part will be performed considering the problems solving and the individual and in-group activities.

During the course there will be two tests scheduled that will include theory contents and problems solving. The value of the two written test is of 35% of the final grade each. The individual and in-group activities will be performed during the entire course. In the following table the distribution of the grades is indicated.

Module	1er test	2nd test	Final grade
Theory contents	25	25	50
Problems contents	10	10	20

Individual and in group activities	30	30
Total	-	100

In order to pass the subject, the student must obtain at least a 5 in the final grade. The failed tests can be reassessed in a final exam. To pass the final exam students should obtain a minimum grade of 5. The students that have not attended the interim exams, or want to obtain a higher grade can reassess the entire subject in the final exam. The grades obtained during the course of those students who decide to take the reassessment exam in order to get a higher grade, will not be affected negatively in any case.

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

The students that cannot attend the reassessment test due to justified causes (disease, first degree relative death or accident) and present the corresponding official certification to the Degree Coordinator, will have the right to perform the test in another date. The Coordinator will be responsible for the new date decision together with the teacher responsible of the subject. On the other hand, according to the regulations of the UAB, those enrolled for the second time, will not have to do again the teaching activities, nor the assessments of the pass modules in previous years. This exemption will be valid for a period of three additional enrolments.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Individual and in-group activities	30%	2	0.08	1, 4, 6, 8, 3, 2, 11
Theory and problems contents (70% of the overall grade) by means a written test	35%	4	0.16	1, 4, 5, 6, 7, 8, 9, 10, 3, 2, 11
Theory and problems contents (70% of the overall grade) by means a written test	35%	4	0.16	1, 4, 5, 6, 7, 8, 9, 10, 3, 2, 11

Bibliography

Text Books:

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

- Michael T. Madigan. 2015. Brock. Biología de los microorganismos. 14a Ed. ISBN: 9788490352793. Pearson Educación, SA.

<http://pearson.es/espa%20B1a/catalogo/brock-biolog%20Da-de-los-microorganismos>

Resources in internet

Blogs

- Esos pequeños bichitos <http://weblogs.madrimasd.org/microbiologia/>
- 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/>

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

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