Universitat Autònoma de Barcelona

2020/2021

Microbiology

Code: 100953
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OB	2	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

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

Prerequisites

There are no official prerequisites to follow the course successfully, but it is assumed that the student has previously acquired basic knowledge on contents and concepts that refer to the microbial world, starting the course having revised them will prove useful.

It is also advisable to have a good knowledge of the subjects studied during the first year of the degree of biotechnology as well as the rest of the subjects to be studied simultaneously during the first semester.

Objectives and Contextualisation

Objectives and Contextualization:

> It is a compulsory subject of the degree of Biotechnology that introduces students to the microbial world, giving an overview of microorganisms in connection with other living beings and the different environments in which microorganisms live.
>
> This subject, given its introductory nature, gives the most basic concepts and competencies referred to Microbiology, so that students can deepen the following courses in the other subjects that are part of the core of Biotechnology.

Learning objectives of the course:

1. Identify the different structures, as well as the composition of the prokaryotic cell.
2. Know the metabolic versatility of the different microbial groups, particularly those of prokaryotes.
3. Understand the growth of microbial populations and how to control them with physical and chemical agents.
4. Know the genomic variability of the microorganisms and the main mechanisms of genetic transfer information in prokaryotes.
5. Recognize broadly the microbial diversity and know how to distinguish the characteristics that define the different microbial groups.
6. Recognize the main relationships of microorganisms with living organisms and the physical environment they inhabit.

7. Understand the role of microorganisms in the development of human societies, as well as their current and future applications.
8. Know how to perform basic calculations to determine microbiological parameters.
9. Understand basic laboratory techniques to work experimentally with microorganisms.

Competences

- Apply the principal techniques for the use of biological systems: recombinant DNA and cloning, cell cultures, manipulation of viruses, bacteria and animal and plant cells, immunological techniques, microscopy techniques, recombinant proteins and methods of separation and characterisation of biomolecules.
- Describe the molecular, cellular and physiological bases of the organisation, functioning and integration of living organisms in the framework of their application to biotechnological processes.
- Identify the genetic, physiological and metabolic properties of microorganisms with potential for application to biotechnological processes and the possibility of manipulating microorganisms.
- Interpret experimental results and identify consistent and inconsistent elements.
- Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English or in one's own language.
- Read specialised texts both in English and ones own language.
- Reason in a critical manner
- Search for and manage information from various sources.
- Think in an integrated manner and approach problems from different perspectives.
- Work individually and in teams

Learning Outcomes

1. Describe the molecular, cellular and physiological bases of the organisation, functioning and integration of microorganisms in the framework of their application to biotechnological processes.
2. Describe the principal techniques for using microorganisms and their structures and molecules in biotechnological processes.
3. Explain microbial metabolic diversity and identify the important processes for food production and processing.
4. Identify the genetic and metabolic potential of microorganisms in the generation of substances of industrial use or as insecticides.
5. Identify the microbial groups and the physiological processes responsible for industrial transformation processes.
6. Interpret experimental results and identify consistent and inconsistent elements.
7. Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English or in one's own language.
8. Read specialised texts both in English and ones own language.
9. Reason in a critical manner
10. Search for and manage information from various sources.
11. Think in an integrated manner and approach problems from different perspectives.
12. Work individually and in teams

Content

I. Theory*

1. INTROCUDCTION

Lesson 1: The world of microorganisms

The history of human societies and microorganisms. Discovering microorganisms. Organization levels. Main differences between virus and cellular organisms. Prokaryotic and eukaryotic organization. Groups of microorganisms and nomenclature.

2. THE VIRUSES

Lesson 2: Introductory overview and general characteristics of viruses

Concept of virus. Structure of viral particles. Viral replication. Taxonomy principles and virus diversity.

3. STRUCTURES AND FUNCTION OF PROKARIOTES

Lesson 3: Prokaryotic cells

Size and morphology. Cytoplasm. Nuclear region. Cytoplasm membrane. Nutrient transport and transport systems.

Lesson 4: Prokaryotic cell envelopes

Structure and function of the cell wall. Capsules and mucous layers.

Lesson 5: Flagella and main motility mechanisms

Flagella. Main motility mechanisms. Microbial taxa.

Lesson 6: Intracellular inclusions and differentiation mechanisms

Functional and storage inclusions. Endospores.

4. BACTERIAL GENETICS

Lesson 7: Prokaryotic genome

Genome structure. Genetic information. Types of genetic elements. Prokaryotic chromosome. DNA replication and transcription. RNA translation. Extrachromosomal genetic material: bacterial plasmids. Mobile elements: insertion sequences and transposons.

Lesson 8. Mutagenesis

Spontaneous and induced mutations. Selection of mutants and phenotypic expression. The meaning of DNA repair mechanisms.

Lesson 9: Genetic transfer mechanisms

Conjugation, transformation and transduction.

5. MICROBIAL GROWTH AND CONTROL

Lesson 10: Cell cycle in prokaryotic cells

Binary fission. Cellular division and control. Diversity of cell cycles in prokaryotic organisms.

Lesson 11: Microbial growth and continuous culture of microorganisms

Cell growth and bacterial population growth. Concepts of continuous culture of microorganisms.

Lesson 12: Influence of environmental factors on microbial growth

Influence of temperature, pH, osmotic effects, oxygen concentration and pressure on microbial growth.

Lesson 13: Microbial growth control using physical and chemical agents

Antimicrobial agents. Difference between antiseptics, disinfectants and chemotherapeutic agents.Resistance to antimicrobial agents.

6. BACTERIAL PHYSIOLOGY AND METABOLISM

Lesson 14: Global metabolism outline

Sources of energy, carbon and reducing power. Biosynthetic strategy. Processes to obtain energy Chemiotrophy and phototrophy. Autotrophy and heterotrophy. Types of microorganisms according to their nutrition. CO_2 fixing pathways. Degradation of organic compounds. Fixation of nitrogen.

Lesson 15: Respiration

Respiratory chains. Aerobic respiration. Respiration of inorganic and organic compounds by facultative organisms. Anaerobic respiration.

Lesson 16: Fermentation

General characteristics of fermentation processes. Final products and classification of fermentation processes. Fermentations without phosphorilation at the substrate level. Syntrophy.

Lesson 17: Chemiolitotrophy

Inorganic energy donors. Inverse flow of electrons. Examples of chemilithotrophy groups.

Lesson 18: Phototrophy

Photosynthetic pigments and organization of the photosyntheticapparatus. Photophosphorylation. Differences between anoxygenic and oxygenic photosynthesis.

7. MICROBIAL DIVERSITY

Lesson 19: Prokaryote diversity

The origin of life and biological diversification. Introduction to prokaryotic taxonomy and phylogeny. Other taxonomy levels. Concept of species in prokaryotic organisms. Phylogenetic organization basis. Main groups: Archaea, Gram-negative proteobacteria, Gram-negative non-proteobacteria, Gram-positive bacteria and mycoplasmas.

Lesson 20. ***Archaea***

Differential characteristics. Phylum *Euryarchaeota*: methanogens, extreme halophiles and hyperthermophils. Phylum *Crenarchaeota*: hyperthermophiles and others.

Lesson 21. Gram-negative bacteria I

Taxonomic groups of proteobacteria. Differential characteristics and examples.

Lesson 22. Gram-negative bacteria II

Taxonomic groups of non-proteobacteria. Differential characteristics and examples.

Unit 23. Gram-positive bacteria and mycoplasmas

Phyla *Firmicutes*, *Tenericutes* and *Actinobacteria*.

8. APPLIED MICROBIOLOGY

Lesson 24: Microbiology in the food industry

Microbial growth in food. Food decomposition. Control of food decomposition. Food-transmitted diseases. Pathogen detection in food.

Lesson 25: Microbiology in the healthcare industry

Industrial microorganisms and their products. Primary and secondary metabolites. Vitamin, amino acid and antibiotic production. Microbial biotransformations. Microbial enzymes as industrial products.

Lesson 26: Biotechnology

Basic principles of biotechnology. Genetic engineering products. Expression of cloned genes. Protein production in bacteria. Protein production in yeast. Obtaining vaccines using genetic engineering. Microbial biopolymers. Gene therapy in humans. Transgenic organisms.

*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

II. Problems*

Lesson 1. Microscopic technique

Optical and electron microscopy applied to microorganisms. In vivo microorganisms examination. Fixing and staining (simple, differential and specific staining).

Lesson 2. Seeding and isolation techniques

Nutritional requirements of microorganisms. Culture medium composition. Types of culture mediums. Microorganism isolation. Seed techniques. Identification methods.

Lesson 3. Problems on basic microbiology

Experimental design. Concentration calculus. Concept of viable and total counting. Concept of viable but unculturable microorganisms.

Lesson 4. Problems about growth and microbial control

Experimental design. Growth curves and parameter calculation. Growth curves of survival to different treatments.

Lesson 5. Problems about basic virology

Counting viral particles. Virulent and temperate bacteriophages.

Presentation, assessment, resolution, individual and/or collective critical discussion and presentation of proposed problems.

Introduction to active learning activities, definition of key ideas, assessment and group activity presentations.

*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

The subject of Microbiology consists of three modules, which have been programmed in an integrated way to reach the competencies indicated in section 5 of this guide.*

The modules are as follows:

Participatory classroom lectures: Lectures will address the main ideas of the different topics. Students should expand and confront autonomously as a personal work. At the beginning of the course the content of the different topics will be explained by the professor, as well as the bibliography that should be consulted to prepare each theory lecture and for personal study of the topics explained.

Scientific problem seminars: These seminars are sessions with the mission of: a) working methodological aspects, b) training the student to design basic microbiology experiments and to propose experimental approaches, c) designing strategies for solving and interpreting scientific problems, d) acquiring the skills necessary to perform literature research, text reading and oral presentations, e) to facilitate the understanding of the knowledge presented in the theory lectures and f) to bridge the gap between theory lectures and laboratory practices, with the objective of integrating the theoretical and the practical knowledge. The student will receive proposals for problems and/or scientific cases that will be developed during the course in class both individually and in a group.

Active learning activities: These activities are sessions with the mission of: a) facilitating the understanding of the knowledge presented in the theory lectures, b) acquiring the necessary skills to perform literature research, text reading and active self-study learning and c) encourage cooperative teamwork, coordination of activities and rational presentation of work plans and results. The student will perform oral, written and/or visual presentation of an issue, activity or scientific case. The professor will indicate the bibliography to be consulted and the relationship of each session with the topics discussed in the theory lectures.

Additional Information

In those sessions, students will have the opportunity to have individual guidance according to their needs.

*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Active learning activities and scientific problems seminars	15	0.6	10, 1, 3, 7, 4, 5, 6, 8, 11, 9, 12, 2
Lectures	30	1.2	1, 3, 4, 5, 2
Type: Supervised			
Personal tutorial duidance sessions	3	0.12	10, 1, 3, 7, 4, 5, 6, 8, 11, 9, 12, 2
Type: Autonomous			
Literature search, text reading	24	0.96	10, 7, 8, 11, 9, 12
Personal study	50	2	10, 1, 3, 4, 5, 6, 8, 11, 9, 12, 2
Scientific problem resolution	20	0.8	10, 1, 3, 7, 4, 5, 6, 8, 11, 9, 12, 2

Assessment

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

Evaluation of classroom lectures competencies

During the course two midterm exams will be scheduled. Each midterm exam will have a weight of 30% of the overall grade. The final mark of this evaluation form will be average of the two midterm exams. To pass each midterm exam, to eliminate the corresponding part of the theoretical subject and make average, students must achieve a minimum mark of 3.5 in each exam. If the average of the midterm exams is equal to or greater than 5 students will not have to do the final exam (or Remedial exam) of the subject. In the case of obtaining a lower mark of 3.5 in one or both midterm exams, students will be presented at the Final exam (or Remedial exam) on the date scheduled for the final evaluation of the course.

Evaluation of scientific problem and seminars

The evaluation of this activity will be done separately from evaluation of classroom lectures competencies considering the seminars and the resolution of problems and will consist of a written exam at the end of the course that will have a weight of 20% of the overall grade. Students who fail the evaluation of scientific problems and seminars can retrieve it on the date scheduled for the final exam of the course.

Evaluation of active learning activities

This activity is assessed separately from evaluation of classroom lectures competencies and seminars and scientific problems evaluation considering oral presentations of the proposed activities and will have a weight of 20% of the final mark. Students will present the reports ofthe assigned active learning activitiesin classroom sessions. Oral presentations will be evaluated oncontent, organization and communicative skills. Students who fail the evaluation of the group activities can retrieve the active learning activities onthe date scheduled for the final exam of the course.

To pass the course, students must obtain a mark of 5 or greater than 5 in each module.

Students who do not pass any of the written and/or oral tests may retrieve them at the scheduled date at the end of the semester. Likewise, on the same date, students who have passed the subject and want to improve their mark may submit to a global examination of the subject, which will include questions from the three evaluation modules. The presentation of the student to the examination of improvement of note implies the renunciation of the qualification obtained previously.

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 weighthin of all conducted evaluation activities is less than 67% of the final score.

*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evaluation public oral presentations of reports	20 %	2	0.08	10, 1, 3, 7, 4, 5, 6, 8, 11, 9, 12, 2
Evaluation scientific problems and seminars	20%	2	0.08	10, 6, 8, 11, 9, 12
Evaluation theory I	30 %	2	0.08	10, 1, 3, 4, 5, 6, 8, 11, 9, 12, 2
Evaluation theory II	30%	2	0.08	10, 1, 3, 4, 5, 6, 8, 11, 9, 12, 2

Bibliography

Textbooks

Martín A., Béjar V., Gutierrez J.C., Llagostera M. y Quesada E. 2019. Microbiología Esencial. 1ª edición. Editorial Médica Panamericana. ISBN: 9788491102427 (en línia)

Madigan, M, KS Bender, DH Buckely, WM Sattley, DA Stahl. 2019. Brock Biology of Microorganisms: Pearson Education Limited. ISBN: 9781292235103 (paperback)

Madigan, M, JM Martinko, K. Bender, D. Buckely, DA Stahl. 2015. Brock Biología de los Microorganismos [Recurs electrònic]. 14ª ed. Pearson. ISBN: 9788490352793

Willey,J, LM Sherwood, CJ Woolverton. 2013. Prescott, Harley y Klein microbiología [Recurs electrònic]. McGraw-Hil. ISBN: 9788448191207

Willey, J, LM Sherwood, CJ Woolverton. 2016. Prescott's microbiology. McGraw-Hil. ISBN: 9781259281594

Wiley, J, LM Sherwood, CJ Woolverton. 2009. 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. ISBN: 9780521842105 (cart.)

Lee Yuan Kun. 2006. Microbial Biotechnology: Principles and Applications. 2ond edition. New Jersey. World Scientific. ISBN: 9789814366816 (cart.)

Recommended readings

De Kruif, P. 1926. Los cazadores de microbios. Ediciones Nueva Fénix. ISBN: 9789700768045

Recommended blogs

Esos pequeños bichitos

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

Blog *Small things considered*

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

Recommended websites

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/