COURSE DATA

Data Subject	
Code	33130
Name	Microbiology
Cycle	Grade
ECTS Credits	9.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1109 - Degree in Biochemistry and Biomedical Sciences	Faculty of Biological Sciences	3	Annual

Subject-matter

Degree	Subject-matter	Character
1109 - Degree in Biochemistry and Biomedical Sciences	6 - Microbiología	Obligatory

Coordination

Name	Department
AMARO GONZALEZ, CARMEN	275 - Microbiology and Ecology
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SUMMARY

The Microbiology is the science that studies microorganisms, a large group of organisms including either prokaryotes (domains Archaea and Bacteria) or eukaryotes (domain Eukarya). Eukaryotic microbes are in the kingdom Protista (protozoa and algae) and Fungi (yeast, filamentous fungi). In addition, microbiology also includes the study of the viruses. Thus, the material which forms the subject of study of microbiology is extremely large, in fact it is estimated that the biosphere contains between 10^{30} and 10^{31} microbial genomes.
This multitude of microorganisms plays a central role in all life on Earth. Although they are the smallest life forms, together constitute the largest biomass on the planet and made many chemical processes that are needed for other organisms. Microbes control the overall use of nitrogen, lead the biogeochemical cycles of sulfur, iron and manganese, and intervene decisively in others, such as carbon. Microorganisms regulate the composition of the atmosphere, influence climate, recycle nutrients and break down pollutants. They take all possible habitats and others almost impossible for life on our planet. Without microbes, multicellular life on our planet did not evolved, and life as we know would not have been

possible. In the human body there is about 10 times as many bacterial cells as human cells, so in large part "we are bacteria." There are also other microorganisms, pathogens, that colonize, invade and damage to animals (including of course humans) and plants. In fact, diseases caused by microorganisms remain a high percentage of illness, sometimes fatal, of man and animals.
As a basic biological science, microbiology provides and develops tools to investigate fundamental processes of life. Microorganisms can be cultured in the laboratory to obtain very high population densities, which makes them excellent models for understanding cellular processes. As applied biological science, microbiology deals with many important practical issues in medicine, agriculture and industry.
Thus, the Microbiology of 3rd year Bachelor's Degree in Biochemistry and Biomedical Sciences includes 22 topics. The development of these topics will allow the students to acquire basic knowledge about the diversity, structure, function, metabolism, growth, genetics and systematic of microorganisms, mainly prokaryotes. Also included are topics to learn about the different groups of viruses, its structural elements and their interactions with the cells they parasitize. Finally, given the characteristics of the Degree, an important part of the course is devoted to clinical microbiology, with topics to be studied pathogens, virulence factors, control and epidemiology.
Besides the theoretical part, the practice is essential in learning Microbiology, because the acquisition of skills are what really make the student fully develop their profession. Thus, the theoretical agenda is completed with practices developed in 16 sessions of 2 hours each, that introduce students to the microbiology laboratory and complement the theory taught.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

OUTCOMES

1101 - Degree in Biochemistry and Biomedical Sciences

- Distinguir e identificar los distintos tipos de microorganismos, situándolos en el contexto de los seres vivos.
- Conocer la biología de los microorganismos en sus aspectos estructurales, metabólicos, genéticos, ecológicos, taxonómicos, evolutivos y aplicados.
- Conocer los campos de aplicación y la proyección social presente y futura de la microbiología.
- Comprender las bases teóricas de los métodos microbiológicos y adquirir las habilidades manuales necesarias para el correcto manejo de los materiales e instrumental propios de la microbiología.
- Conocer las fuentes documentales de la microbiología, con especial atención a los textos básicos y también a las fuentes accesibles mediante redes informáticas.

LEARNING OUTCOMES

- Distinguish and identify the different types of microorganisms, placing them in the context of living beings.

- Know the biology of microorganisms in their structural, metabolic, genetic, ecological, taxonomic, evolutionary and applied aspects.

- Know the fields of application and the present and future social projection of microbiology.

- Understand the theoretical bases of microbiological methods and acquire the necessary manual skills for the correct handling of microbiology materials and instruments.

- Know the documentary sources of microbiology, with special attention to the basic texts and also to the sources accessible through computer networks.

DESCRIPTION OF CONTENTS

1. Introduction. concept of Microbiology and historical development

The aim is that students acquire the concept of microorganism, and recognizes the types of living that encompasses this concept, that get an overview of the development of microbiology, together with its importance in biology.
Item 1. Concept of Microbiology. Historical development. The primary divisions between microorganisms: historical approach. Basic differences between microorganisms: viruses, bacteria, fungi and protists

2. Prokaryotic cell structure and function

In this thematic unit, students will learn about the complexity of the prokaryotic cell, for which the major prokaryotic structures are outlined, establishing the differences found in bacteria and archaea. Also, we will study the functions related to each component or cellular structure. This block is divided into 4 thematic areas in which the grouping of different cell structures is based on their functions in the cell (protection, mobility, latency, adhesion, reservation) and ends with a theme (Item 5) which introduces the complexity of life cycles of some bacteria.
Item 2. Prokaryotic cell: shape and size. Cytoplasmic membrane: functions of the prokaryotic membrane. Bacterial cell wall: structure, composition and biosynthesis. Wall growth and agents that affected it. Gram negative wall. Gram-positive wall. Mycobacteria wall. secretion systems. Adherence structures: capsules, fimbriae.
Item 3. Bacterial cytoplasm. Reserve materials and other cytoplasmic inclusions. Ribosomes. Nucleoid and plasmids. Bacterial endospores: formation, germination and regulation of the process
Item 4. Structures related to mobility. Bacterial flagella: structure and mobility mechanism. spirochete mobility. Gliding mobility. Other structures related to mobility: gas vacuoles and magnetosomes. Tactisms: molecular bases. Regulation by two-component systems. Biofilms.
Item 5. Archaea. Types. Differences from bacteria. Habitats. Importance

3. Microbial growth and effects of environmental factors

This unit describes the growth of microbial populations and parameters that define it (Item 6). It also analyzes the influence of physicochemical parameters in the distribution of microbial populations and adaptations of these populations to extreme environments (Item 7).

Item 6. Structural and/or functional differentiation in prokaryotes. Unicellular bacteria: growth and division, processes involved. Filamentous and mycelial bacteria. Representative life cycles. Signal perception. Microbial growth: basic parameters. Growth curve in closed environments: phases. Growth as a function of nutrient concentration. Continuous cultivation. Chemostat
Item 7. Influence of physicochemical factors on microbial growth. Temperature. Water activity. pH. Oxygen and radiation. Extreme environments. Organic and inorganic inhibitors of microbial growth. Antiseptics and disinfectants.

4. Microbial nutrition and metabolism

This block consists of 3 subjects whose contents allow introducing students to the variety of physiological types or trophic modalities present in bacteria. In addition, this unit establish the differential basis among the various metabolic processes of energy generation, both common to bacteria and other living and those unique to bacteria (such as anaerobic photosynthesis or chemolithotrophy).

Item 8. Principles of microbial nutrition and culture. Nutritional categories. Media design and culture conditions. Microbial metabolism: flow of energy reducing power and precursor metabolites.
Item 9. Obtaining carbon: degradation pathways. Obtaining energy: aerobic and anaerobic respiration: methanogenesis. Obtaining energy: fermentations

Item 10. Replenishment reactions in autotrophs. Generation of precursor metabolites: diversity of autotrophic pathways. ATP generation and reducing power in photoautotrophs: oxygenic and anoxygenic photosynthesis. Bacterial rhodospsins. ATP generation and reducing power in chemolithotrophs

5. Prokaryotic diversity

The thematic unit 5 contains a single item (Item 11), which treats on classification of microorganisms, their taxonomy and phylogeny, including methods for both types of analysis. Besides the prokaryotic diversity is studied.
Item 11. Microbial evolution and systematics. Functional diversity of bacteria (some groups): phototrophs; nitrogen and iron cycle bacteria; predatory and bioluminescent bacteria; pathogens; antibiotic producers. Functional diversity of archaea (some groups); Euryarchaeota; Chrenarchaeota. Evolution and life at high temperatures..

6. Genetics and virology

Theme block 6 consists of three topics. Topic 12 describes the main mechanisms of horizontal gene transfer in prokaryotes and their importance in the evolution of pathogens. Topics 13 and 14 are devoted to viruses. Topic 13 deals with generalities about viruses and topic 14 deals with the life cycles of the main bacterial and human viruses, in the latter case relating them to the diseases they cause.
Gene transfer in prokaryotes: types and mobile genetic elements (MGEs); transformation, transduction and conjugation. Importance of MGE in the evolution of pathogens. Mechanisms that preserve genome integrity in prokaryotes: membrane, wall and cytoplasmic defences.
Nature of viruses: What is a virus? Virion structure. Genome and evolution. Virus culture, detection and enumeration. General information on viral life cycles.
Topic 14. Phages: receptors, entry and consequences of infection; DNA phages; RNA phages. Animal viruses: consequences of infection with an animal virus: DNA viruses; RNA viruses; reverse transcriptase viruses; viroids and prions.

7. Microbial diseases. Diagnostic, control and epidemiology

Block 7 deals with pathogen-host relationships leading to disease, the microbiome and the treatment of infectious diseases. Topic 15 focuses on the human microbiome and diseases caused by dysbiosis and describes the mechanisms of microbial pathogenesis. Topic 16 deals with antimicrobials and resistance. Topic 17 introduces the science of epidemiology and the following topics deal with the main diseases caused by viruses, bacteria and fungi.
Topic 15. Human microbiome: Microbiota. Diseases caused by dysbiosis. Modulation: antibiotics, probiotics and prebiotics. Infection and pathogenesis: adhesion; multiplication and invasion and tissue damage.
Topic 16. Antimicrobials. Definition and types. Characteristics and spectrum of action. Antibacterial agents: antibiotics; types by target of action and resistance; genesis and transfer of resistance; superbacteria and new antibacterials; alternative therapies. Antifungal agents. Antiviral agents.
Topic 17. Epidemiology and Public Health. Concepts. Transmission and reservoirs. Host community and herd immunity. Characteristics of epidemic diseases. Global diseases. Emerging diseases. Bioterrorism.
Topic 18. Viral diseases. Airborne: measles, rubella and varicella-zoster; common cold; influenza; contact and other routes; hepatitis; Ebola; STD; HIV. By animals; rabies. By vector: yellow fever and dengue fever.
Topic 19. Bacterial diseases. Airborne: diphtheria and pertussis; tuberculosis; meningitis. By contact: leprosy; STD; gonorrhea; syphilis. Soil-associated: anthrax. Water- and food-associated: cholera.
Topic 20. Parasitic and fungal diseases. Pathogenic fungi, diseases and treatments: mycosis. Gastrointestinal parasitic diseases: amebiasis and giardiasis. Blood and internal tissues: malaria or malaria.

8. Laboratory of Microbiology

In this thematic unit the practices that will develop over 8 weeks at two weekly sessions of 2 hours, are detailed. The contents of the practices detailed below, introduce students to the microbiology laboratory and complement the theory taught.
Practice 1. Standards of work in the microbiology laboratory. Sterilization methods.
Practice 2. Management of microorganisms under aseptic conditions. Inoculation techniques.
Practice 3. Obtaining microbial pure cultures. Colonial growth characteristics.
Practice 4. Nutrition and microbial cultures: types of culture media according to their nutritional and physical-chemical properties.
Practice 5. Cultivation of bacteria and fungi. Selective and differential media.
Practice 6. Visualization of microorganisms with light microscopy. Simple and differential stains (Gram, spores, acid-resistance).
Practice 7. Total counts and viable microorganisms: microscopic counting on camera, by extension plate count, counts by membrane filtration.
Practice 8. Cultivation and enumeration of bacteriophages.
Practice 9. Antimicrobial susceptibility testing.
Practice 10. Detection of microbial activity: extracellular enzymes, oxidative and fermentative activity on carbohydrate fermentation routes.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	56,00	100
Laboratory practices	32,00	100
Tutorials	2,00	100
Attendance at events and external activities	3,00	0
Development of group work	8,00	0
Study and independent work	100,00	0
Readings supplementary material	8,00	0
Preparing lectures	8,00	0
Preparation of practical classes and problem	8,00	0
TOTAL	**225,00**	

TEACHING METHODOLOGY

The development of the course is divided into:
Theory classes: A total of 49 one hour- sessions are needed to cover this facet of teaching. In these sessions the lecture will be used basically. The teacher will present the most relevant contents for the subject, using audiovisual equipment for agile development and consistent application of them. The teacher will available early enough in the platform supporting the virtual classroom teaching, the material necessary for proper monitoring of the lectures.

Critical analysis of scientific papers selected by the teachers. This activity aims at training the student in reading scientific papers (which necessarily involves technical reading in English) about the original literature from which we obtain new knowledge that allows the development and advancement of biomedical sciences. This activity is mandatory, will be organized jointly with the other subjects in their third year, corresponding to each subject 3 to 6 items, by number of credits. The preparation, presentation and discussion (30 minutes) of the items are held in groups of 2 students and will be supervised by the teacher through tutoring.
Hands-on lab: Sixteen laboratory practice sessions for eight weeks to develop, to implement the above internship program, after reading the booklet of practice, facilitated by the teacher before. Attendance at practical sessions is mandatory for all students and failure to attend sessions two or more disabled students to overcome that part of the course. Faults, up to a maximum of three, must be adequately justified. During the practice sessions, teachers perform a continuous assessment of the skills acquired by students, so the failure to attend three or more practice sessions require the student to make an additional practical examination in the laboratory, which must be approved to pass the subject.
Tutorials: One tutorial group focused on the resolution of practical cases and / or problems that require applying the knowledge acquired. The number and amount of personal tutoring that students want to ask, in agreement with the teacher.

EVALUATION

The numerical grade of knowledge and skills acquired will be set from methods that allow objective and comparable measure, with record results, which means the rating of written evidence and, where appropriate, of work produced by the student.

There will be two mid-term exams at the end of each term and it will be necessary to obtain an average of 5.0 between the two mid-term exams to pass the theoretical part of the course.

- Class attendance teacher: optional

- The theory grade may be increased by up to 10% depending on the completion of extra tasks proposed by the teacher.

PRACTICES: 30 out of 100.
- Mandatory attendance: entitles review (at least 14/16 sessions).
- Practical exam: 30 points (minimum 15 points: the assessment of practice has been to overcome it alone in the theory).

- The practice grade may be increased by up to 10% depending on the completion of extra tasks proposed by the teacher.

CRITICAL ANALYSIS OF SCIENTIFIC PAPERS: 5 out of 100
- Mandatory attendance
- For the evaluation of this activity will take into account the following evaluation criteria: knowledge and understanding of the information contained in the articles, the correct use of terminology and speaking skills. You can also valued integration with other theoretical and practical content of this or other subjects of the degree. We could get a maximum score of 10 points, 5 points still needed to overcome this activity. The score represents 10% of the final grade for each of the subjects in their third year participating in this activity. If the student does not reach the minimum score required, it shall suspend the subject in which

such activities. Likewise, the participation of other students in the presentation and discussion sessions may be taken into account by the teacher to modulate the final grade for the course.

To pass the course will be essential to attend the practical classes.

- After passing each of the above parts of the evaluation, the grade obtained will be kept until the second round (July) if any of the other parties were not exceeded in the first call. There will, therefore, a review of theory and a practice exam on second call.
- Students in second registration (repeaters), they have made the minimum number of practice sessions in the course immediately above may, if they decide not to attend the contact sessions in the laboratory, and may retain the grade of the road test they had approved, as long as you credit the teacher in charge of last year. Such accreditation should be submitted during the month of February of the current course. The rest of assessable activities of the subject (theory testing) should be performed in its entirety

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  Presenta una visión más condensada y generalista del mundo microbiano que los anteriores. El texto trata con menor detalle ciertos apartados que en los anteriores son desarrollados en extenso, pero ofrece la información esencial del mundo microbiano de un modo excelente. Hay traducción al catalán.

Additional

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  SINGLETON, P. & D. SAINSBURY. (2001). Dictionary of Microbiology and Molecular Biology. 3rd ed. Wiley.
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