COURSE DATA

Data Subject	
Code	33130
Name	Microbiology
Cycle	Grade
ECTS Credits	9.0
Academic year	2021 - 2022

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
MATEO TOLOSA, JOSE JUAN	275 - Microbiology and Ecology

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

Knowledge and understanding of the biology of organisms in their structural, metabolic, genetic, ecological, taxonomic, evolutionary and applied aspects.
Performing practical work involving problem solving, data analysis and critical interpretation.
Preparation and presentation of individual as well as short seminars in small groups involving oral presentation and defense of them.

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: structure and composition in archaea and bacteria. Membrane-associated functions in prokaryotes. Pits and compartments
Item 3. Cell wall of bacteria and archaea. Structural and chemical differences between bacteria. Murein or peptidoglycan: structure, composition and biosynthesis. Wall growth and agents that affect it. Gram-negative wall. Gram-positive wall. Functional differences between the groups. Wall of mycobacteria. Walls of archaea.
Item 4. Structures related to mobility. Bacterial flagella: structure and mechanism of mobility. Tactism: molecular basis. Mobility of spirochetes. Gliding mobility. Other structures related to mobility, gas vacuoles and magnetosomes. Adhesion structures: capsule, fimbriae. Reserve materials and other cytoplasmic inclusions.
Item 5. Structural differentiation and / or functional in prokaryotes. Unicellular bacteria: cell growth and division, processes involved. Mycelial and filamentous bacteria. Alternation of cell states: bacterial endospores. Representative life cycles.

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. Microbial growth: basic parameters. Real growth curve of a population in closed environment: stages. Growth in terms of nutrient concentration, yield and maintenance energy. Continuous culture: definition and parameters. Chemostats.
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. Fueling reactions in aerobic and anaerobic heterotrophs. Anaerobic respirations and fermentations. Methanogenesis
Item 10. Fueling reactions in autotrophs. Generation of precursor metabolites: autotrophic route diversity. Generation of ATP and reducing power in chemolithotrophic and autotrophic: anoxygenic

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. The classification of microorganisms, inherent problems. Nomenclature. Identification. Prokaryotic diversity. Archaea: general features and major groups. Bacteria : major groups.

6. Genetics and virology

Block 6 consists of 3 items, which aims to provide the basic ideas of the mechanisms involved in the exchange of genetic information between organisms (Item 12). The study of Virology is divided into two topics, first issue (item 13) treat of general concepts of virus structural components and classification. The rest of Virology concepts are distributed among the three basic types of potential hosts, bacterial viruses (bacteriophages, item 13), plants and animals (Item 14). Item 14 explains the possible mechanisms of virus entry to the eukaryotic cell, the proliferation pathways and the effects on the host. Also explains certain models of interest, especially those that affect humans and other infectious acellular elements.

Item 12. Genetic differences between prokaryotes and eukaryotes, genome organization in prokaryotes. Horizontal transfer of genetic information in prokaryotes: transformation, conjugation and transduction.
Item 13. Viruses: structure and types. Detection and enumeration of virus. Kinetics of virus multiplication. Bacteriophages: general features and major groups. Lytic cycle and lysogenic cycle.
Item 14. Eukaryotic viruses. Consequences of viral infection in animal cells. General characteristics of major groups. Other acellular infectious agents.

7. Microbial diseases. Diagnostic, control and epidemiology

The thematic section 7 is devoted to the study of microbial diseases, control and distribution. This block develop the concepts of infection and disease, pathogenic mechanisms and modes of transmission. Here are the main chemotherapeutic agents and the mechanisms of resistance to them. The identification of infectious agents are also addressed and the last 4 items are devoted to the study of the major human infectious diseases, grouped by the type of causative organism)as well as to basic epidemiology.
Item 15. Host-parasite relationships. Human microbiota. Pathogenesis and virulence: virulence factors. Adhesion, colonization, invasiveness. Microbial interaction with host defenses. Toxins.
Item 16. Chemotherapeutic agents: antibiotics and synthetic chemotherapics. Mechanisms of action. Mechanisms of antimicrobial resistance. Immunotherapies.
Item 17. Epidemiology of infectious diseases. Terminology and basic concepts. Reservoirs and transmission of infectious diseases. Emerging and reemerging pathogens. War and bacteriological weapons. Public health measures and control.
Item 18. Human diseases caused by viruses and prions. Air-borne diseases, arthropods vector, direct contact, food and water. Antiviral therapy.
Item 19. Human diseases caused by bacteria. Air-borne diseases, arthropods vector, direct contact, food and water.
Item 20. Human diseases caused by fungi and protists. Air-borne diseases, arthropods vector, direct contact, food and water. Antiprotozoal therapy.

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.
It is necessary to approve having obtained a minimum of 50 out of 100 distributed as follows:
THEORY: 65 out of 100. Minimum necessary to overcome the theory: 35 points, obtained as follows:
a) partial.
b) Final.
- Class attendance teacher: optional
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).
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

REFERENCES

Basic

- Prescotts Microbiology. Willey, J.M., L.M. Sherwood % C.J. Woolverton. 9th ed. McGraw Hill Education. 2015
  Un texto muy completo en cobertura para el nivel de la asignatura.

  Brock- Biología de los Microorganismos. Madigan, M.T., J.M Martinko, K.S. Bender, D.H. Buckley & D.A. Stahl. 14ª ed. Pearson. Adison Wesley. 2015.
  Es la traducción de un clásico de la Microbiología, en constante renovación.

Microbe. 2006. Schaechter, M., J.L. Ingraham & F.C. Neidhard. 1st ed. ASM Pressw. Whashington DC.

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

- SLONCZEWSKI, J. L. & J.W. FOSTER. 2009. Microbiology: an evolving science. 1st ed. W.W. Norton. New York. London.
  WILSON, B.L., SALYERS, A.A., WHITT, D.D. & M. E. WINKLER. 2011. Bacterial pathogenesis. A molecular approach. 3ª ed. ASM Press.
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  SNYDER, L. & W. CHAMPNESS. 1997. Molecular Genetics of Bacteria. ASM Press. Washington DC.
  GOTTSCHALK, G. 1986. Bacterial Metabolism. 2ª ed. Springer-Verlag. New York.
  TORTORA, G.J., FUNKE, B.R. Y CASE C.L. 2007. Introducción a la Microbiología, 9ª ed. Médica Panamericana. Madrid.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contenidos y Volumen de trabajo

Sin cambios.

Metodología

Si la evolución de la situación derivada de la COVID-19 obliga a una reducción de la presencialidad, se tomarán las siguientes medidas:

1) Las actividades presenciales en aula se sustituirían por las siguientes metodologías:

- Videoconferencia síncrona

- Propuestas de actividades de resolución de Cuestionarios de Aula Virtual y entrega de tareas y cuestiones por Aula Virtual

- Clases en forma de power point con audio y discusión usando la herramienta tutorías

2) Las actividades presenciales de prácticas de laboratorio, se sustituirían por las siguientes metodologías:

- Prácticas de laboratorio simuladas mediante videoconferencia

- Trabajo con datos experimentales suministrados

- Discusiones en foros asíncronos en Aula Virtual

3) Para tutorías y dudas se utilizarían las siguientes metodologías:

-Chats síncronos en Aula Virtual

-Foros asíncronos en Aula Virtual

-Comunicación directa profesor-estudiante a través del correo institucional

Evaluación

En caso de que los exámenes no pudieran ser presenciales, se realizarían ‘on line’ en Aula Virtual mediante las herramientas disponibles.

Los detalles concretos de la adaptación a las situaciones que se pudieran producir se supervisarán por la CAT y se comunicaran a los estudiantes a través de Aula Virtual