Universitat de Lleida

DEGREE CURRICULUM

MICROBIOLOGY

Coordination: DE LA TORRE RUIZ, M. ANGELES

Academic year 2021-22

MICROBIOLOGY 2021-22

Subject's general information

Subject name	MICROBIOLOGY
Code	101537
Semester	PRIMER QUADRIMESTRE
Typology	

Degree	Course	Character	Modality
Bachelor's Degree in Biomedical Sciences	2	COMPULSORY	Attendance-based

Course number of credits (ECTS)	9
Type of activity, credits, and groups	

Activity type	PRALAB	PRAULA	TEORIA
Number of credits	1.2	2.5	5.3
Number of groups	4	1	1

Coordination	DE LA TORRE RUIZ, M. ANGELES
Department	BASIC MEDICAL SCIENCES
Teaching load distribution between lectures and independent student work	90 hours of lectures/seminars/cases/laboratory sessions plus 150 hours of independent student work
Important information on data processing	Consult this link for more information.
Language	Catalan and spanish
Distribution of credits	9,0 credits distributed as: lectures 5,3 credits; seminars and problems: 2,5 credits; laboratory sessions: 1,2 credits

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
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Learning objectives

Competence 15. Knowing the biology of microorganisms in their structural and physiological aspects and their genetics and diversity.

Specific objectives:

-To know the structural diversity of bacteria, and to be able to relate it with other biological properties such as physiology, virulence or antibiotic sensitivity (blocks 1 and 2 sessions and seminars and problems)
-To know the main features of bacterial metabolism, linking them with growth characteristics and adaptation to environmental changes (block 3 sessions and seminars and problems)
-To understand the mechanisms that determine the genetic variability of bacteria and to be able to relate them to the virulence and resistance to antibiotics (block 4 sessions and seminars and problems)
-To know the characteristics of microbial growth in laboratory and natural conditions and the environmental factors that affect it, and to be able to practise with it (block 5 sessions, seminars and practical classes)
-To know the mechanisms of action of antimicrobial agents and also be able to determine antimicrobial sensitivity in laboratory conditions (block 5 sessions, seminars and practical classes)

Competence 16. Knowing the main infectious agents and their mechanisms of action.

Specific objectives:

-To know the biological properties of microorganisms and relate them to their infectious capacity and the different ecological relationships they establish with the human body (block 6 sessions and seminars and problems)
-To know the structure and genetic mechanisms of virus multiplication (block 7 sessions and seminars and problems)
-To know the main diseases caused by viruses and the mechanisms of action of antiviral agents (block 7 sessions and seminars and problems)

-To know the different bacterial groups and their specific properties, especially bacteria that cause diseases in humans (block 8 sessions and seminars and problems)
-To know the biology of protozoa and fungi, their relationship with human diseases and how to treat their infections (Blocks 9 and 10 sessions and seminars and problems)

Competence 17. To be able to use the basic techniques for manipulation of microorganisms.

Competence 18. To understand, critically evaluate and know how to use technologies and sources of biomedical information to obtain, organize, interpret and communicate scientific information, especially the biomedical information.

Specific objectives:

-To be able to relate the information obtained in the theoretical and practical classes with the bibliographic material available (all blocks of lectures and practical classes)
-To be able to obtain information from databases to solve microbiological questions (classes of problems)

Competence 19. Ability to use basic laboratory material and techniques

Specific objectives:

-To know how to prepare culture media for the growth of microorganisms, manipulate them and work under sterile conditions (practical classes)
-To know how to isolate and identify microorganisms based on their morphology, physiological and biochemical properties (practical classes)
-To know determining the sensitivity to antimicrobial agents with laboratory tests (practical classes)
-To be able to Isolate bacterial plasmids and transform them into cultures of bacteria (practical classes)
-To grow microorganisms in laboratory cultures and measure and interprete growth parameters (practical classes)

Competences

Competences to acquire:

CB1 That students have demonstrated possession and understanding of knowledge in an area of study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that they involve knowledge coming from the forefront of their field of study.

CB2 That students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.CB4 That students can transmit information, ideas, problems and solutions to both specialized and non-specialized audiences.

CB5 That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

CE14. Design simple studies and analyze the results according to the proposed objectives.

CE15. Differentiate the biology of microorganisms in their structural, physiological and genetic aspects, as well as their diversity.

CE16. Describe the main infectious agents and their mechanisms of action.

CE18 Critically assess and use technologies and sources of clinical and biomedical information to obtain, organize, interpret and communicate clinical, scientific and health information

CE19. Use laboratory material and apply basic laboratory techniques.

CE39 Identify the indications for biochemical, hematological, immunological, microbiological, pathological and imaging tests.

CE58. Apply and evaluate qualitative and quantitative immunological techniques applied to the analysis of molecules and cells.

CE59. Apply luminometry, citometry, chromatography and spectrometry techniques

Subject contents

THEORY CLASSES (53 hours)

SECTION 1. INTRODUCTION (1 hour)

1.1. The world of microorganisms. Historical aspects. Microorganisms as causative agents of diseases: Koch's postulates. Types of microorganisms. Prokaryotic and eukaryotic microorganisms: differences in cellular organization. Relationship between viruses and other microorganisms.

SECTION 2. BACTERIAL STRUCTURES (4 hours)

2.1. GENERAL MORPHOLOGY OF BACTERIA. Components of the bacterial cell. Morphology of bacteria. Pleomorphism. Cell size. Cell grouping.

2.2. THE SURFACE OF THE BACTERIAL CELLS. Cell wall: structure in grampositive gramnegative bacteria. Functions of the wall. Wall synthesis. Extracellular materials. Capsule: clinical importance. Flagella. Other surface structures: Pili.

2.3. BACTERIAL MEMBRANES AND CYTOPLASM. The cytoplasmic membrane. Ribosomes.Secretion of proteins. Nucleoid. Chromosome replication and cell division. Storage materials. Bacterial endospores.

SECTION 3. MICROBIAL METABOLISM (3 hours)

3.1. CATABOLIC PROCESSES IN MICROORGANISMS. Nutritional types of microorganisms. Sources of energy and carbon. Aerobic and anaerobic respiration: differential characteristics in bacteria. Bacterial fermentations.

3.2. ANABOLIC PROCESSES IN MICROORGANISMS. General scheme of biosynthetic mechanisms. Growth factors. Regulation of metabolism in bacteria. Two-component systems.

SECTION 4. BACTERIAL GENETICS (4 hours)

4.1. BACTERIAL GENETIC VARIABILITY. Organization of the bacterial genome. Comparative bacterial genomics and clinical microbiology. Spontaneous and induced mutations. Main mutagenic agents. Types of bacterial mutants.

4.2. MECHANISMS OF TRANSFER OF GENETIC INFORMATION AND BACTERIAL PLASMIDS. Genetic recombination in bacteria. Transformation: clinical relevance. Transduction. The bacteriophages: lytic and lysogenic cycles. Bacterial conjugation. Mobile elements. Types of plasmids. Resistance factors: molecular structure and

transferability.

SECTION 5. PROCARIOTA DIVERSITY (11 hours)

5.1. PHILOGENY AND BACTERIAL DIVERSITY. Fundamentals of taxonomy. Diversity in Bacteria: *Proteobacteria, Firmicutes, Tenericutes, Actinobacteria, Bacteroidetes, Chlamydiae, Planctomycetes and Verrucomicrobia*, Hyperthermophilic Bacteria, Other Bacteria.

5.2. DEFENSE MECHANISMS AND IMMUNITY AGAINST MICROBIAL INFECTIONS: Natural barriers. General characteristics of the elements that participate in defense against microorganisms. Innate immunity. Specific immunity. Inflammation. Vaccines.

5.3. BACTERIA CAUSING HUMAN DISEASES: Bacterial diseases of airborne transmission: *Streptococcus pyogens and Streptococcus pneumoniae, Corynebacterium diphtheriae, Bordetella pertusis, Mycobacterium sps, Neisseria meningitidis, Staphylocccus sps, Helicobacter.*Sexually transmitted bacterial diseases: *Neisseria gonorrhoeae, Treponema pallidum, Chlamydia trachomatis.* Bacterial diseases transmitted by arthropods. *Rickettsia prowazekii, Borrelia burgdorferi, Yersinia pestis.* Soil-transmitted bacterial diseases: *Bacillus anthracis, Clostridium tetani.* Waterborne Bacterial Diseases: *Vibrio cholerae, Legionella pneumophila, Salmonella enterica serovar Thyphi.* Foodborne Bacterial Diseases: *Staphylococcus aureus. Clostridium perfringens and Clostridium botulinum, Salmonella, Escherichia coli, Listeria monocytogenes.*

5.4. ARCHAEA Differential Physiological, Morphological and Biochemical Characteristics: Taxonomic Classification. Halophilic Archaea. Methanogenic Archaeal. Hyperthermophilic Archaeal

SECTION 6. CONTROL OF MICROBIAL GROWTH (7 hours)

6.1. MICROBIAL GROWTH. The division cycle of bacteria and other microorganisms. Growth of microbial populations. Growth phases. Measurement of growth. Influence of environmental conditions.

6.2. MECHANISMS OF ACTION OF ANTIMICROBIAL PHYSICAL AND CHEMICAL AGENTS. Physical agents. Heat sterilization. Other physical methods of control. Chemical agents: disinfectants and antiseptics. Optimal action of disinfectants. Inactivation of disinfectants. Microbial resistance to disinfectants.

6.3. CHEMOTHERAPEUTIC AGENTS. Properties. Evaluation of the chemotherapeutic effect. Antibiograme. Microbiostatic and microbicide actions. Analogues of growth factors: sulfonamides. Synthetic chemotherapeutic agents. Antibiotics. Spectrum of action. Mechanisms of action of antibiotics. Chromosomal and extrachromosomal resistance to antibiotics: biochemical mechanisms. Strategies for clinical use of chemotherapeutic agents.

SECTION 7. VIROLOGY (18 hours)

7.1. GENERAL CHARACTERISTICS OF VIRUS. Structure of the viral particle. Characteristics of the capsid and nucleic acid. Classification of viruses. Genetics of viruses. Bacterial viruses. Detection methods. General mechanisms of animal virus multiplication. Immunity against viral infections.

7.2. STRUCTURE AND GENETICS OF VIRUSES. Morphology and size of virions. Methods of study. Capside architecture: types of symetry. Enveloped viruses. Complex viruses. Interaction capside/nucleic acid. Structure and complexity of viral genomes. Segmented and multipartite genomes. Viral mutants. Genetic interactions between viruses. Defective viruses. Satelite viruses. Recombination between viral genomes.

7.3. PURIFICATION AND ANALISIS OF VIRUSES. Obtention of viral particles. Culture of cells. Purification methods. Purification of virions: direct and indirect methods. Biochemical analysis of viral components. Working methofs in the Virology laboratory.

7.4. BACTERIAL VIRUSES. Clasification of bacterophages. Morphology of phage capsides. Multiplication of DNA

and RNA bacteriophages: lytic cycle. Temperate bacteriophages and lysogeny. Phage conversion. Protection of bacteria against phages: restriction enzymes and CRISPR systems. Phages of biotechological and clinical interest.

7.5. MULTIPLICATION OF ANIMAL VIRUSES. Cellular specificity. Receptors. Entry and decapsidation. Effects on cell metabolism. Synthesis of RNA, DNA and viral proteins. Protein processing and maturation. Virion assembly. Exit of viral particles. Retrotranscription. Antivirals: mechanisms of action.

7.6. PATOGENICITY OF ANIMAL VIRUSES. Characteristics of viral infections. Persistent, latent and slow infections. Entry and extension of viruses in organisms. Mechanisms of transmission. Types of reservories. Main pathogenic viruses in humans and other animals: pathological effects. Influenze virus. HIV. Herpesviruses.

7.7. PRIONS AND OTHER VIRUS-TYPE AGENTS. Prions as infectious particles. Molecular aspects: PrPc and PrPsc particles. Propagation of prions. Phenotypic diversity. Prion diseases in animal species. Interspecific barriers. Prions in other organisms. Delta agent.

SECTION 8. FUNGI (3 hours)

8.1. FUNGI. General characteristics. Physiology. Cycle. Nutrition and metabolism. Ecology. Reproduction. Taxonomy. Antifungals. Type of fungal infection and strategies. Defense mechanisms. Major pathogenic species.

SECTION 9. PROTOZOA (2 hours)

9.1. PROTOZOA. General characteristics and life cycles. Cellular structure. Nutrition and metabolism. Resistance forms. Reproduction. Pathogenicity.

LABORATORY SESSIONS PROGRAMME (12 hours)

1. -Culture media for the isolation of microorganisms.
2. Sterilization and preparation of material. Inoculation.
3. Liquid and solid cultures
4. -Staining techniques of microorganisms. Microscopy. Observation of fungal and bacterial cultures
5. -Identification of enterobacteria through a gallery of biochemical tests
6. -Other tests for bacterial identification (catalase, coagulase, etc)
7. -Determination of the sensitivity of bacterial isolates to desinfectants and antibiotics (antibiogram)
8. -Serological diagnostic: ELISA test

SEMINAR SESSIONS (10 hours)

PROBLEMS SESSIONS (15 hours)

Problems related to the contents of the theoretical sessions will be discussed in order to apply these contents to specific cases.

Methodology

To achieve the objectives and acquire the listed competences the follwoing activities are scheduled:

Master classes

These will be done with all students in the classroom. Their purpose is to give an overview of the thematic content, highlighting those aspects that will be useful in their training.

Seminaries

These will be held in small groups, in person. At the beginning of the course, a series of topics will be proposed for students to work on and make oral presentations.

Problems / cases

They will be held in person at the end of each thematic unit in the classroom in small groups. A series of problems or practical cases related to the topic taught will be proposed to be discussed and solved by the students in the classroom. -

Laboratory practices

These will be carried out in small groups in person, and are mandatory. The purpose of the laboratory practices is to familiarize students with basic microbiological techniques (microscopy, identification and diagnosis of microorganisms, work in sterile conditions, determination of sensitivity to antibiotics, etc.) as well as basic techniques for genetic manipulation of microorganisms .

Development plan

Lectures, seminars, problems and laboratory sessions will be carried out in parallel, on the basis that new information will be given when the required knowledge has already been introduced in the theory sessions

Evaluation

The final grade is the sum of the different aspects evaluated:
-The knowledge acquired in the theoretical classes will be assessed in two written exams in the periods set by the Faculty. Thus, each of the exams will represent **30% of the final grade**. Their specific content will be quantitatively proportional to the number of hours devoted to each of the blocks of theory classes. Each of the two theoretical exams will be considered passed when the mark is at least 5 out of a total of 10. The laboratory practices are compulsory and will be evaluated with a written exam that will account for **20% of the final mark.** To pass the subject it will be necessary to have passed the theoretical part and the practical part with a minimum of 5 in each of the two, they are not compensable. Other practical activities in the classroom will be: a) Oral seminars: these will be lecture sessions where each of the small groups of students (approximately 4) will give a class to the rest of the classmates who must attend and participate compulsorily. This activity will be assessed in the classroom by means of a rubric, once the presentation has been made with **0.5 points (5% of the total mark).** b) Problem activities related to the theoretical classes given that will be solved in class in small groups and whose evaluation will be continuous. This activity will have a total score of **1.5 points (15% of the total mark).**

Learning evaluation		
	% final grade	Evaluation type
Theory	60	Written exams (two)
Pràctical sessions	20	written exam
Seminars	5	Oral presentation
Problems sessions	15	Continuous evaluation

Bibliography

General bibliography:

-Madigan, M.T. and others. Brock Biología de los microorganismos (14ª ed.). Pearson Int., (2015)

-Willey, J.M. and others. Microbiología de Prescott (7ª ed.). McGraw Hill (2009)

-Schaechter, M. and others. Microorganismes. Ed. Reverté (2008)

-Tortora, G.J, Funke, B.R. and Case, C.I. Introducción a la Microbiología (9ª ed.). Ed. Panamericana (2007)

-Ingraham, C.A. and Ingraham, J.L. Introducción a la Microbiología. Ed. Reverté (1999)

Complementary bibliography:

-Mims, C.A. and others. Microbiología Médica (2ª ed.). Harcourt-Brace (1999)

-Murray, P.R., Kobayashi, G.S., Pfaller, M.A and Rosenthal, K.S. Microbiología Médica (6ª ed.). Elsevier (2009)

-Nath, S.K. and Revankar, S.G. Microbiología basada en la resolución de problemas. Elsevier (2007)

-Salyers, A.A. and Whitt, D.D. Microbiology: diversity, disease and the environment. Fitzerald Sic. Press (2001)

-Salyers, A.A. and Whitt, D.D. Bacterial Pathogenesis: A Molecular Approach. ASM Press (2002)

-Shors, T. Virus: estudio molecular con orientación clínica. Ed. Panamericana (2009)

Other electronic addresses of interest:

http://www.bact.wisc.edu/microtextbook

http:/www-micro.msb.le.as.uk

http://www.microbebook.org