Universitat de Lleida

DEGREE CURRICULUM

MICROBIOLOGY

Coordination: HERRERO PERPIÑAN, ENRIQUE

Academic year 2020-21

MICROBIOLOGY 2020-21

Subject's general information

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<tr><td>Subject name</td><td>MICROBIOLOGY</td></tr>
<tr><td>Code</td><td>101537</td></tr>
<tr><td>Semester</td><td>PRIMER QUADRIMESTRE</td></tr>
<tr><td>Typology</td><td>
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<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Biomedical Sciences</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>9</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
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<tr><th>Activity type</th><th>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>1.2</td><td>2.5</td><td>5.3</td></tr>
<tr><td>Number of groups</td><td>4</td><td>2</td><td>1</td></tr>
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<tr><td>Coordination</td><td>HERRERO PERPIÑAN, ENRIQUE</td></tr>
<tr><td>Department</td><td>BASIC MEDICAL SCIENCES</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>90 hours of lectures/seminars/cases/laboratory sessions plus 150 hours of independent student work</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Catalan</td></tr>
<tr><td>Distribution of credits</td><td>9,0 credits distributed as: lectures 5,3 credits; seminars and problems: 2,5 credits; laboratory sessions: 1,2 credits</td></tr>
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MICROBIOLOGY 2020-21

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
BELLÍ MARTÍNEZ, GEMMA	gemma.belli@udl.cat	1,2	
COLOMINA GABARRELLA, M. NIEVES	neus.colomina@udl.cat	2,1	
HERRERO PERPIÑAN, ENRIQUE	enric.herrero@udl.cat	11,8	

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:

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

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

-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.

-Competitence 19. Ability to use basic laboratory material and 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. CONTROL OF MICROBIAL GROWTH (7 hours)

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

5.2. 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.

5.3. 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 6. VIROLOGY (18 hours)

6.1. 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.

6.2. 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.

6.3. 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.

6.4. 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.

6.5. 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.

6.6. 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.

6.7. 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 7. BACTERIAL DIVERSITY (11 hours)

7.1. BACTERIAL TAXONOMY. Basic aspects. Phenetic and phylogenetic classification. Molecular taxonomy. Evolution of microorganisms. Comparison between archaea, bacteria and eukaryotes.

7.2. PROTEOBACTERIA. Role in the biological cycle of various elements. Rickettsiae: ecology and virulence. Saprophytic and pathogenic Neisseria. Pseudomonas: ecology and virulence factors. Enterobacteria: general properties and pathogenicity; classification criteria. Vibriae and related bacteria: ecology and toxigenicity. Helicobacter. Other Proteobacteria of biomedical interest: Brucella, Bordetella, Legionella, Haemophilus.

7.3. GRAMPOSITIVE BACTERIA WITH LOW % GC. Staphylococci: Species of biomedical interest. Streptococci and other lactic bacteria of biomedical importance. Spore-forming bacilli: pathogenic and virulence factors. Mycoplasms: structure, lifestyles and pathogenicity.

7.4. GRAMPOSITIVE BACTERIA WITH HIGH % GC. Corinebacteriae and propionibacteriae: pathogenic mechanisms. Mycobacterial pathogens: ecology of infections. Actinomycetae pathogens.

7.5. CHLAMYDIA. Structure. Cycle. Pathogenicity. SPIROCHETES. Structure and ecology. Major pathogenic species: virulence factors. BACTEROIDES. Ecology and pathogenicity.

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)

-Culture media for the isolation of microorganisms. Sterilization and preparation of material. Inoculation. Liquid and solid cultures

-Staining techniques of microorganisms. Microscopy. Observation of fungal and bacterial cultures

-Identification of enterobacteria through a gallery of biochemical tests

-Other tests for bacterial identification (catalase, coagulase, etc)

-Determination of the sensitivity of bacterial isolates to desinfectants and antibiotics (antibiogram)

-Purification of a bacterial plasmid and agarose gel electrophoresis

-Manipulation of bacteriophages: obtention and quantification of lysates

-Serological diagnostic: ELISA test

COMPLEMENTARY SEMINAR SESSIONS (8 hours)

-Regulation of bacterial metabolism
-Microbial genomics
-Genetic modification of microorganisms
-Molecular basis of antibiotic resistance
-Microbial and serological diagnostics (I)
-Microbial and serological diagnostics (II)
-Virus and cancer
-Vaccines

PROBLEMS SESSIONS (15 hours)

Issues related to the content of the lectures will be discussed, with cases related to:
-Structure-physiology and genetics of microorganisms
-Desinfection and chemotherapy
-Virology
-Biology of pathogenic bacteria

Methodology

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

-Lectures
These will be conducted with all students. This purpose is to give an overview of the thematic content are emphasizing those aspects that will be useful in student training. In 2020-21 these sessions will be on-line, except the first two, that will be lectured at the classroom.

-Seminars and classes of problems
These will be in small groups, at the classroom. The seminars aim the students to apply the theoretical concepts and deepening those aspects more relevant as well as the more complex topics.

-Practical sessions at the laboratory
These will be in small groups at the laboratory, and they are compulsory. The laboratory sessions are intended to familiarize students with basic general microbiological techniques (microscopic identification and diagnostics of

microorganisms, working in sterile conditions, determination of antibiotic sensitivity, 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 lectures, seminars / exercises and laboratory sessions will be evaluated in two written exams during the periods set by the faculty. Thus, each exam **will represent 45% of the final grade**. The specific content will be proportional to the number of hours spent on each block of lectures and each of the other learning activities. Thus, the lectures will represent approximately 60% of the content evaluated in the sum of both exams, laboratory practice sessions will represent about 15%, and seminars / problems / classroom will correspond to about 25%. To aprove each exam a note of at least 5 out of a total of 10 should be obtained, and to approve the matter both exams should be aproved. The exams will evaluate the acquisition by the student of: (I) specific knowledge of the respective matter contents; (II) ability to relate aspects described in different parts of the program, and mainly theoretical versus practical classes / problem / seminars sessions; (III) clarity in the presentation in written form.

-Students will ellaborate a written report of work practices at the laboratory, evaluation of which **will represent 10% of the final grade**. The report is graded based on: (i) a description of the work performed and the biological material used; (ii) a description of the biological foundations of practice, (iii) the correct description of the results, and (iv) the interpretation and discussion of results.

Learning evaluation		
	% final grade	**Evaluation type**
Theory	60	Written exams
Pràctical sessions	15	In situ abilities plus report and written exam
Seminars and problems sessions	25	Continuous evaluation plus written exam

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