COURSE DATA

DATA SUBJECT

Code: 33168
Name: Microbiology
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1111 - Grado en Biotecnología	Facultat de Ciències Biològiques	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1111 - Grado en Biotecnología	Foundations of functional biology	COMPULSORY

COORDINATION

ESTEVE SANCHEZ CONSUELO

SUMMARY

Microbiology is part of the Degree in Biotechnology, University of Valencia (2009 Plan). It is a compulsory, 6 -credit subject pertaining to Fundamentals of Functional Biology, along with Genetics, Animal Biology and Plant Biology. These three subjects are studied in the second course and Microbiology corresponds to the first semester of the third course. It has been preceded by the compulsory subjects Biological Diversity (1), Cell Biology (2nd year, first semester), and Methods in Biochemistry and Molecular Biology (2nd year, annual), in which the student develops and assimilates knowledge that is a basis for Microbiology. The course, therefore, will not develop basic aspects, since they are previously acquired. Also, we avoid the recurrence with concepts acquired with Introduction to Biochemical Engineering and Plant Biology, subjects coursed in the second course.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

- Eukaryotic cell biology.
- General aspects of Biochemistry and Molecular Biology, with particular attention to metabolism and regulation.

COMPETENCES / LEARNING OUTCOMES

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Actuar con autonomía en el aprendizaje, tomando decisiones fundamentadas en diferentes contextos, emitiendo juicios en base a la experimentación y el análisis y transfiriendo el conocimiento a nuevas situaciones

Adquirir, desarrollar y aplicar las principales técnicas de preparación, tinción y observación de muestras biológicas

Apply analytical, synthetic and critical thinking skills in the application of the scientific method.

Aprender a trabajar de forma adecuada en un laboratorio con material biológico (microorganismos, plantas y animales) incluyendo seguridad, manipulación y eliminación de residuos biológicos, y con registro anotado de actividades.

Be able to observe and interpret the results obtained through optical microscopes.

Be able to place the different living beings in the phylogenetic tree.

Be able to understand the evolutionary relationships between organisms.

Colaborar eficazmente en equipos de trabajo, asumiendo responsabilidades y funciones de liderazgo y contribuyendo a la mejora y desarrollo colectivo

Contribuir en el diseño, desarrollo y ejecución de soluciones que den respuesta a demandas sociales, teniendo en cuenta como referente los Objetivos de Desarrollo Sostenible

Demostrar razonamiento crítico y autocrítico en el ámbito de la titulación, considerando aspectos tales como la ética profesional, los valores morales y las implicaciones sociales de las diferentes actividades realizadas

Disseminate and engage in public debate on issues related to biotechnology and its applications.

Learn, develop and apply the main techniques for the preparation, staining and observation of biological samples.

Manejar cultivos de microorganismos en medio sólido y líquido y realizar pruebas bioquímicas básicas.

Participate in multidisciplinary teams, engaging in teamwork and collaboration.

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Que el estudiantado demuestre su capacidad para reconocer la diversidad biológica y conocer la organización de los seres vivos y la ubicación del ser humano y de los organismos modelo en

experimentación biotecnológica en dicha diversidad

Que el estudiantado demuestre su capacidad para utilizar las diferentes fuentes bibliográficas y bases de datos biológicos y usar las herramientas bioinformáticas

Saber comunicarse de manera efectiva, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia

Saber predecir las consecuencias de la actividad humana sobre la biodiversidad y el medio ambiente.

Ser capaz de identificar organismos eucarióticos y procarióticos a nivel de género y/o especie.

Ser capaz de observar e interpretar los resultados obtenidos a través de microscopios ópticos

Ser capaz de situar los distintos seres vivos en el árbol filogenético

Understand evolutionary relationships among organisms.

Use English to write reports and to interpret information from protocols, manuals and databases.

Work in laboratories, including safety procedures, waste management and accurate activity logging.

DESCRIPTION OF CONTENTS

1. Introduction

The concept of Microbiology. Historical development and nature of the microbial world.

2. Prokaryotic structure and function

Cellular morphology and size. Cytoplasmic membrane in Archaea and Bacteria. Membrane functions. Bacterial cell Wall. Murein or peptidoglycan. Differences between Gram-negative and Gram-positive bacteria. Mycobacterial cell Wall. Archaea cell walls.
Bacterial flagella. Spirochaetal motility. Archaeal flagella. Gliding motility. Tactisms. Magnetosomes, gas vacuoles. Adhesión structures: capsules and fimbria. Biofilms. Cell storage inclusions.
Unicellular bacteria: cell división. Filamentous bacteria. Alternating cell stages: bacterial endospores. Other life cycles.

3. Microbial growth. Physico-chemical factors influencing microbial growth

Growth of microbial populations: parameters. The batch culture curve: phases and parameters. Continuous culture. Temperature. Water activity. pH. Oxygen. Hydrostatic pressure. Radiation. Organic and inorganic growth inhibitors. Desinfectants and antiseptics. Sterilization and control.

4. Nutrition and metabolism

Principles of microbial nutrition and metabolism. Microbial metabolisms: energy, reducing power and precursor metabolites. Nutritional types.
Types of microbial phototrophs. Pigments. Anoxygenic photosynthesis. Oxygenic photosynthesis. Bacteriorhodopsin system.
Types of microbial chemotrophs. Redox potential. Aerobic and anaerobic respiration. Chemolitotrophy. Heterotrophic catabolism. Fermentation.
Carbon assimilation by microbial autotrophs. Nitrogen assimilation from nitrate and from N2.

5. Microbial genomes and its evolution

Types of genetic elements in the eukaryotic and prokaryotic cell. Genomics of microorganisms. Mutation and recombination. Horizontal transfer of genetic information in Prokaryotes. MMR system. Cas/CRIPR system. Concept of pan-genome and essential genome. Regulation of gene expression in prokaryotes: strict response; catabolite repression; quorum sensing.

6. The Virus

Definition. Composition, structure and Types. Classification. Viral detection and quantification. General features of viral growth. Bacteriophages: virulent and temperate phages. Animal and vegetal viruses. Viroids, prions. Antiviral drugs.

7. Microbial biodiversity

Main structural and functional characteristics of Bacteria, Archaea and Eukarya. Microbial systematics, taxonomy and nomenclature. Taxonomic categories and species concept in Microbiology.
Generalities of the Bacteria domain. General characteristics of the main Phyla and their genera/species of biotechnological interest.
Overview of the Archaea domain. General characteristics of the main Phyla and their genera/species of biotechnological interest.
Phylogenetic tree of the Eukarya domain. Main groups of protists and their main genera. Fungi: general characteristics and groups of biotechnological interest.

8. Human microbiome and disease

Human microbiome and dysbiosis. Bacterial pathogenesis. Chemotherapeutic agents: antibiotics and synthetic chemotherapeutics. Antibiotic resistance.

9. Biotechnological applications of microorganisms

Theme 9. Food production and preservation. Obtaining products at an industrial level. Biomining. Bioremediation. Obtaining biofuels. Bioinsecticides. Improvement of monumental heritage

10. Practice

- The principles of safety and good practice at the microbial lab. Sterilization methods.
- Microbial handling and transfer techniques.
- Nutrition and culturing microorganisms: types of culture media. Culturing bacteria and fungi. Differential and selective media.
- Isolation of pure microbial cultures.
- Ligth microscopy of microbes: differential staining techniques (Gram, endospore staining).
- Counting microrganisms: total and viable counts (plate count of bacteria and phages, membrane counts).
- Detecting microbial activities: extracelular enzymes, oxidation/fermentation of carbohydrates, fermentative paths.
- Antimicrobial sensitivity: antibiogram.
- Identification through miniaturized tests and numerical profiling.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	2,00
Theory	38,00
Laboratory	20,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	5,00
Independent study and work	35,00
Preparation of lessons	10,00
Preparation for assessment activities	40,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

Lectures: thirty-eigth lectures given by the professor on fundamental aspects of the theory syllabus. Assistance is optional. Students will be provided in advance with the recommended specific literature and images to be used for the presentations (\\\\\"Aula Virtual\\\\\") .

Tutorial group: two group tutorials in which model questionnaires (previously available to the students through \\\\\"Aula Virtual\\\\\") are discussed and solved. The tests refer to content already developed in lectures. Attendance is mandatory.

Laboratory: The lab sessions are developed intensively for two weeks. These classes are compulsory and

they are supported by a booklet of practice (available through \\\\\"Aula Virtual\\\\\") with the protocols and a brief description.

Additional optional activities include reading scientific texts (articles, reviews), informed commentary on news in the field of Microbiology in the media, commented conferences and seminars on the subject and any other activity that, in agreement with professor, serve to supplement the student's education or microbiological illustrates the development of skills provided in the Teaching Guide.

EVALUATION

It is considered fundamental for the evaluation of the learning carried out by the student the direct verification of their level through the tutorials carried out throughout the course and the relationship established with the teacher in the laboratory, this level of relationship being one of the most informative and efficient. All this will allow the teacher to directly establish a dynamic image of the evolution throughout the course of each student, provided that the maximum number of students per group and subgroups of practices is respected. The numerical qualification of the knowledge and skills acquired will have to be established, however, using methods that allow a comparable and objective measurement of the same, with a record of results, which implies the qualification of written tests and the preparation of assignments.

To pass the evaluation, you need to have obtained a minimum of 5 points out of 10, with the following distribution: THEORY: 7.0 out of 10.

- Attendance at the classes: Optional

- Attendance at group tutorials: required

- Final exam: up 7.0 points (3.5 points minimum required).

The evaluation will be done on the basis of a written exam in the official calls: first round (june) and second one (july).

PRACTICES: 2.5 out of 10.

- Attendance to the lab sessions is mandatory.

- Practice Exam: up 2.5 points (minimum 1.25 points).

The evaluation of this part will be based on a written exam in the official calls. The attendance to lab sessions is mandatory and the student must have completed them in order to request an advance notice.

OTHER ACTIVITIES: 0.5 out of 10. No minimum or mandatory.

The highest score cannot be reached if the student does not involve in other activities, since in that case the maximum achievable score would be 9.5 out of 10.

After passing each of the parties listed above the marks obtained will be kept until the second call if any of the other parts were not surpassed in the first call. There will, therefore, an examination of theory and practical examination in the second call, whose qualifications rating will add, once they are both passed independently.

Second enrollment students who have passed the course practices can conserve their practical examination marks only for the next immediately following course.

REFERENCES

- MADIGAN, M.T., J.M MARTINKO, P.V. DUNLAP & D.P. CLARK. 2009. Brock- Biología de los Microorganismos. 14ª ed. Pearson. Adison Wesley. La asignatura comprende los contenidos que se desarrollan en las Unidades 1-6 y 9, cuyo conocimiento se considera esencial para superar la asignatura.

- WILLEY, J.M., L.M. SHERWOOD & C.J. WOOLVERTON. 2009. Microbiología de Prescott, Harley y Klein. 9ª ed. McGraw-Hill-INTERAMERICANA DE ESPAÑA, S.A.U. La asignatura comprende los contenidos que el libro desarrolla en las Partes I (T1 y T3), II (T5-T7), III (T9 y T10), IV (T12 y T13), VI (T16-T18), VII (T19-T24), VIII (T27 y T30), X (T33 y T34) y XI (T40 y T41).

- SCHAECHTER, M., J. L. INGRAHAM & F. C. NEIDHARDT. 2006. Microbe. 1st ed. ASM Press. Washington DC.

- BARTON, L.L. 2005. Structural and functional relationships in prokaryotes. Springer. New York.

- DWORKIN, W. (Editor in Chief). 2006. The Prokaryotes. A handbok on the Biology of Bacteria. 3nd ed. Vol. I - VII. Springer.

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

- SLONCZEWSKI, J.L. & J.W. FOSTER. Microbiology, an Evolving Science. 2009. W.W. Norton. New York. London.

- REDDY, C.A. (Ed. in chief). Methods for General and Molecular Microbiology. 2007. ASM Press. Washington DC.