Functional Diversity of Microorganisms

Code: 100774
ECTS Credits: 6

2025/2026

Degree	Type	Year
Biology	OB	3

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Although no official prerequisite exists, students are advised to review concepts that refer to the microbial world, previously studied. Likewise, it is convenient to have a good knowledge of the courses previously studied in the degree of Biology.

To be able to take the laboratory practice module of this subject, students must have passed the test of Safety and Biosafety that he/she will find in the corresponding Moodle space. It is necessary to present, on the first day of class, the printed PDF document generated when passing the test. Also, it is necessary to know and accept the operating rules of the laboratories of the Faculty of Biosciences. In addition, the student must follow the rules of work indicated by the teaching staff. For safety reasons, if the test has not been passed, or the student does not wear a lab coat and safety glasses, access to the lab will not be allowed.

Objectives and Contextualisation

This is a mandatory course in the third year of the Degree in Biology, which introduces students to the basic knowledge of prokaryotic and viral diversity, with special emphasis on their structural and ecophysiological characteristics, as well as their biotechnological importance, and the need for constant updating of information through the bibliographic databases.

The main objective of the course is to provide basic training for the study of the microbial diversity, physiology, and metabolism of the main groups of prokaryotes and viruses.

The specific objectives of the course are the following:

- Recognize the diversity of prokaryotic microorganisms and virus
- Identify the principles of classical and molecular taxonomy.
- Distinguish the characteristics that define the different taxonomic groups, their structural particularities, their ecophysiological characteristics, and their importance.
- Apply the knowledge studied to carry out the identification and characterization of the main prokaryotic and viral groups.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Be able to analyse and synthesise
- Be able to organise and plan.
- Describe and identify the levels of organisation of living beings.
- Identify and classify living organisms.
- Isolate, culture and modify microorganisms and cells and tissues of multicellular organisms.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Understand the processes that determine the functioning of living beings in each of their levels of organisation.
- Work in teams.

Learning Outcomes

1. Analyse a situation and identify its points for improvement.
2. Apply the conventional microbiological techniques that allow differentiation between the various microbial groups.
3. Apply the methodologies needed to characterise and identify microorganisms in pure cultures and in complex samples.
4. Be able to analyse and synthesise.
5. Be able to organise and plan.
6. Critically analyse the principles, values and procedures that govern the exercise of the profession.
7. Explain the role of microorganisms as agents of disease or toxicological problems in human beings, animals and plants.
8. Present the different groups of microorganisms, describe their differential characteristics and situate them phylogenetically.
9. Propose new methods or well-founded alternative solutions.
10. Propose viable projects and actions to boost social, economic and environmental benefits.
11. Recognise the diversity of the microbial world and identify the different groups it is composed of.

12. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
13. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
14. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
15. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
16. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
17. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
18. Work in teams.

Content

Theory

Prokaryotic Diversity

1. Introduction to prokaryotic diversity

What do we mean by prokaryotic diversity? Functional diversity as a concept.

2. Phylogeny and microbial systematics

Molecular phylogeny. The species concept for prokaryotes. Classification, nomenclature and identification. Classification systems. Polyphasic taxonomy: phenotypic, genotypic and phylogenetic methods. Classification units. Bergey´s Manual of Systematic Bacteriology. Culture collections.

3. Diversity of Archaea

Structural particularities of archaea. Phylogeny and metabolism. Main physiological groups and key genera. Applied importance.

4. Diversity of Bacteria

Ecophysiological characteristics of the different groups. Main phototrophic, chemolithotrophic and chemoorganotrophic groups and their significance. Key genera.

5. Extension of prokaryotic diversity

What do we know about the diversity of prokaryotes? Current tools available to assess the hidden diversity of bacteria and archaea. Phylogenetic groups dominated by uncultured microorganisms. Distribution and characterization.

Viral diversity

6. Introduction: virology and its origins

Relevant facts in the history of virology. The eradication of smallpox and the risk of re-emergence. Clinical and biotechnological aspects of virology. Bioterrorism.

7. Virus nature and virological methodology

Strict parasitism, multiplication, and transmission. Viral diversity. The viral cycle. Obtaining viral particles. Quantitative analysis of viral particles. Detection ofviral componentsand applications in the diagnostic methodology. Biological security Contention levels: P1 to P4.

8. Virions: viral particles and their genomes

The viral particle. Functions of the capsid. Morphology of viral particles. Sites of binding to receptors. Chemical composition, structure and organization of the viral genome: structural and non-structural genes. Principles of complexity of viral genomes and genome reduction. Recombination, reorganization, and phenotypic mixing.

9. The viral cycle

Cellular recognition. Internalization. Decapsidation. Cell shutdown. Synthesis of RNA, DNA, and viral proteins: temporal sequences. Cytopathic effects. Release of viral particles. Apoptosis. Cell transformation and oncogenesis. Productive and non-productive infections. Lithic cycles vs. lysogenic cycles.

10. Origin and evolution of viruses

Origin of viruses; Regressive and progressive theories. Mechanisms of diversity generation. Mutation frequencies and relative abundance of mutants. Mutation fixation. Viral replicase and copy fidelity. Variability and evolution in RNA viruses and retroviruses. Viral quasispecies. Evolution and evolutionary potential. Founder effects and bottlenecks. Genetic and antigenic divergence; influenza virus. Analysis of viral phylogeny.

11. Principles of viral taxonomy

First classifications of viruses: Baltimore classification of animal viruses. The International Committee of Virus Taxonomy and the classification system. Viral properties used in taxonomy.

12. Double-stranded DNA viruses (Classe I)

The life cycle of polyomaviruses and papillomaviruses. Medical aspects: cell transformation and oncogenesis. The life cycle of adenoviruses. Medical aspects: recombinant adenoviruses. The life cycle of herpesviruses. Medical aspects:latent infections. Diseases caused by herpesvirus. The life cycle of poxviruses. Medical aspects: the smallpox virus. Eradication of smallpox. Bioterrorism.

13. Single-stranded DNA viruses (Classe II)

The life cycle of parvoviruses. Medical aspects: Parvovirus B19.

14. Doubled-stranded RNA viruses (Classe III)

The life cycle of reoviruses. Medical aspects: rotavirus.

15. Single-stranded RNA viruses (+) (Classe IV)

The life cycle of picornaviruses. Medical aspects: poliovirus, rhinovirus, and the virus of hepatitis A. The life cycle of flaviviruses. Medical aspects: hepatitis C virus, dengue virus, and Zika virus. The life cycle of coronaviruses. Medical Aspects: SARS, MERS and COVID-19.

16. Single-stranded RNA Viruses (-) (Classe V)

The life cycle of rhabdoviruses. Medical aspects: rabies virus. The life cycle of paramyxoviruses. Medical aspects: measles and mumps. The life cycle of orthomyxoviruses. Medical aspects: the flu viruses. The influenza pandemic of 1918. Origin of epidemics and pandemics: antigenic drift and antigenic shift. Avian flu and its transmission to humans. The life cycle of filoviruses. Medical aspects: Ebola virus.

17. Retroviruses (Classe VI)

The life cycle of retroviruses. Medical aspects: oncogenesis. The *Lentivirus* genus: The human immunodeficiency viruses.

18. Hepadnavirus (Classe VII)

The life cycle of hepadnaviruses: DNA retrovirus. Medical aspects: the hepatitis B virus.

Problems / Seminars

1. Methods of isolation of microorganisms

2. Techniques of microscopic observation

3. Methods of identification and characterization of microorganisms

4. Work sessions with scientific articles

Laboratory work

1. Isolation of microorganisms from natural environments

2. Identification: biochemical and physiological tests

3. Preparation and quantification of viral lysates

4. Neutralization of viruses

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory work	12	0.48	1, 3, 2, 9, 15, 14, 12, 13
Seminar/case resolution classes	8	0.32	1, 9, 10, 15, 14, 12, 13, 4, 5, 18
Theory lectures	31	1.24	17, 6, 1, 8, 7, 9, 10, 11
Type: Supervised			
Individual/group tutorials	2	0.08	17, 6, 8, 7, 15, 11, 4
Type: Autonomous			
Bibliografy search	9	0.36	16, 15, 4, 18
Estudy	50	2	6, 1, 8, 7, 11, 4
Preparation and writing of works	20	0.8	17, 6, 1, 8, 7, 9, 10, 16, 15, 12, 13, 11, 4, 18
Text reading	12	0.48	1, 8, 7, 10, 11, 4

The course consists of three modules, which have been programmed in an integrated way so that the student will have to relate throughout the course to the content and activities programmed to achieve the skills indicated in this guide.

Several learning strategies will be combined:

Theory classes: Students must acquire the scientific and technical knowledge of this course by attending these classes and complementing them with the autonomous study of the topics explained. At the beginning of the course, students will be given a detailed calendar of the topics that will be worked on throughout the course, as well as the bibliography that they will have to consult to prepare for each theory class and the autonomous study of the topics explained. Within this module, classes will be based on master or expository lectures and in a brief discussion of the same.

Seminars/case resolution classes: The purpose of these sessions is: a) working methodological aspects, b) facilitate the understanding of the knowledge presented in the theoretical classes, c) enable the students to design basic experiments id) make a bridge between the participatory theoretical classes and the practical work of the laboratory, to integrate the theoretical knowledge with the practical ones. The students will work on specific practical cases that will have to be developed during the course. In addition, the bibliography that will be consulted and the relationship of each session with the subjects treated in the participative theoretical classes will also be indicated. Attendance at these sessions is mandatory. In case of absence for unjustified reasons, there will be a penalty in the seminar module grade.

In these activities, the use of Artificial Intelligence (AI) is permitted but in a restricted manner. Therefore, for this subject, the use of AI is allowed exclusively in support tasks, such as bibliographic or information searches, text correction or translations. The student must clearly identify which parts have been generated with this technology, specify the tools used and include a critical reflection on how these have influenced the process and the final result of the activity. The lack of transparency in the use of AI in this assessable activity will be considered a lack of academic honesty and may lead to a partial or total penalty in the grade of the activity, or greater sanctions in serious cases.

Laboratory work: The objectives of these activities are: a) facilitate the understanding of the knowledge exposed to the theory classes, b) apply the knowledge developed in the sessions of seminars/case resolution, c) acquire manual skills, d) interpret results and e) acquire the ability to work with microorganisms. Class attendance is compulsory to be able to acquire the skills of the course. To take this course the student must be passed the test of Safety and Biosafety that he/she will find in the corresponding Moodle space. It is mandatory to present, on the first day of class, the printed PDF document generated when passing the test. Also, it is necessary to know and accept the operating rules of the laboratories of the Faculty of Biosciences. In addition, the student must follow the rules of work indicated by the teaching staff. For safety reasons, if the two tests have not been passed, or the student does not wear a lab coat and safety glasses, access to the lab will not be allowed.Finally, to achieve good performance and acquire the competencies corresponding to this activity, the student must make a comprehensive reading of the proposed practices before their completion.

Additional information

To support the training activities indicated above, classroom tutoring sessions can be programmed at the request of the students. Likewise, the students will be able to carry out individual tutorials in the office of professors Neus Ferrer Miralles (C3-331) and Maira Martínez Alonso (C3-329).

The student will have at the Moodle space all the documentation delivered by the teacher for the good monitoring of the course. He/she will also be able to consult the teaching space of the Degree Coordination to obtain updated information.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory work assessment	20	1	0.04	1, 3, 2, 9, 14
Seminar/case resolution assessment	20	1	0.04	1, 9, 10, 14, 12, 13, 4, 5, 18
Theory assessment I	30	2	0.08	17, 6, 8, 7, 16, 15, 11
Theory assessment II	30	2	0.08	17, 6, 8, 7, 16, 15, 11

The evaluation of the course will be individual and continued through the following tests:

Assessment of the theory classes module (60% of the global mark): During the course, two written exams of this module will be programmed. Each of the tests will have a weight of 50% of the module's mark, but the average will only be used if the test scoreis equal or superior to 5; otherwise, the student will have to carry out a second-chance examination of the failed written test.
Each test will consist of short answer questions, aimed at assessing whether the key conceptual objectives have been achieved, and/or multiple choice test questions which will allow the evaluation of a large part of the contents.

Assessment of the seminar/case resolution classes module (20% of the overall mark): The evaluation will include the following aspects: autonomous deliveries, oral presentation of the work done, and written tests consisting of multiple choice questions that will include the different aspects covered in the seminar sessions.

Only the average will be made if the score of the tests is equal to or superior to 5.

Assessment of lab work module (20% of the global mark): The evaluation will include the following aspects:

Completion of a questionnaire and monitoring of practical skills acquired which will consist of the delivery of different practical results to the teaching staff during the laboratory sessions (2% of the overall mark).

Oral presentation of the practical results (8% of the overall mark)

Written test (10% of the overall mark), which will consist of multiple choice test questions.

Only the average will be made if the mark of the tests is equal to or superior to 5.

Final Considerations:

- To pass the course, you must obtain a score of 5 or superior in each module. Students who do not pass any of the modules will be able to retake them on the scheduled date for the final evaluation of the course.
- To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two-thirds of the final score of the course. Thus, the student will be graded as Non-evaluable if the weighing of all conducted evaluation activities is less than 67% of the final score.
- Students who can not attend an individual assessment test for a justified cause and provide the corresponding documentation will be entitled to take the test in question on another date.
- Students who wish to improve their grade will renunciate to that previously obtained, and she/he will have to perform the re-assessment of all the contents corresponding to the different modules of the course on the day scheduled for that purpose.
- From the second enrolment, the repeating students will not have to carry out the activities, nor the evaluations of those skills surpassed, corresponding to the modules of seminars and practices. That is, the mark obtained in these modules will be saved, as long as they have been passed.

Single evaluation

This subject considers the single assessment system that consists of a single summary test in which the contents of the entire theory program of the subject will be assessed. The test will consist of short-answer questions aimed at assessing whether the key conceptual objectives of the subject have been achieved, as well as multiple-choice and/or true/false test-type questions, which will allow a large part of the content to be assessed. The grade obtained in this synthesis test will account for 60% of the final grade for the subject and must be equal to or greater than 5 to average with the seminars module. The single assessment will be done on thesameday as the subject's assessment 2.

The evaluation of the seminar and lab work modules will follow the same process as the continuous evaluation. The grade obtained from both modules will account for 40% of the final grade of the subject.The seminar and lab work modules are compulsory attendance for all sessions. It is required to have passed both modules (grade of 5 or higher) in order to pass the subject.

Bibliography

Recommended books:

- Brown JW. 2015. Principles of microbial diversity. 1st ed. ASM Press.

- Madigan MT, Martinko JM, Bender KS, Buckley DH, Stahl DA. 2015. Brock Biología de los Microorganismos. 14ª ed. Pearson Education. Electronic resource.

- Madigan MT, Bender KS, Buckley DH, Sattley WM, Stahl DA. 2021. Brock Biology of Microorganisms. 16th ed. Pearson SA.

- Martín A, Béjar V, Gutiérrez JC, Llagostera M, Quesada E. 2019. Microbiología Esencial. 1ª ed. Editorial Médica Panamericana. Electronic resource.

- Ogunseitan O. 2008. Microbial diversity. Form and function in Prokaryotes. Blackwell Publishing. Electronic resource.

- Staley JT, Reysenbach AL. 2002. Biodiversity of microbial life: foundation of earth's biosphere. Willey-Liss, Inc, New York.

- Willey J, Sherwood LM, Woolverton CJ. 2009. Microbiología de Prescott, Harley y Klein. 7ª ed. MacGraw-Hill.

- Willey JM, Sandman KM, Wood DH. 2023. Prescott's Microbiology. 12th ed. MacGraw-Hill.

- Willey JM, Sandman KM. 2021. Prescott's Principles of Microbiology. 2nd ed. MacGraw-Hill. Electronic resource.

- Cann A J. 2016. Principles of molecular virology. (6th Ed). Academic Press. London.

- Cann A J. 2012. Principles of molecular virology. (5th Ed). Academic Press. London.

- Collier L, Oxford J. 2014. Virología humana : texto para estudiantes de medicina, odontología y microbiología. 3ª Ed. McGraw-Hill, México.

- Dimmock NJ, Easton AJ, Leppard KN. 2016. Introduction to modern virology. (7th Ed). Blackwell Publishing. Oxford.

- Domingo E. 2015. Virus as Populations: Composition, Complexity, Dynamics, and Biological Implications. Academic Press. Electronic resource.

- Flint SJ, Rall GF, Racaniello VR, Skalka AM, Enquist LW. 2015. Principles of virology: Molecular biology, pathogenesis, and control. (4th Ed). ASM Press. Washington. Electronic resource.

- Louten J. 2016. Essential human virology. Elsevier

- Oxford JS, Kellam P, Collier L. 2016. Human virology. (5th Ed). Oxford University Press. Oxford.

- Shors T. 2009. VIRUS. Estudio molecular con orientación clínica. Bogotà-Madrid.

- Tennant P, Fermin G, Foster JE. 2018. Viruses; molecular biology, host interactions, and applications to biotechnology. Academic Press.

- Wagner EK, HewlettMJ, Bloom DC, Camerini D. 2008. Basic virology. 3rd Ed. Blackwell Science, Massachusetts. Electronic resource.

Complementary books:

- The Prokaryotes.

Rosenberg E, DeLong EF, Lory S, Stackebrandt E, Thompson F (Editors). 2013-14.The Prokaryotes. Fourth Edition. 11 vol. Springer, New York. Electronic resource.

- Volume 1: The Prokaryotes: Prokaryotic Biology and Symbiotic Associations
- Volume 2: The Prokaryotes: Applied Bacteriology and Biotechnology
- Volume 3: The Prokaryotes: Prokaryotic Physiology and Biochemistry
- Volume 4: The Prokaryotes: Prokaryotic Communitiesand Ecophysiology
- Volume 5: The Prokaryotes: Human Microbiology
- Volume 6: The Prokaryotes: Alphaproteobacteria and Betaproteobacteria
- Volume 7: The Prokaryotes: Firmicutes and Tenericutes
- Volume 8: The Prokaryotes: Actinobacteria
- Volume 9: The Prokaryotes: Gammaproteobacteria
- Volume 10: The Prokaryotes: Deltaproteobacteria and Epsilonproteobacteria
- Volume 11: The Prokaryotes: Other Major Lineages of Bacteria and the Archaea

- The Prokaryotes: a handbook on the biology of bacteria

Dworkin M,Falkow S, Rosenberg E, Schleifer KH, Stackebrandt E (Editors). 2006. Third Edition. 7 vol. Springer, New York. Electronic resource.

- Volume 1: Symbiotic Associations, Biotechnology, AppliedMicrobiology
- Volume 2: Ecophysiology and Biochemistry
- Volume 3: Archaea. Bacteria: Firmicutes, Actinomycetes
- Volume 4: Bacteria: Firmicutes, Cyanobacteria
- Volume 5: Proteobacteria: Alpha and Beta Subclasses
- Volume 6: Proteobacteria: Gamma Subclass
- Volume 7: Proteobacteria: Delta and Epsilon Subclasses. Deeply Rooting Bacteria

- Bergey's Manual® of Systematic Bacteriology

Garrity G (Ed.) 2001-2012. Bergey's Manual of Systematic Bacteriology. Second Edition. 5 vol. Springer, New York.

Volume package:

- Volume 1: Boone DR, Castenholz RW (Eds.). 2001. Bergey's Manual of Systematic Bacteriology, Second Edition. Volume One: The Archaea and the Deeply Branchingand Phototrophic Bacteria. Springer, New York.
- Volume 2: Brenner DJ, Krieg NR, Staley JT (Eds.). 2005. Bergey's Manual of Systematic Bacteriology, Second Edition, Volume Two: The Proteobacteria. Springer, New York.

- Volume 3: De Vos P, Garrity G,Jones D, Krieg NR, Ludwig W,Rainey FA, Schleifer K-H, Whitman WB (Eds.). 2009. Bergey's Manual of Systematic Bacteriology: Volume 3: The Firmicutes. Springer, New York.
- Volume 4: Krieg NR, Ludwig W, Whitman WB, Hedlund BP, Paster BJ, Staley JT, Ward N, Brown D(Eds.). 2010. Bergey's Manual of Systematic Bacteriology, Second Edition. Volume 4: The Bacteroidetes, Spirochaetes, Tenericutes (Mollicutes), Acidobacteria, Fibrobacteres, Fusobacteria, Dictyoglomi, Gemmatimonadetes, Lentisphaerae, Verrucomicrobia, Chlamydiae, and Planctomycetes. Springer, New York.
- Volume 5: GoodfellowM, Kämpfer P, Busse H-J,Trujillo M, Suzuki K-I, Ludwig W, WhitmanWB (Eds.). 2012. Volume 5: The Actinobacteria. Springer, New York.

- Bergey's Manual® of Systematics of Archaea and Bacteria

Whitman WB (Ed.). 2015. Bergey's Manual of Systematics of Archaea and Bacteria (digital Ed.). First Edition. John Wiley & Sons, Inc. http://wileyonlinelibrary.com/ref/bergeysmanual

- Encyclopedia of Virology

Bamford, Dennis H, and Mark A. Zuckerman (Eds.). 2021. Encyclopedia of Virology. Fourth Edition. Academic Press. https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010400654406709

In this link, you can find an infographic prepared by the Library Service to facilitate the location of electronic books:
https://bibcercador.uab.cat/discovery/search?search_scope=CourseReserves&vid=34CSUC_UAB:VU1&query=c

Software

No specific software is needed in this subject.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	131	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	132	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	131	Catalan	first semester	afternoon
(PLAB) Practical laboratories	132	Catalan	first semester	afternoon
(PLAB) Practical laboratories	133	Catalan	first semester	afternoon
(PLAB) Practical laboratories	134	Catalan	first semester	afternoon
(TE) Theory	13	Catalan	first semester	morning-mixed