UAB
Universitat Autònoma de Barcelona

Laboratory IV

Code: 100977
ECTS Credits: 3

2024/2025

Degree	Type	Year
2500502 Microbiology	OB	2

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

Students are advised to review the scientific-technical content on which this subject is based.

It would be desirable if students review basic concepts of the microbial world previously acquired in the first course of the Degree in Microbiology, especially the subjects of *Laboratoris integrats I* and *II*, and the subjects programmed in the first semester of the second course, such as *Laboratori integrat III* and Protistology, and also a good knowledge about the subjects coursed simultaneously in the second semester of the second course.

For attending this subject, the student must justify having passed the Safety Test in the teaching laboratories found in the "Security" space of the moodle of the Faculty of Biosciences, and be knowledgeable and accept the rules of operation of the laboratories of 'this Faculty. For safety reasons, if this test has not been passed or you are not wearing a lab coat, access to the laboratory will not be allowed.

Objectives and Contextualisation

This is a compulsory subject, a nuclear course from the degree of Microbiology, which introduces students to the knowledge of different microbiological techniques to study in situ the ecophysiology in natural or artificial

environments and in a microbiology laboratory. The achievement of the competencies of the course will allow students to acquire new knowledge related to other practical and theoretical subjects simultaneously and subsequently coursed in the degree of Microbiology.

In addition to the learning outcomes listed in the following section, students at the end of this subject will be able to:

1.- Identify and apply different methodologies for the ecophysiological study of microbial ecosystems.

Apply appropriate sampling strategies and techniques for different types of environment.

Apply sample processing methods for subsequent microbiological analysis.

Determine environmental parameters and relate them to the habitat where the different functional groups of microorganisms are found.

2.- Develop and analyse experimental laboratory models.

Create microcosms and reproduce natural environments in the laboratory.

Use procedures and strategies for selecting, sowing, cultivating and enriching different functional groups of microorganisms.

Determine the microbial concentration in various samples using microscopy and/or seeding methods in culture media.

Interpret electron microscopy images related to microorganisms.

Use conventional techniques for the identification of microorganisms.

3.- Apply and interpret isolation and counting techniques, biomass determination, activity measurements and primary production useful in microbial ecology.

Identify and use different methodologies of biological analysis for the ecophysiological study of microbial ecosystems.

4.- Integrate and use methodologies for the characterization of microbial communities (prokaryotes and eukaryotes) that are part of a given ecosystem.

Apply appropriate sampling strategies and techniques for different types of environment.

Apply sample processing methods for subsequent microbiological analysis.

Determine environmental parameters and relate them to the habitat where the different functional groups of microorganisms are found.

5.- Use bibliography or Internet tools, specific to microbiology and other related sciences, both in English and in their own language.

Review, classify and select information.

Demonstrate the ability to work individually, in groups, in multidisciplinary teams and in an international context.

Learning Outcomes

1. CM17 (Competence) Critically evaluate experimental results in the field of microbiology for their presentation clearly and concisely.
2. CM18 (Competence) Integrate knowledge and skills for the design of experiments in the field of microbiology and the interpretation of their results working individually and in teams.
3. KM25 (Knowledge) Describe the theoretical foundations and instrumentation used in basic and advanced experimental techniques in microbiology and other related sciences, including sterilization and microbial load reduction procedures in industrial, clinical and experimental environments.
4. KM26 (Knowledge) Identify the principles and standards of good laboratory and biosafety practices.
5. SM25 (Skill) Manage computer resources for the treatment of experimental data within the field of microbiology and other biosciences.
6. SM26 (Skill) Apply conventional microbiological techniques that allow differentiating and characterizing different microbial groups and manipulate materials and samples under aseptic conditions.
7. SM27 (Skill) Develop appropriate methodologies to sample, characterise and manipulate microbial populations and communities in natural and artificial ecosystems.
8. SM28 (Skill) Use different indicators and tests based on microorganisms or their components for industrial, sanitary, biotechnological purposes or to assess environmental impacts.

Content

The subject is organized into three sections, as detailed below:

Section 1: Methodological block

3 methodological and monographic sessions of three hours each session.

Section 2: Characterization of experimental models of laboratory (microcosms)

7 sessions related to the characterization of the microcosms designed in the previous module. These sessions are divided into 2 different weeks. The first week corresponds to 3 sessions of three hours and a session of four hours, and the second week with 2 sessions of three hours and a sessió of two hours.

Section 3: Study of a natural environment: microbial diversity

In this module, a field trip to a specific natural environment of 8 hours is programmed. Later there will be 2 sessions of 3 hours, 1 session of 2 hours, and 1 session of 4 hours, in order to analyze the field samples of microbial diversity.

The content for each module session are as follows:

Section 1: Methodological block

It is intended to introduce the student to different methodologies to study the ecophysiology of microbial ecosystems.

Session	Content
1	Phototrophic and heterotrophic microbial activity evaluation. Oxygen and sulfide: initial measures. Phototrophic (pigments) and total (DNA) microbial biomass determination.
2	Phototrophic (pigments) and total (proteins) microbial biomass determination Preparation of experimental models of laboratory (microcosms).

3	Phototrophic and heterotrophic microbial activity evaluation. Oxygen and sulfide: final measures. Primary production in planktonic environments.

Section 2: Characterization of experimental models of laboratory (microcosms)

The purpose of this module is an integration of different methodologies for the characterization of microbial communities and shows the usefulness of experimental models of the laboratory in research.

Session	Content
1	Observation and description of the experimental models. Preparation of enrichment cultures (liquids and solids) of phototrophic and heterotrophic and aerobic and anaerobic. Enrichment cultures of prokaryotes viruses. Plate counts of water and sediment samples: spread on plates.
2	Metabolic characterization of the microcosms (carbon sources, enzymes). Enrichment observation. Viable plate counts. Isolation and quantification of the virus: the plaque assay (part I) Isolation and quantification of a microorganism (Gram stain, cultures)
3	Metabolic characterization of the microcosms (enzymes) Quantification of the virus: the plaque assay (part II) Isolation and quantification of a microorganism (biochemical and physiological characterization). DNA extraction of the isolated microorganism from the microcosm
4	Biochemical identification of the isolated microorganism Metabolic characterization of the microcosms (carbon sources) Virus DNA extraction from the microcosm Discussion of the obtained results
5	Enrichments (observation) DNA amplification (rRNA 16S gene and viral DNA)
6	Enrichments (observation) TEM preparation of virus enrichment, PCR gel Results analysis

7	Sequencing sample preparation Viral observation by TEM Discussion

Section 3: Study of a natural environment: microbial diversity

This module takes into account the contents of the modules made previously so that all the knowledge and content achieved previously will be applied to the study of a natural ecosystem.

Session	Content
Field trip	Limnology and sampling collection techniques Physical and chemical parameters determination
1	Photosynthetic protist observation
2	Heterotrophic protist observation
3	The abundance of different bacterial groups using techniques of hybridization in situ with fluorochromes-labeled probes. Gel agarose for detection of the virus of eukaryotes. Detection of the virus of eukaryotes
4	Microbial diversity by Confocal laser scanning microscopy (CLSM). Results analysis Final discussion

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Field trip	8	0.32	CM17, CM18, KM25, KM26, SM25, SM27, SM28, CM17
Laboratory Classes	42	1.68	CM17, CM18, KM25, KM26, SM25, SM26, SM27, SM28, CM17
Presentation of the subject	1	0.04	KM25, KM26, SM25, KM25
Type: Supervised			
Tutory	1	0.04	KM25, KM26, SM25, KM25

Type: Autonomous			
Comprehensive reading of the Manual of the course	6	0.24	CM18, KM25, KM26, SM25, SM26, SM27, SM28, CM18
Drafting of the lab delivery	2	0.08	CM17, CM18, KM25, KM26, SM26, SM27, CM17
Solving problems	2	0.08	CM17, CM18, KM25, KM26, SM25, SM26, SM27, CM17
Study	10	0.4	CM17, CM18, KM25, KM26, SM25, SM26, SM27, SM28, CM17

This course will be taught in three small groups of students (maximum of 24 students per session).

Class attendance is a mandatory requirement in order to pass the course. A student who cannot attend an individual or different sessions for justified and unforeseeable cause (as a health problem, death of a relative up to a second degree, accident, enjoy the status of the elite athlete and have a competition or sports activity of obligatory attendance, etc) shall be present, as soon as possible, official documentation to the responsible of the course (official medical certificate stating explicitly the inability to attend the session/s, police attestation, justification of the competent sports authority, etc.).

The field trip that is part of module 3 will be held jointly by all the groups of practices. To be able to attend this outing, students must give the teachers, as sufficiently in advance, a printed and signed copy of the pdf generated about the Safety Test corresponding to the Out-of-Campus Outings (section "Security" moodle Faculty of Biosciences).

Before the beginning of the practice sessions, the students will have the Manual of the course.

At each lab session, it is compulsory for the students to wear their own lab coat, laboratory glasses, permanent marker, lighter, calculator, and the Manual of the course, which will be available in the Virtual Campus, Moodle platform, or where the teacher says. It is also necessary, and only during module 2, to carry a Miquelrius, Abacus, or Oxford notebook with sewn sheets. In this notebook lab, students must write the information according to the *Guia de característiques i anotacions* that they will find in the Manual of the course and that student should be read before starting module 2.

Students will work in pairs and under the supervision of the teacher. At the beginning and/or during each session the teacher will make brief theoretical explanations of the practice content and procedures to be carriedout by the students, as well as specific safety measures and the different chemical and biological generated waste treatment.

It is essential that the student makes a comprehensive reading of the Manual of the course, and becoming familiar with the practices that will take place in each session, as well as the methodology that will be applied in each case. During each practice session, and whenever the teacher considers it necessary, it will do questions to students in reference to the previous reading of the Manual.

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

Section 1: Exercices delivery	5	0	0	CM17, CM18, KM25, KM26, SM25, SM26, SM27, SM28
Section 1: Questionnaire with multiple choice questions	20	1	0.04	CM17, CM18, KM25, KM26, SM26, SM27, SM28
Section 2: Exercices delivery	4	0	0	CM17, CM18, KM25, KM26, SM25, SM26, SM27
Section 2: Notebook lab delivery	8	0	0	CM17, CM18, KM25, KM26, SM26, SM27
Section 2: Questionnaire with multiple choice questions	28	1	0.04	CM17, CM18, KM25, KM26, SM25, SM26, SM27, SM28
Section 3: Questionnaire with multiple choice questions/short questions	17.5	0.5	0.02	CM17, CM18, KM25, KM26, SM25, SM26, SM27
Section 3: Report delivery	3.5	0	0	CM17, CM18, KM25, KM26, SM25, SM26, SM27, SM28
Section 3: Visum examination	14	0.5	0.02	CM18, KM25, KM26, SM25, SM26, SM27, SM28

The assessment of the course will be done by section and in a continuous manner. The weight of each module with respect to the final grade of the course is Section 1, 25 %; Section 2, 40 %; and Section 3, 35 %. To pass the course students must get at least a 5 in each module and in the final grade of the course.

The evaluation in each section will be as follows:

Section 1: Methodological block. Exercises delivery (5 %); Questionnaire with multiple-choice questions (20 %).

Section 2: Characterization of experimental models of laboratory (microcosms). Exercises delivery (4 %); Notebook lab delivery (8 %); Questionnaire with multiple-choice questions (28 %).

Section 3: Study of a natural environment: microbial diversity. This integrated section is taught by three teaching units: Microbiology (M), Botany (B), and Zoology (Z). A Visum examination (14 %, B, and Z); Report delivery (3.5 %, M); Questionnaire with multiple choice and/or short questions (17.5 %, M, B, and Z). Questions concerning the content included in the Manual of the course explained in practical laboratory sessions and/or explained in the field trip (module 3) could be included in the three questionnaires. The final grade for this module will be distributed in the following manner: Microbiology (17.5 %), Botany (8.75 %), and Zoology (8.75 %). The requirements to sum the obtained notes in the other units are A minimum note of 4.5 in each Visum examination (B and Z), and a 4 in the report delivery (M) and in the questionnaires (M, B, and Z).

In each section, the student's attitude in the laboratory, punctuality, the use of laboratory equipment (gown and goggles), having passed the safety tests in the teaching laboratories and the safety tests on the out-of-campus activities, and the understanding and follow-up of the Manual of the subject will be taken into account. This assessment does not entail an increase in the score, but it can mean the reduction of up to 20% of the final mark obtained in each section.

Since attendance to the activities programmed in this course is mandatory (practical sessions and field trips), the absence of any of the sessions must be justified 48h after the date of the activity. The non-attendance to the field trip without justified cause will result in a penalty (2 points) in the final note of Section 3, and this penalty shall be maintained in the recovery exam. In case of a strike, if a student decides to exercise his right to strike, he will have to communicate to the responsible for a maximum period of 48h after the day of the

strike. In any case, the absence may exceed 20 % of the programmed activities. The maximum absence in each of the sections is set at a maximum of 10% to be evaluated. If this value is exceeded, the student will be qualified as Not-Valuable.

Students who do not pass the evaluations of the different sections of the course will be able to recover them in the date scheduled at the end of the semester (recovery exam), performing a questionnaire with multiple choice and/or short questions and/or a visum examination associated with the section not previously passed. In this course, there will be no consideration of improvement, neither global nor by sections. To be able to attend this exam it is necessary that the student has been previously evaluated for continuous evaluation activities equivalent to 2/3 (67 %) of the final mark.

Students who do not obtain the minimum qualification required to pass each of the sections of the integrated laboratory, will not be able to pass the subject. In this case, the final maximum grade of the subject will be 4.

As this course is differentiated into sections, from the second enrolment, students will only have to perform again the specific sections that have not been previously passed.

Single assessment

Students entered for a single assessment must complete face-to-face practical sessions (PLAB) and field trips (PCAM).

Single assessment consists of a single examination with short-answer and multiple-choice questions on the contents of the practical sessions taught during the different modules of the subject. Specifically, by Module, it will include Test questionnaires (Modules 1, 2 and 3 (Microbiology)) and Visum exams of Zoology and Botany (Module 3). In the case of Module 3, the same requirements will be requested, to be able to add the grades obtained in the other units, indicated for continuous evaluation.

This exam will have a weight of 65.4 % of the final grade of the subject, the rest of the final grade will correspond to the rest of training activities programmed by Module: Delivery Exercises (Modules 1 and 2); Delivery Laboratory notebook (Module 2); Submission of the Microbiology Report (Module 3), as well as the Questionnaires Tests / Short Questions of Zoology and Botany (Module 3), which will follow the same procedure as in the continuous evaluation.

The single assessment examination will coincide with the same date set in the calendar for the last continuous assessment test (final assessment Module 3). It can be recovered on the day set for the subject's recovery.

Bibliography

The objectives and the protocols that students will be used in each session will be detailed in the Manual of the course. This Manual also contains the bibliography associated with each of the different practical sessions. If it was necessary, teachers may also give further information to the students via the Virtual Campus or Moodle platform. However, some relevant references (books and web links) are listed below.

Books

Altaba, C. et al. 1991. Invertebrats no artròpodes. Història Natural dels Països Catalans. Vol. 8. Enciclopèdia Catalana. Barcelona.

Atlas, R.M. & Bartha, R. 2002. Ecologia microbiana y Microbiologia ambiental.(Trad.4a ed. americana Addison Wesley). Pearson Educación. Madrid.
http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4649

Bandh, S.A. 2019. Freshwater Microbiology: Perspectives of Bacterial Dynamics in Lake. Elsevier.
https://www.sciencedirect.com/science/book/9780128174951

Barton, L.L, and Northup D.E. 2011. Microbial Ecology. Wiley-Blackwell. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118015841

Bellinger, E.G., and Sigee D.C.2015. Freshwater Algae: identification and use as bioindicators. Wiley-Blackwell.UK. https://onlinelibrary.wiley.com/book/10.1002/9781118917152; https://ebookcentral.proquest.com/lib/uab/detail.action?docID=1895748

Burlage, R.S. Atlas, R., Stahl, D., Geesey, G., and Sayler, G. 1998. Techniques inmicrobial ecology. Oxford University Press. Washington, DC.

Cann, A.J. 2012. Principles of molecular virology. 5th Ed. Academic Press, Waltham, MA. https://www.sciencedirect.com/science/book/9780123849397

Carrion, J. S. 2003. Evolución vegetal. DM. Murcia.

de Bruijin FJ. 2011. Handbook of Molecular Microbial Ecology I: Metagenomics and Complementary Approaches. Wiley-Blackwell. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118010518

de Bruijin FJ. 2011.Handbook of Molecular Microbial Ecology II: Metagenomics in Different Habitats. Wiley-Blackwell. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118010549

Hurst, J. 2000. Viral Ecology. Academic Press. https://www.sciencedirect.com/science/book/9780123626752

Llimona, X. (ed.) 1985. Plantes inferiors. Història Natural dels Països Catalans. Vol. 4. Enciclopèdia Catalana.Barcelona.

Madigan, MT., JM. Martinko, KS. Bender, DH. Buckley, DA. Stahl. 2015 (14 ed). Brock Biología de los microorganismos. Pearson Educación, S.A. https://www.academia.edu/39077515/Biolog%C3%ADa_de_los_microorganismos_BROCK; http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5850

Madigan, MT., KS. Bender, DH. Buckley, WM Sattley, DA. Stahl. 2019. Brock Biology of microorganisms. 15th edition. Pearson, S.A. ISBN: 9780134261928.

Margulis, L., Corliss, J.O., Melkonian, M, Chapman, D.J. (1990). Handbook of Protoctista. Jones& Barlett Publishers, Boston.

Martín A,V Béjar, JC Gutierrez, M Llagostera, E. Quesada. 2019. Microbiología Esencial. 1ª edición. Editorial Médica Panamericana. ISBN: 9788498357868. https://www.medicapanamericana.com/VisorEbookV2/Ebook/9788491102427

Maunsbach, A.B. 1999. Biomedical Electron Microscopy Illustrated Methods and Interpretations. Academic Press. https://www.sciencedirect.com/science/book/9780124806108; https://ebookcentral.proquest.com/lib/uab/detail.action?docID=340619

Ogunseitan, O.2005. Microbial Diversity: form and function in prokaryotes. Blackwell Publishing. https://onlinelibrary.wiley.com/book/10.1002/9780470750490

Pepper, IL., CP. Gerba, TJ Gentry. 2014. Environmental Microbiology. 3rd edition. Academic Press (Elsevier).ISBN: 978-0-12-394626-3.

Sigee, DC. 2005. Freshwater microbiology: Biodiversity and Dynamic Interactionsof Microorganismes in the Aquatic Environment. John Wiley & Sons, Ltd. https://onlinelibrary.wiley.com/doi/book/10.1002/0470011254

Simpson, M.G. 2006. Plant Systematics. Elsevier. Academic Press.

Streble, H. and Krauter, D. 1987. Atlas de los microorganismos de agua dulce. La vida en una gota de agua.Ed.Omega, S.A. (Barcelona).

Willey, J.M., Sherwood, L.M., and Woolverton, C.J. 2009. Microbiologia de Prescottogy, Harley y Klein. Séptima edición. McGraw-Hill-Interamericana de España. ISBN:9788448168278.

Willey, J.M., Sherwood, L.M., and Woolverton, C.J. 2017. Prescott's Microbiology, 10th edition. McGraw-Hill-Education. ISBN:9781259669934.

In this link, it can be found an infographic prepared by the Library Service to facilitate the location of electronic books: Cercador Biblioteques UAB - 100977

Web links

Aula Virtual de l'Autònoma Interactiva: https://cv2008.uab.cat/

All the Virology on the WWW http://www.mirrorservice.org/sites/www.virology.net/

British Society for Protist Biology http://www.protist.org.uk/

Introduction to the Viruses http://www.ucmp.berkeley.edu/alllife/virus.html

Manual of Aquatic Viral Ecology http://www.aslo.org/books/mave/

Natural History Museum http://www.nhm.ac.uk/jdsml/research-uration/research/projects/protistvideo/

Tree of life web project http://tolweb.org/tree/

Software

No specific software is required to take this subject.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	721	Catalan	second semester	morning-mixed
(PCAM) Field practices	721	Catalan	second semester	morning-mixed
(PCAM) Field practices	722	Catalan	second semester	morning-mixed
(PCAM) Field practices	723	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	721	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	722	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	723	Catalan	second semester	morning-mixed