

Degree programme	Type	Course
Microbiology	OB	3

Contact lecturer

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Teaching staff

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Group languages

You can consult this information at the [end](#) of the document.

Prerequisites

- Students are advised to review the scientific-technical content on which this subject is based
- It is advisable to take this course once all the subjects programmed in the first and second years of the Degree of Microbiology have been studied, especially the subjects of Microbiology, Genetics, Molecular Biology of Eukaryotes, and Virology since it is essential to have reached the competences of all of them to reach those associated to the subject of Prokaryotic Molecular Biology.

Objectives

This is a mandatory subject in the Microbiology Degree program, which introduces students to the knowledge of Molecular Biology of Prokaryotes. This subject is crucial in the student's education as it enables them to understand the molecular functioning of prokaryotic organisms, allowing them to grasp the productive potential of microorganisms and their applications.

The specific objectives to be achieved in this subject are defined as follows:

- Identify at a molecular level the mechanisms and microbiological processes.
- Recognize the structure of prokaryotic genetic material, distinguish its replication and repair mechanisms, as well as the organizational variability they present and the relationship between these mechanisms and the cell cycle.
- Recognize the factors that control gene expression in prokaryotes and relate them to existing environmental conditions.
- Identify the molecular mechanisms in prokaryotic organisms to control the entry of exogenous material.
- Distinguish the different genetic elements in prokaryotes, their distribution capacity, and the gene

expression control systems they include.

- Identify the molecular bases of antibiotic resistance, their origins, transmission mechanisms, and the impact they have on infectious processes.

Learning outcomes

- CM11 (Propose strategies for molecular cloning, mutant generation and genetic improvement using omics analysis with ethical responsibility and gender perspective to provide innovative responses to the needs and demands of society.) Propose strategies for molecular cloning, mutant generation and genetic improvement using omics analysis with ethical responsibility and gender perspective to provide innovative responses to the needs and demands of society.
- CM12 (Integrate knowledge and skills of molecular biology and genomics to develop and present academic work in the field of microbiology, either in English or in one's own language or others and working individually and in groups.) Integrate knowledge and skills of molecular biology and genomics to develop and present academic work in the field of microbiology, either in English or in one's own language or others and working individually and in groups.
- KM17 (Describe the molecular mechanisms responsible for the replication, conservation and transfer of genetic material, gene expression and regulation.) Describe the molecular mechanisms responsible for the replication, conservation and transfer of genetic material, gene expression and regulation.
- SM15 (Use bibliography and databases related to molecular biology and genomics, both in English and in one's own language.) Use bibliography and databases related to molecular biology and genomics, both in English and in one's own language.
- SM16 (Relate the factors that control the different levels of gene expression with adaptation to existing environmental conditions and their application in biotechnology.) Relate the factors that control the different levels of gene expression with adaptation to existing environmental conditions and their application in biotechnology.
- SM18 (Relate the processes of transfer and conservation of genetic information with its diverse applications in genetic engineering.) Relate the processes of transfer and conservation of genetic information with its diverse applications in genetic engineering.

Contents

The subject will be organized into two different parts:

- Participatory theoretical classes
- Resolution of practical cases, in which theoretical concepts are applied to solve problems and real cases associated with the subject matter.

The content of the subject consists of the following lessons:

Topic 1. The Bacterial Chromosome and the Cell Cycle

Structural organization of the bacterial chromosome. Initiation, elongation, and termination of replication. Chromosome segregation and associated mechanisms. Regulation of cell division. Phases and regulation of the bacterial cell cycle.

Topic 2. Transcription in Prokaryotes I: Basic Organization and Control

Structure of promoters in bacteria and archaea. Monocistronic and polycistronic transcriptional units. Mechanisms of transcription initiation, elongation, and termination in bacteria. mRNA degradation. Mechanisms of transcription attenuation. Transcription in archaea: similarities and differences with bacteria.

Topic 3. Transcription in Prokaryotes II: Complex Regulation of Gene Expression

Mechanisms of transcriptional control. Regulation at the level of the RNA polymerase. Global modulators and multigenic regulatory networks. Operons, regulons, and modulons. Regulatory RNAs and post-transcriptional control.

Topic 4. Mutagenesis and DNA Repair Mechanisms

Types of mutations: spontaneous, induced, lethal, and suppressor mutations. Adaptive response to alkylating agents. Mismatch repair (MMR). Photoreactivation. Base and nucleotide excision repair. Recombination-based repair. Emergency repair response or SOS system.

Topic 5. Bacterial Defense Mechanisms

Restriction-modification systems: types and functions. Mcr/Mrr systems. Adaptive immune systems in bacteria: CRISPRs. Retrons and other anti-phage systems. Type VI secretion systems as mechanisms of microbial competition.

Topic 6. Bacteria-Bacteriophage Interaction

Structure of bacteriophages. Regulation of viral gene expression. Temperate and virulent phages and their life cycles. Bacteriophage T4 as a lytic virus model. Lambda and P22 phages as models of temperate phages. Generalized, specialized, and lateral transduction. Phage conversion and its impact on bacterial physiology.

Topic 7. Mobile Genetic Elements

Insertion sequences (IS). Transposons. Mechanisms of transposition and their regulation. Integrons and their role in the cell. Pathogenicity islands and other mobile genetic elements.

Topic 8. Plasmids and Integrative Conjugative Elements (ICEs)

Molecular structure and properties of plasmids. Replication and maintenance. Incompatibility systems. Plasmid stability.

Topic 9. Bacterial Conjugation

Mechanisms of plasmid conjugation in Gram-positive and Gram-negative bacteria. Conjugative and mobilizable plasmids. Transfer of plasmids and mobilization of the bacterial chromosome. ICEs and their role in microbial evolution. Ecological and evolutionary implications of conjugation.

Topic 10. Transformation, Vesiculation, and Other Horizontal Gene Transfer Mechanisms

Natural transformation. Competence state. Molecular mechanisms associated with natural transformation. Bacterial extracellular vesicles (BEVs): biogenesis, composition, and functions. Intercellular nanotubes.

Topic 11. Mechanisms of Antimicrobial Resistance

Origin and evolution of antimicrobial resistance. Mechanisms of resistance to antimicrobials. Intrinsic vs. acquired resistance. Horizontal gene transfer and dissemination of resistance genes. The silent pandemic.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Individual tutorials	1	0.04	CM11, KM17, SM16, SM18
Practical cases resolution	15	0.6	CM11, CM12, KM17, SM15, SM16, SM18
Autonomous practical cases resolution	31	1.24	CM11, CM12, KM17, SM15, SM16, SM18
Study	60	2.4	KM17, SM15, SM16, SM18
Participatory master classes	30	1.2	KM17, SM16, SM18
Reading recommended texts	8	0.32	SM15, SM16

The Prokaryotic Molecular Biology course consists of two modules of in-person activities:

Theoretical module: Composed of participatory lecture classes.

Practical case module: Consists of sessions in which practical cases and problems are solved, along with occasional methodological aspects related to the field of Prokaryotic Molecular Biology. These classes are conducted using a problem-based learning (PBL) approach with a small number of students, with the dual purpose of:

- a) Facilitating the understanding of the knowledge presented during the theoretical classes. Solving practical cases should allow the student to integrate theoretical knowledge with applied aspects.
- b) Enabling the student to design basic experiments related to the course material and to interpret the data obtained.

At the beginning of the course, students will receive a dossier with a proposed set of problems for each topic, which they will work on throughout the semester. During the sessions of this module, methodological aspects are addressed, and part of the problems in the dossier are collaboratively resolved.

To ensure that the concepts used in the problem-solving sessions match the content already covered in the lectures, some reorganizing and/or swapping between theoretical and problem classes may be carried out at certain points in the course.

These changes will under no circumstances alter the total number of in-person teaching sessions for the course.

The autonomous activities for this subject include: studying, reading texts, and solving problems.

Finally, students also have access to individual tutorials, scheduled in advance with the teaching team.

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

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Second in-person exams	45% of the final grade	2	0.08	CM11, CM12, KM17, SM16, SM18
First in-person exams	35% of the final grade	2	0.08	CM11, CM12, KM17, SM16, SM18
Class participation in discussions and case development	2% of the total course grade	0	0	CM11, CM12, KM17, SM15, SM16, SM18
Individual resolution of case studies	10% of the final grade	1	0.04	CM11, CM12, KM17, SM15, SM16, SM18
Practical case resolution in the classroom	8% of the total course grade	0	0	CM11, CM12, KM17, SM15, SM16, SM18

The course assessment will be individual and may follow either a continuous or a single-assessment format, through the following evaluations:

Continuous Assessment

Theory Assessment Module (80% of the final grade)

Assessment of this module will be based on two written examinations that will include short-answer theoretical questions (worth up to 4 points out of 10) and problem-solving exercises (worth up to 8 points out of 10).

- The first examination will account for 35% of the overall course grade. It will be scheduled in the middle of the semester and will cover all concepts presented in the theoretical sessions up to that point.
- The second examination will account for 45% of the overall course grade. It will be scheduled at the end of the semester and will cover all theoretical concepts included in the course, including those assessed in the first examination.

To pass this assessment module, students must pass both written examinations with a grade of 5.0 or higher. If the student passes the module and the grade obtained in the second examination is higher than the weighted average of the two examinations, the final grade for this module will be the grade obtained in the second examination.

Students who do not pass this module will be entitled to a resit assessment, scheduled at the end of the semester, in which they may retake the first examination, the second examination, or both. In this case, the maximum achievable grade will be 8 out of 10. To pass the module, students must obtain a grade of 5.0 or higher.

Students who have passed the module may sit for a grade improvement examination for the Theory Assessment Module. This examination will take place at the end of the semester on the date scheduled for the resit assessment. Taking the grade improvement examination implies relinquishing the grade previously

obtained in the Theory Assessment Module. To pass the improvement examination, students must obtain a score of 5.0 or higher.

Students wishing to take the grade improvement examination must notify the course coordinator in writing at least 72 hours before the date scheduled for the resit assessment.

To be eligible for the resit examination of the Theory Module, students must previously have been assessed in activities accounting for at least two-thirds of the total course or module grade.

Practical Case Studies Module (20% of the final grade)

Assessment of this module will consist of the following activities:

- a) Class participation (1 point out of 10).
- b) Individual resolution of problems and questions proposed in class (4 points out of 10).
- c) Individual completion of a questionnaire related to the course content, which will be made available at the end of the semester and must be submitted through the virtual campus before the second course assessment (5 points out of 10).

General Considerations

To pass the course, students must obtain a grade of 5.0 or higher in the Theory Module, and an overall final course grade of 5.0 or higher.

The final course grade corresponds to the weighted average of the grades obtained in the two modules.

If, following the resit assessments, a student obtains a final grade of 4.0 to 4.9 in any module, this grade may be averaged with the grades of the other module(s). If the resulting overall grade is 5.0 or higher, the course will be considered passed. In this case, the final course grade awarded will be 5.0.

The final grade may be adjusted upward when the teaching team considers it appropriate in order to compensate for the effects of grade fragmentation associated with continuous assessment.

To be eligible for resit assessments, students must previously have been assessed in activities accounting for at least two-thirds of the total course or module grade. Therefore, students will receive the grade "Not Assessable" (NA) when completed assessment activities account for less than 67% of the final course grade.

Any irregularity committed during an assessment activity (academic fraud, plagiarism, or misuse of Artificial Intelligence, unless such use is explicitly authorized in the course guide) that may result in a significant alteration of the assessment outcome will lead to a grade of 0 for that activity. If the course guide establishes that obtaining a minimum grade in that activity is a mandatory requirement for passing the course, or if multiple irregularities occur within the same course, the final grade for the course will be 0. In addition, disciplinary proceedings may be initiated against the student.

From the second enrollment onwards, students will not be required to complete Module 2 if they successfully achieved the competencies associated with this part of the course in previous academic years.

Use of Artificial Intelligence (AI) Technologies

For this course, the use of AI is permitted exclusively for support tasks, such as bibliographic or information searches, text proofreading, translations, or other purposes authorized at the discretion of the teaching staff.

Students must clearly identify which parts of their work have been generated using this technology, specify the

tools employed, and include a critical reflection on how these tools have influenced both the process and the final outcome of the activity.

Lack of transparency regarding the use of AI in an assessed activity will be considered a breach of academic integrity and may result in a partial or total penalty in the grade for the activity, or more severe sanctions in serious cases.

Single Assessment

The single assessment consists of a single comprehensive examination covering all the theoretical contents of the course as well as students' problem-solving skills.

The grade obtained in this comprehensive examination will account for 100% of the final course grade.

This examination will be scheduled on the same date as the second midterm examination of the continuous assessment pathway.

To pass the course, students must obtain a grade of 5.0 or higher.

If the examination is not passed, students will be required to sit for a resit assessment, consisting of an equivalent examination. In order to pass the course, students must obtain a grade of 5.0 or higher in the resit examination.

Bibliography

Henkin, Tina M. & Peters, Joseph E. (2020). *Snyder and Champness Molecular Genetics of Bacteria* (5th ed.). American Society for Microbiology.

- Available in print at the library.

Park, Simon. (2010). *Molecular Genetics of Bacteria* (5th ed.). Wiley-Blackwell.

- Available online.

Snyder, Larry. (2013). *Molecular Genetics of Bacteria* (4th ed.). ASM Press.

- Available online.

Snyder, Larry. (2013). *Molecular Genetics of Bacteria* (4th ed.). ASM Press.

- Available in print at the library.

Software

Not done

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	73	Catalan	first semester	morning-mixed

(PAUL) Classroom practices	731	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	732	Catalan	first semester	morning-mixed