Molecular Biology of Prokaryotes

Code: 100985
ECTS Credits: 6

2025/2026

Degree	Type	Year
Microbiology	OB	3

Contact

Name: Susana Campoy Sanchez

Email: susana.campoy@uab.cat

Teachers

Susana Campoy Sanchez

Jesus Aranda Rodriguez

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 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 and Contextualisation

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

1. CM11 (Competence) 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.
2. CM12 (Competence) 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.
3. KM17 (Knowledge) Describe the molecular mechanisms responsible for the replication, conservation and transfer of genetic material, gene expression and regulation.
4. SM15 (Skill) Use bibliography and databases related to molecular biology and genomics, both in English and in one's own language.
5. SM16 (Skill) Relate the factors that control the different levels of gene expression with adaptation to existing environmental conditions and their application in biotechnology.
6. SM18 (Skill) Relate the processes of transfer and conservation of genetic information with its diverse applications in genetic engineering.

Content

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 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.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Participatory master classes	30	1.2	KM17, SM16, SM18, KM17

Practical cases resolution	15	0.6	CM11, CM12, KM17, SM15, SM16, SM18, CM11
Type: Supervised			
Individual tutorials	1	0.04	CM11, KM17, SM16, SM18, CM11
Type: Autonomous			
Autonomous practical cases resolution	31	1.24	CM11, CM12, KM17, SM15, SM16, SM18, CM11
Reading recommended texts	8	0.32	SM15, SM16, SM15
Study	60	2.4	KM17, SM15, SM16, SM18, KM17

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 understanding of the knowledge presented in 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 the content already covered in the lectures, some reordering and/or swapping between theoretical and problem classes may be carried out at certain points in the course.

These changes will under no 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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Class participation in discussions and case development	2% of the total course grade	0	0	CM11, CM12, KM17, SM15, SM16, SM18

First in-person exams	35% of the final grade	2	0.08	CM11, CM12, KM17, 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
Second in-person exams	45% of the final grade	2	0.08	CM11, CM12, KM17, 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

1. Theory Module (80% of the final grade):
   Throughout the course, two written evaluations will be scheduled for this module. These are cumulative: the second test will include all course content. The first exam will account for 35% of the final grade and will cover theoretical aspects, while the second will represent 45%. To pass this module, the weighted average of both exams must be equal to or higher than 5 (out of 10).

If the grade obtained in the second exam is higher than the first, the final module grade will correspond to the second exam.

Each exam will include short-answer theoretical questions (worth up to 4 points out of 10) and problem-solving questions (worth up to 8 points out of 10).

If the module is not passed, it may be retaken during the resit period at the end of the semester. In this case, the maximum achievable grade will be 8 out of 10.

Students who have passed the module may opt for a grade improvement exam, scheduled for the same day as the resit. This improvement assessment will include questions covering all course content. Students choosing to take this exam must formally waive their previous grade in writing to the course coordinator at least 72 hours before the scheduled exam date.

1. Practical Case Module (20% of the final grade):

Assessment for this module will consist of the following components:

a) In-class resolution of assigned case studies - worth 4 out of 10 points.
b) Class participation in discussions and case elaboration - worth 1 out of 10 points.
c) Individual resolution of a practical case, assigned at the end of the semester and submitted via the virtual campus before the second theory exam - worth 5 out of 10 points.

General Considerations:

To pass the course, students must obtain a minimum score of 5 in the theory module and achieve an overall final grade of at least 5. The final grade is the weighted average of the grades from both modules.

To be eligible for the test, students must have been previously assessed on activities accounting for at least two-thirds of the total course grade. Therefore, students will receive a grade of "Not Assessable" if the completed assessment activities account for less than 67% of the final grade.

From the second enrollment onward, students who have already passed the practical case module are not required to repeat it.

Use of Artificial Intelligence(AI):

For this course, the use of AI is permitted solely for support tasks, such as literature or information searches, text correction or translation, or other uses as determined by the instructor.

Students must clearly indicate which parts were generated using AI, specify the tools used, and include a critical reflection on how these tools influenced both the process and final outcome.

Failure to transparently disclose the use of AI in an assessed activity will be considered academic dishonesty and may result in partial or total penalization of the activity grade, or more severe sanctions in serious cases.

Single Assessment:

Single assessment consists of one comprehensive exam that covers all theoretical content of the course and assesses problem-solving skills. The grade from this exam will constitute 100% of the final course grade. This exam will be scheduled on the same day as the second theory test in the continuous assessment format. To pass, students must achieve a score equal to or greater than 5. Otherwise, they must take the test, which will be equivalent in format and content. A passing grade of 5 or higher is required to pass the course.

Bibliography

Larry Snyder and Wendy Champness. Molecular Genetics of Bacteria (5th Edition). ASM press (ISBN: 9 78-1555819750)

Larry Snyder and Wendy Champness. Molecular Genetics of Bacteria (4th Edition). ASM press (ISBN: 978-1555816278)

Availaible *on line* (https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010432874206709)

Jeremy W. Dale and Simon F. Park. Molecular Genetics of Bacteria (5th Edition). Wiley- Blackwell (ISBN: 978-0-470-74184-9)

All the information associated with the subject as well as the link to the online application is available to the student through the Virtual Campus.

Software

Not done

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	731	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	732	Catalan	first semester	morning-mixed
(TE) Theory	73	Catalan	first semester	morning-mixed