Molecular Biology of Prokaryotes

Code: 100985
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500502 Microbiology	OB	3

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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 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:

Lesson 1. The bacterial chromosome. Structure of the bacterial chromosome. Start replication. Replication, termination, and segregation of the bacterial chromosome. Cellular division. The bacterial cell cycle.

Lesson 2. Gene Expression in Prokaryotes I. Structure of bacterial promoters. Monocistronic and polycistronic RNAs. Start and elongation of the bacterial transcript. Bacterial transcription terminators. Degradation of the mRNA. Transcription in archaea. Transcriptional attenuation and regulation of transcription.

Lesson 3. Gene expression in prokaryotes II. Global modulators of gene expression. Multigenic networks. Stressful response. Repression by catabolite. Positive and negative transcriptional regulation. Transcriptional regulators. Bacterial operons. Posttranscriptional regulations. Regulones. Regulatory RNAs.

Lesson 4. Mutagenesis and DNA repair systems in bacteria. Conditional lethal mutations. Suppressor muttations. Mismatch repair. Photoreactivation. Reparation by excision. Adaptive response to alkylating agents. Emergency repair response or SOS system.

Lesson 5. Bacterial Restriction. DNA restriction and modification systems. Types of restriction enzymes. In vivo regulation of restriction-modification. Mcr / Mrr System. CRISPRs and other immunity systems of bacteria.

Lesson 6. The bacterial-bacteriophage cell system. Attenuated and lytic bacteriophages. Lambda and P22 bacteriophages as attenuated bacteriophage models. Transduction. Phage conversion.

Lesson 7. Mobile genetic elements in bacteria. Insertion sequences. Transposons. Transposition mechanisms and their regulation. Mutagenesis with transposons. Mobile pathogenicity islands. Integrons. Other Mobile genètic elements.

Lesson 8. Plasmids and conjugation. Molecular structure and property of plasmids. Mechanisms of maintenance. Aggregation and cointegration of plasmids. Replication. Incompatibility groups. Plasmid conjugation in Gram-negative and Gram-positive cells. Mobilization of the bacterial chromosome. Other conjugative elements (ICEs). Importance of the conjugative elements in the evolution of the microbial world.

Lesson 9. Mechanisms of antimicrobial resistance. Plasmid resistance. Chromosomal resistance. Mechanisms of antimicrobial inactivation. Synthesis of alternative enzymes. Resistances by alternative metabolic pathways. Modifications of cellular structures by plasmid enzymes. Mechanisms of distribution of plasmid resistances.

Lesson 10. Molecular biology of bacterial infection. Molecular aspects of the host-pathogen interaction. Concept and types of bacterial virulence factors. Regulation of virulence gene expression. Methods of study of virulence genes.

Activities and Methodology

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

The subject of Molecular Biology of Prokaryotes consists of two modules face-to-face of activities:

Theoretical module: composed of participatory master classes.
Case resolution module: consisting of sessions in which practical cases and problems will be solved.

These classes are sessions with a reduced number of students with the dual mission of:
a) To facilitate the understanding of the knowledge exposed in the theoretical classes. The resolution of practical cases should enable the student to integrate theoretical knowledge with practical aspects.

b) To train the student to design basic experiments associated with the subject of the subject and to know how to interpret the obtained data.

At the beginning of the course the student will receive a dossier with a proposal of problems that must be developed during the course. The sessions of this module deal with methodological aspects and solve some of the problems of the dossier.

With the aim that the concepts to be used in the sessions of resolution of practical cases are always coordinated with the contents already developed in the theory classes, in certain moments of the course reordering and / or exchanges between the classes of theory and problems.

The autonomous activities of this subject are: study, reading of texts and resolution of problems. Finally, the student also has individual tutorials, which will be held in office C3-421 or C3-323 during hours previously agreed 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
Resolution of a case	10% of the total grade for the course	2	0.08	CM11, CM12, KM17, SM15, SM16, SM18
Two in-person exams and the delivery of the resolution of a case	Each of the two written tests will be worth 45% of the final grade	4	0.16	CM11, KM17, SM16, SM18

The evaluation of the course, which will be individual and continuous, consists of three activities of two different types without any of these activities exceeding 50% of the final grade:

i) Two written tests in which the student must demonstrate the degree of achievement of theoretical concepts through the resolution of problems;

ii) The delivery of the resolution of a concrete practical case for which it will have to apply in a global way the knowledge developed in the different subjects of the course interconnected among them.

If any student is 30 minutes late from the start of any of the written tests, he/she will have a non-evaluable mark for the corresponding test.

The final score will be the average of the marks obtained in the two partial tests (90% of the final grade) to which the qualification of the practical case will be added (10% of the final grade) that must be delivered, a maximum of one week. before the exam of recovery from the course. To approve the assignment, it will be necessary to obtain, at least, a final score of 5.

The first test will take place in the middle of the semester and will include all the concepts worked on so far in the theoretical sessions and in the resolution of practical cases. The second will be carried out at the end of the semesterand will include all the concepts addressed in the theory and problem-solving classes that have not been subject to evaluation in the first test. In order to be able to perform the average of the grades obtained in both partial tests none of them may be less than 4.

Students who have not passed the value of 4 in any of the partial tests or in any of them, must examine the partial or partial pending on the day of the recovery test. If only the recovery of a written test is made, the grade obtained in it will average (provided it is equal to or greater than 4) that would have been in the test exceeded to which will be added the score obtained in the practical case delivered. If the recovery is made for the two partials, the final grade will be the one obtained in this final exam plus the grade obtained in the practical case delivered.

Students who have passed the two written tests may take a grade improvement test that will take place on the date scheduled for the recovery test. The presentation to the grade improvement test may be for one or for both written tests, and implies the resignation of the qualification previously obtained for the performed grade improvement test/s. If the improvement is for the two written tests, the final grade for the subject will be the one obtained in the former plus the score achieved in the practical case resolution delivered. If the improvement is only for a single written test, then the final grade will be the average of the former (if it is greater or equal than 4) with that obtained in the written test that has not been reassessment plus the qualification in the submitted case.

Students who wish to take the grade improvement test, either for one or both partials, must notify the professor responsible for the subject in writing at least 72 hours before the day scheduled for the recovery evaluation, explicitly indicating thewaiver of the grade. obtained in the previous exam for which they want to improve the grade

Due to the existing limitations for the awarding of honor qualifications, specific tests may be scheduled for this purpose.
Students who have not participated in 50% of the evaluation activities will be considered NO RATING ASSESSABLE.

Single evaluation:

The single evaluation consists of a single summary test in which all the contents of the theory program and the ability to solve problems will be assessed. The grade obtained in the test will mean 100% of the final grade of the subject. The test will be scheduled on the same day as the test of the second written test of the continuous assessment. To pass it, the grade must be equal to or greater than 5. Otherwise, it will be necessary to take the recovery evaluation, which will be as the former, and in which the student must obtain a grade equal to or greater than 5 to be able to pass the subject.

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

Language list

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