Universitat Autònoma de Barcelona

2022/2023

Molecular Biology of Prokaryotes

Code: 100775
ECTS Credits: 6

Degree	Type	Year	Semester
2500250 Biology	OT	4	2

Contact

Name: Jordi Xavier Feliu Gil
Email: jordixavier.feliu@uab.cat

Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

- Students are advised to review the scientific-technical content on which this subject is based
- It is advisable to take this course once the following subjects programmed in the previous years of the Degree of Biology have been studied: Microbiology, Molecular Genetics and Functional Diversity of Microorganisms

Objectives and Contextualisation

It is a compulsory subject of the Biotechnology Bachelor, which introduces students to the knowledge of Molecular Microbiology. This subject is fundamental in the formation of the student since it enables him to understand the functioning of prokaryotes at the molecular level, allowing an understanding of the potential of microorganisms at the productive level as well as their possible applications.
The specific objectives to be achieved in this subject are the following:

- Know how to identify at the molecular level the mechanisms and microbiological processes
- Know how to identify the structure of the prokaryotic genetic material, know its mechanisms of replication and repair 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.
- To know the molecular mechanisms existing in prokaryotic organisms to control the entry of exogenous genetic material.
- Know the different genetic elements existing in prokaryotes, their distribution capacity and control systems for expression of the genes they include.
- Recognize the molecular basis of antibiotic resistance, its origins, transmission mechanisms and the impact they have on infectious processes.

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.

- 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 heredity mechanisms and the fundamentals of genetic improvement.
- Understand the processes that determine the functioning of living beings in each of their levels of organisation.

Learning Outcomes

1. Analyse a situation and identify its points for improvement.
2. Be able to analyse and synthesise.
3. Be able to organise and plan.
4. Critically analyse the principles, values and procedures that govern the exercise of the profession.
5. Explain the genetic bases of microorganisms and their mechanisms of genetic transfer.
6. Propose new methods or well-founded alternative solutions.
7. Propose viable projects and actions to boost social, economic and environmental benefits.
8. Relate the basic microbial components and structures to their functions.
9. 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.
10. 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.
11. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
12. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
13. 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.
14. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.

Content

The subject is organized in two distinct parts*:

- Theoretical classes
- Resolution of practical cases, in which the theoretical concepts developed in the theoretical classes will be applied for the resolution of problems and real cases of the subject matter.

The content of the subject consists of the following subjects:

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
Lesson 6. The bacterial-bacteriophage cell system. Attenuated and lytic bacteriophages. Lambda and P22bacteriophages as attenuated bacteriophage models. Restricted and generalized transduction. Phage conversion.
Lesson 7. Mobile genetic elements in bacteria. Insertion sequences. Transposons. Transposition mechanisms and their regulation. Mutagenesis with transposons. Mobile pathogenicity islands. Integrones. Other Mobile genètic elements.
Lesson 8. Plasmids. Molecular structure and property of plasmids. Mechanisms of maintenance. Aggregation and cointegration of plasmids. Replication. Incompatibility groups.
Lesson 9. Conjugation. 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 10. Transformation. Natural transformation. Competence state. Molecular mechanisms associated with natural transformation. Induced transformation.

Lesson 11. 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.

Methodology

The subject of Molecular Microbiology consists of two modules of activities*:
Theoretical module: composed of participatory master classes.
Case studies 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 hours previously agreed.

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.

Activities

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Participatory master classes	30	1.2	5, 8
Practical cases resolution	15	0.6	8, 2
Type: Supervised			
Individual tutorials	1	0.04	5, 8
Type: Autonomous			
Autonomous practical cases resolution	30	1.2	5, 8, 2, 3
Reading recommended texts	8	0.32	2, 3
Study	60	2.4	8, 2, 3

Assessment

The evaluation of the subject will be continuous and individual and will be done through written tests,in which the student must demonstrate the degree of achievement of the subject concepts through theory questions and with the resolution of problems.

At mid semester, there will be a first evaluation block consisting of two different tests, one based on theory questions, with a specific weight of 10% of the total of the subject, and another of problems solving, with a value of 40%. Both tests will include all concepts developed up to that moment in the theory sessions and in the resolution classes of practical cases.

At the end of the semester the second evaluation block will be carried out, also composed of a test of theory questions (with a value of 10%) and another based on the resolution of problems (with a weight of 40% of the total of the subject). This second part will include all the concepts worked on the theory classes and in the problem-solving classes that have not been evaluated in the first test.

The final grade of the subject will be the average of the marks obtained in both evaluation blocks, as long as none of them has obtained a score lower than 4. This average must necessarily be equal to or greater than 5 topass the course. In the event that it is lower, the student must submit to the recovery test. The student can choose between examining the whole subject or only the evaluation block in which he has obtained the lowest mark. In the latter case, the final grade will be determined through the average with the mark obtained in the exam that has not been repeated. To pass the subject, this average must be greater than or equal to 5.

Those students who have not passed the value of 4 in one or in both evaluation blocks will have to examine the pending evaluation block or blocks through a retake process. In the event that the recovery of a single block is made, the grade obtained in this test will average with the mark achieved in the previously passed block, being necessary that this average is greater than or equal to 5 to pass the subject. If it is necessary to retake the two evaluation blocks, the final grade will be the one obtained in this recovery test and that must be at least 5 to pass the course. To be eligible to participate in 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.

Students who have passed the two evaluationblocks can take a test to improve the final grade that will take place on the datescheduled for the recovery test. The presentation to the improvement exam can be for the subject corresponding to a single evaluation block or both and implies the rejection of the preliminary qualification in the block or blocks that will be reevaluated. If the two blocks are reevaluated, the final grade of the subject will be the score achieved in this improvement test and must be greater than or equal to 5. If only one block is reevaluated, the final grade of the subject will be the average of the mark obtained in this improvement test with the one obtained in the block that has not been reevaluated. In this case, the average should also be equal to or greater than 5 to pass the course.

Students who wish to take the improvement test for one or both blocks must inform the teacher responsible for the subject in writing at least 72 hours before the scheduled day for the recovery test.

Students will be graded as "Non-Evaluable" if the weight in of all conducted evaluation activities is lower than 67% of the final score.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Problems exam (1st block)	40% of the total of the subject	2	0.08	14, 4, 1, 5, 6, 7, 13, 12, 11, 9, 10, 8, 2, 3
Problems exam (2nd section)	40% of the total of the subject	2	0.08	5, 8, 2, 3
Theory written exam (1st section)	10% of the total of the subject	1	0.04	5, 8, 2, 3
Theory written exam (2nd section)	10% of the total of the subject	1	0.04	5, 8, 2, 3

Bibliography

Tina M. Henkin, Joseph E. Peters. Snyder and Champness Molecular Genetics of Bacteria (5th Edition). Wiley-Blackwell (ISBN: 978-1-555-81975-0)

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

All bibliography related with the matter will be avalaible through the Campus Virtual.

Software

In this course it is not foreseen to use any specific software