Universitat Autònoma de Barcelona

2020/2021

Molecular Biology of Prokaryotes

Code: 100985
ECTS Credits: 6

Degree	Type	Year	Semester
2500502 Microbiology	OB	3	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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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 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

It is a compulsory subject of the Microbiología Bachelor, which introduces students to the knowledge of Molecular Biology of Prokaryotes. 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

- Communicate orally and in writing.
- Develop creativity and initiative.
- Identify and solve problems.

- Identify the molecular mechanisms of pathogenesis and relate them to the response to infection in order to design and develop strategies for diagnosing and combating diseases caused by microorganisms.
- Interpret, on a molecular scale, microbial mechanisms and processes.
- Use bibliography or internet tools, specific to microbiology or other related disciplines, both in English and in the first language.

Learning Outcomes

1. Communicate orally and in writing.
2. Describe the molecular mechanisms related to the infectious capacity of microorganisms.
3. Develop creativity and initiative.
4. Discern the characteristics of the different genetic elements and their evolutionary and functional importance.
5. Evaluate the functioning, the importance and the variability of chromosomal and plasmidic conjugation systems.
6. Identify and solve problems.
7. Identify the differences between prokaryotes and eukaryotes on the molecular scale.
8. Know the principles behind mutagenic processes in bacteria and the importance of DNA repair in the life of cells and in bacterial evolution.
9. Recognise the molecular bases of resistance to antibiotics and the capacity of transmitting this resistance, and their impact on microbial pathogenesis.
10. Solve problems in molecular aspects of microorganisms.
11. Understand the bacterial cell cycle process and relate it to chromosome replication.
12. Understand the different systems of transformation in prokaryotes.
13. Understand the mechanisms of transduction and their importance in the transfer of genetic material.
14. Understand the relationship between bacteriophages and bacterial cells and the mechanisms that control the gene expression of bacteriophages.
15. Use bibliography or internet tools, specific to microbiology or other related disciplines, both in English and in the first language.

Content

The content of the subject consists of the following lessons:

Lesson 1. The bacterial coromosoma. 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 P22 bacteriophages as attenuated bacteriophage models. Restricted and generalized transduction. Phage conversion.
Lesson 7. Mobile genetic elements inbacteria. Insertion sequences. Transposons. Transposition mechanisms and their regulation. Mutagenesis with transposons. Mobile pathogenicity islands. Integrones. Other Mobile genètic elements.
Lesson 8. Plasmids and conjugation. Molecular structure and property of plasmids. Mechanismsof 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. Islands of pathogenicity. Regulation of virulence gene expression. Methods of study of virulence genes.

Unless the requirements enforced by the health authorities demand a priorization or reduction of these contents

Methodology

The subject of Molecular Biology of Prokaryotes 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.
Throughout the course will be hanging in the virtual campus problems of the various subjects of the program so that the student can work autonomously. After 10 days from the publication of these problems, will be hung on the virtual campus their solutions so that the work can be checked.
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 the office C3-421 in hours previously agreed.

The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activitie enforced by health authorities.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Participatory master classes	30	1.2	13, 8, 2, 4, 11, 12, 14, 7, 9, 1, 5
Practical cases resolution	15	0.6	13, 8, 2, 3, 4, 11, 12, 14, 6, 7, 9, 10, 1, 5
Type: Supervised			
Individual tutorials	1	0.04	13, 8, 2, 3, 4, 11, 12, 14, 6, 7, 9, 10, 15, 5
Type: Autonomous			
Autonomous practical cases resolution	30	1.2	13, 8, 2, 3, 4, 11, 12, 14, 6, 7, 9, 10, 1, 15, 5
Reading recommended texts	8	0.32	13, 8, 2, 4, 11, 12, 14, 7, 9, 15, 5
Study	60	2.4	13, 8, 2, 3, 4, 11, 12, 14, 7, 9, 10, 15, 5

Assessment

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 his / her 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 a student is 30 minutes late from the start of a written test, they will have a non-evaluable mark for this.

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 of 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 semester and 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 partial is made, the grade obtained in it will average (provided it is equal to or greater than 4) that would have been in the partial exceeded to which will be addedthe score obtained in the case practical 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 partial exams may take a test to improve their grades, which will take place on the date scheduled for the recovery test. The presentation to the test of improvement of note may be for the subject corresponding to a single partial or both and implies the waiver of the qualification previously obtained for this partial, or in its case, for the two partial.

If the improvement is for the two partial, the final grade of the subject will be the one obtained in this test plus the score achieved in the practical case delivered. If the improvement is for a single partial, the final grade of the subject will be the average of the one obtained in this improvement test (provided it is equal to or greater than 4) with the one obtained in the partial exam that has not been object of re-evaluation plus the qualification achieved in the delivered case.

Students wishing to take the grade improvement test, either by one or both of them, must inform the teacher responsible for the subject in writing at least 72 hours before the scheduled day for the evaluation of recovery explicitely indicating the waiver 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

Student's assessment may experience some modifications depending on the restrictions to fae-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Two face to face examen and delivery of a case resolution	Value of each one of two examens will be 45 % of the end qualification and delivery of the case correctly resolved a 10 %	6	0.24	13, 8, 2, 3, 4, 11, 12, 14, 6, 7, 9, 10, 1, 15, 5

Bibliography

Larry Snyder i Wendy Champness. Molecular Genetics of Bacteria (3rd Edition). ASM press (ISBN: 978-1-55581-399-4)

http://resolver.ebscohost.com.are.uab.cat/openurl?sid=EBSCO:nlebk&genre=book&issn=&ISBN=978155581627

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