

Molecular Biology of Prokaryotes

Code: 100985
ECTS Credits: 6

Degree	Type	Year	Semester
2500502 Microbiology	OB	3	1

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 Microbiologia 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.

Skills

- 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 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 mutations. Mismatch repair. Photoreactivation. Replication 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 in bacteria. Insertion sequences. Transposons. Transposition mechanisms and their regulation. Mutagenesis with transposons. Mobile pathogenicity islands. Integrons. Other Mobile genetic 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. Islands of pathogenicity. Regulation of virulence gene expression. Methods of study of virulence genes.

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.

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

Evaluation

The evaluation of the course will be individually through two written tests in those the student must prove their level of theoretical concepts achievement through solving problems.

The first test will take place in the middle of the semester and will include the concepts developed up during theoretical sessions be resolution of practical cases. The second will be held at the end of the semester and will include all the concepts studied in the lectures through solving problema. The final assessment will be the average of the results obtained in both tests as long as partial none of them has received a rating of less than 4. This average will necessarily be equal or greater than 5.

If it is lower, the student must submit to a recovery examination at which could choose to be examined of the whole subject or that it has obtained the lowest qualification. The final qualification will be determined by the average of the marks obtained in the recovery exam with that obtained in which it has not been repeated. To pass the course, this average must be equal to or greater than 5. Students who have not passed the value of any of the two partial tests or any of them, shall examine the pending partial the recovery day. If the recovery is made by the two partials the final rating will be that obtained in the final exam which must be at least 5 in order to pass the course.

Students who have completed the course through the exams may be submitted to a note improving test to be held on the date scheduled for the test of recovery.

The presentation to this test could be improved by grade material corresponding to a single part or both and involve the waiver previously obtained qualification in partial exams. If the improvement is for two partial the final grade for the course will be achieved in this test and it must be equal or greater than 5. If the improvement is only by a partial qualification of the subject the final course qualification will be the average obtained with the unrecovered exam. Students wishing to improve test whether a note or for both partials will notify the teacher responsible for the course in writing at least 72 hours prior scheduled for the assessment of recovery.

Due to limitations on the granting of honors, we will be able to schedule tests specifically for this purpose. That student has not participated in 50% of the planned evaluation activities, receive No rating assessable.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Faca to face examen	100 %	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)

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