Universitat Autònoma de Barcelona

2020/2021

Molecular Biology of Prokaryotes

Code: 101982
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	OB	2	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

Teachers

Elena García Fruitos
Jesús Aranda Rodríguez

Prerequisites

It is desirable to have coursed or are coursing Genetics, Biochemistry, Microbiology and Cell Biology programmed in the first year of the Degree of Genetics.

Objectives and Contextualisation

The specific objectives to be achieved in this subject are defined in the following points:

- To be able to identify at the molecular level the mechanisms and microbiological processes.
- To know how to identify the structure of the prokaryotic genetic material, to know the replication and repair mechanisms as well as the organizational variability they present and the relationship between these mechanisms and the cell cycle.
- To recognize the factors that control gene expression in prokaryotes and relate them to existing environmental conditions.
- To know the different genetic elements existing in prokaryotes, their distribution capacity and the mechanisms of control of gene expression.
- Recognize the molecular basis of antibiotic resistance, its origins, transmission systems and the impact they have on infective processes.
- To understand the biological meaning and applications of genetic transfer mechanisms, immunity systems and genetic elements present in microorganisms.

Competences

- Apply knowledge of theory to practice.
- Apply scientific method to problem solving.

- Be able to analyse and synthesise.
- Describe and identify the structural and functional characteristics of nucleic acids and proteins including their different organisational levels.
- Describe the genetic bases of the development and control of genic expression.
- Design and execute complete protocols of the standard techniques that form part of molecular genetics instruments: purification, amplification and sequencing of genomic DNA from biological sources, genetic engineering in microorganisms, plants and animals.
- Develop self-directed learning.
- Reason critically.

Learning Outcomes

1. Apply knowledge of theory to practice.
2. Apply scientific method to problem solving.
3. Be able to analyse and synthesise.
4. Describe the mechanisms for regulating genic expression in viruses, bacteria and eukaryotes.
5. Describe the processes of replication, transcription, translation and regulation of genes in prokaryotes and eukaryotes.
6. Design applicable protocols for the genetic manipulation of microorganisms.
7. Develop self-directed learning.
8. Reason critically.
9. Relate the structure of nucleic acids with their biological functions.

Content

The course will be organized into two distinct parts:

Participatory Master Classes
Resolution of practical cases, in which the theoretical concepts reached in the master classes for the solution of problems and real cases will be applied.

The content of the subject will be divided into the 10 units that are listed below, unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Unit 1. The bacterial chromosome. The structure of the bacterial chromosome. Initiation of replication. Replication, termination, and segregation of the bacterial chromosome. Cellular division. The bacterial cell cycle.

Unit 2. Gene Expression in Prokaryotes I. Structure of bacterial promoters and mRNAs. Bacterial transcription terminators. Transcriptional attenuation.

Unit 3. Gene expression in prokaryotes II. Positive and negative transcriptional regulation. Post-transcriptional regulations. Bacterial operons. Multigenic networks, regulons, and stimululons. Applications of mechanisms of expression control in bacteria.

Unit 4. Mutagenesis and DNA repair systems in bacteria. Conditional lethal mutations. Mutation suppression. Mismatch repair. Photoreactivation. Excision repair. Adaptive response to alkylating agents. Recombination repair. Emergency repair response or SOS system. Identification of mutagens.

Unit 5. Mechanisms of bacterial immunity. DNA restriction and modification systems. Type of restriction enzymes. *In vivo* regulation of restriction-modification. Mechanisms of acquired immunity.

Unit 6. The bacterial - bacteriophage cell system. Attenuated and lytic bacteriophages. Lambda and P22 bacteriophages as lysogenic models. Specialized and generalized transduction.

Unit 7. Mobile genetic elements in bacteria. Insertion sequences. Transposons. Mechanisms of transposition and its regulation. Mutagenesis with transposons. Mobile pathogenicity islands. Integrons.

Unit 8. Plasmids and conjugation. Molecular structure. Properties of the plasmids. 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). The importance of conjugative elements in the evolution of the microbial world.

Unit 9. Transformation. Natural transformation. State of competition. Molecular mechanisms associated with natural transformation. Induced Transformation.

Unit 10. Mechanisms of antimicrobial resistance. Plasmid resistance. Chromosomal resistance. Mechanisms of antimicrobial inactivation. Synthesis of alternative enzymes: Resistance by alternative metabolic pathways. Waterproofing cells to antimicrobials. Flow Pumps. Modifications of cellular structures by plasmid enzymes. Mechanisms of distribution of plasmid resistances.

Methodology

The subject consists of two modules of activities:

Theoretical module: Composed of participatory master classes.

Practical cases' module: Comprising 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 course and to know how to interpret the data obtained.

At the beginning of the course, the student will receivea dossier with proposed problems that must be developed. The sessions of this module deal with methodological aspects and solve some of the problems of the dossier.

The students also have in the classroom Moodle problems *online*, being able, autonomously, to self-assess their ability to solve problems related to the subject.

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

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Case Studies	15	0.6	2, 1, 4, 7, 6, 8, 3
Participatory Master Classes	30	1.2	4, 6, 8, 3
Type: Supervised			
Tutorship	2	0.08	2, 1, 4, 7, 6, 8, 3
Type: Autonomous			

Autonomous case study resolution	20	0.8	2, 1, 4, 7, 6, 8, 3
Reading recommended texts	6	0.24	2, 1, 4, 7, 6, 8, 3
Study	69	2.76	2, 1, 4, 7, 6, 8, 3

Assessment

The evaluation will be individual and continuous. There will be different tests that will allow evaluating the achievement of the competencies associated with the subject.

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

Evaluation of the theoretical module (75% of the overall mark)

The evaluation of this activity will be done through two written tests:

A) The first test will have a weight of 25%. It will be scheduled in the middle of the semester and will include all the concepts explained so far in the theoretical sessions.

B) The second test will have a weight of 50%. It will be programmed at the end of the semester and will include all the theoretical concepts of the subject, also those that were the object of evaluation in the first test.

In order to pass the module, it is necessary to pass the two written tests with a score equal to or higher than 5. If the student has passed the module and the qualification obtained in the second test is better than the weighted average of the two tests, the final grade will be that of the second tests.

In the case of not passing this module, the student will have a retake evaluation, scheduled at the end of the semester, where he can perform the first, second or both tests.Students who take the second chance exam will opt for a maximum rating of 8 points out of 10 possible.To be eligible for 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 or module.

Students who have passed the module may submit to an improvement testof the theoretical evaluation module, which will be done, at the end of the semester, on the date scheduled for the second chance evaluation. The presentation to the test of improvement implies the renunciation to the previously obtained qualification. To pass the module it will be necessary to obtain a score equal to or higher than 5. Students who wish to take the grade improvement test must communicate it in writing to the teacher.

Evaluation of the case study module and autonomous activity (25% of the overall mark)

The evaluation of this activity will consist of the following tests:

A) The active participation of the student in the case study module (with a weight of 5% over the total of the subject)

B) It will evaluate the autonomous resolution of a set of problems that will be delivered, through the moodle, in two independent deliveries throughout the semester (each delivery will have a weight of 10%s)

The final qualification of the subject will be calculated as the weighted average of the grades obtained in the two evaluation modules, being a necessary condition to pass the theoretical evaluation module. In order to pass the course, the student must obtain a final grade equal to or higher than 5. The student will be graded as "Non-evaluable" if the weighth in of all conducted evaluation activities is less than 67% of t final score.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1rst Evaluation of the theoretical module	25%	3	0.12	2, 1, 4, 5, 6, 8, 9, 3
2nd Evaluation of the theoretical module	50%	3	0.12	2, 1, 4, 5, 6, 8, 9, 3
Autonomous problem resolution (Delivery 1)	10%	0.75	0.03	1, 4, 5, 7, 6, 8, 9, 3
Autonomous problem resolution (Delivery 2)	10%	0.75	0.03	2, 1, 4, 5, 7, 6, 8, 9, 3
Classroom active participation	5%	0.5	0.02	2, 1, 5, 7, 6, 8, 9, 3

Bibliography

Bibliography of reference:

Larry Snyder and Wendy Champness. Molecular Genetics of Bacteria (3rd Edition or 4th Edition). ASM Press (ISBN: 978-1-55581-399-4 ISBN: 978-1-55581-627-8)

eBook available at the Biblioteques de la UAB.

Jeremy W. Dale and Simon F. Park. Molecular Genetics of Bacteria, (5th edition)

Wiley-Blackwell (ISBN: 978-0-470-74184-9)

Other recommended references will be indicated in the virtual campus of the course