Universitat Autònoma de Barcelona

2020/2021

Genetic Engineering of Microorganisms

Code: 101977
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	OT	4	0

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: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: Yes

Other comments on languages

Es treballarà amb material en llengua anglesa

Teachers

Jesús Aranda Rodríguez

Prerequisites

It is recommendable to have studied or are studying Molecular Biology of Prokaryotes.

Objectives and Contextualisation

The main objective of this course is that the student will be able to design procedures for the genetic manipulation of microorganisms.

Therefore during the development of the subject, the student must reach the following capacities:
• To know how to identify different types of microbial vectors, recognize their applications and design new ones
• To know how to apply methodologies and strategies of cloning
• To recognize the implication of the characteristics of each microorganism (immunity systems, recombination capacity, codon usage, etc.) in the proposed experimental design
• to know how to choose the most appropriate genetic transfer technique in each proposed case
• To be able to design efficient strategies for obtaining, enriching and selecting mutants
• To know how to build gene fusions and recognize their possible applications
• To recognize the main characteristics of potential bacterial targets for drugs, vaccines, and diagnostic reagents development.

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.
- 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.
- Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

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 processes of replication, transcription, translation and regulation of genes in prokaryotes and eukaryotes.
5. Design applicable protocols for the genetic manipulation of microorganisms.
6. Develop self-directed learning.
7. Reason critically.
8. Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Content

The content of the course consists of the following topics:

Unit 1. Bacterial transformation. Natural transformation. State of competition. Molecular mechanisms associated with natural transformation. Induced transformation. Electrotransformation.

Unit 2. Introduction of exogenous DNA in bacteria by conjugation. Molecular mechanisms associated with conjugation. Mobilizable vectors and conjugative vectors. Conjugation biparental and triparental. Donor strains.

Unit 3. Introduction of exogenous DNA in bacteria by transduction. Specialized transduction. Generalized transduction. High transduction frequency bacteriophages.

Unit 4. DNA vectors in bacteria. Requirements of cloning vectors. Vector expression. T-type vectors. Suicide vectors. Shuttle Vectors. Integrational vectors. Molecular bases of vector replication. Genetic characteristics of vector accepting cells.

Unit 5. Bacterial gene fusions. Operon and protein fusions. Fusion constructing methods. Fusion vectors: general characteristics. Transposons. Applications of gene fusions.

Unit 6. Construction of Genomic DNA Libraries. General concept. Representation. Strategies for obtaining genomic DNA libraries. Phage DNA libraries. Cosmid DNA libraries. BACS, PACS and YACS. Systems by the screening of genomic DNA libraries.

Unit 7. ***In vivo*** random mutagenesis in bacteria. Use of chemical or physical methods. Criteria and methods for selection and enrichment of mutants. Transposons. Minitransposons. Plasposons. Transposomes. Methods for the identification and confirmation of bacterial mutants.

Unit 8. ***In vitro*** mutagenesis of cloned genes. Methods of introducing point mutations. Insertional mutagenesis: use of transposons. Systems of mutated genes reintroduction. Synthetic genes.

Unit9. Gene inactivation in bacteria. Molecular mechanisms of homologous recombination. Obtaining mutants by gene disruption and gene replacement. Lambda Red, I-SceI and CRISPR/Cas9 systems. Counter-selection systems, obtaining scarless mutants. Methods for the identification and confirmation of mutants.

*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

Genetic Engineering of Prokaryotes course is organized in two modules:

Theoretical module: where participatory master classes are combined with problem-based learning sessions where theoretical concepts are worked through the resolution of practical cases.

Seminar module: in which through collaborative learning, students work on different aspects of actual experimental designs present in recent scientific articles. At the beginning of the course, students choose, following the guidelines set by the teaching staff, a scientific article related to the field of genetic engineering of microorganisms from which they make a poster. The schedule of activities like classroom work sessions, exhibition, and discussions, as well as the delivery dates of the proposed activities will be defined at the beginning of the course by the teachers.

*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			
Participatory master classes	30	1.2	4, 5
Seminars	12	0.48	2, 1, 6, 7, 3, 8
Type: Supervised			
Tutorship	1	0.04	4, 5
Type: Autonomous			
Preparation of posters and questionnaires	34	1.36	2, 1, 6, 7, 3, 8
Reading recommended texts	20	0.8	8
Study and other autolearning activities	50	2	1, 6, 7, 3, 8

Assessment

Seminar module evaluation
The evaluation of the seminars is done through the evaluation of different activities related to a scientific article:

A) Autonomous deliveries that will be delivered through the Moodle classroom and deliveries in the classroom work sessions. With a maximum rating of 2 points out of 10.

B) The poster and questionnaire associated with the chosen scientific article. With a maximum rating of 5

points out of 10.

C) The defense of the poster during its classroom exhibition. With a maximum rating of 1 point out of 10.

D) The resolution of the questionnaires related to the presented seminars. With a maximum rating of 1.5 points out of 10.

E) Individual and workgroup self-evaluation. With a maximum rating of 0.5 points out of 10.

To pass this module the student must obtain a grade equal or superior to 5.

Theoretical module evaluation
The evaluation of this activity is done through an individual written exam. The maximum rating of this section is 10 points out of 10.
To pass this module it is necessary to obtain a score equal to or greater than 5 points.

If the grade obtained is less than 5, the student must take the retake examination. This test will have a maximum qualification of 8 points out of 10 and a score equal to or greater than 4 will be necessary to pass the module.

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 a grade improvement test waiving the grade obtained previously in the individual written exam. The scheduled date for the second chance test is that of the second chance examination. Students wishing to take the grade improvement test must communicate it by mail to the teacher responsible for the subject at least 72 hours before the day scheduled for the second chance examination.

The final grade of the course will be the average of the grades obtained in both modules, being necessary to have passed separately each of them.
The student will be graded as "Non-evaluable" if the weight in of all conducted evaluation activities is less than 67% of the final score.

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

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Classroom and virtual classroom submissions	10%	0	0	2, 1, 6, 7, 3
Discussion and participation in the classroom	5%	0	0	2, 1, 4, 6, 5, 7, 3, 8
Poster	25%	0	0	2, 1, 4, 6, 5, 7, 3, 8
Resolution of questionnaires in the classroom	7.5%	0	0	2, 1, 4, 6, 5, 7, 3, 8
Written test (resolution of practical cases)	50%	3	0.12	2, 1, 4, 5, 7, 3
team-work or individual self-evaluation	2.5%	0	0	2, 1, 4, 6, 5, 7, 3, 8

Bibliography

The following is the ecommended bibliography:

Larry Snyder and Wendy Champness. Molecular Genetics of Bacteria (3rd gold 4th Edition). ASM press (ISBN:

978-1-55581-399-4 and ISBN: 978-1-55581-627-8)

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

Other recommended texts as well as links of interest will be available to the student in the Moodle classroom of the course.