Universitat Autònoma de Barcelona

2023/2024

Genetic Engineering of Microorganisms

Code: 100972
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OT	4	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Maria Perez Varela

Susana Campoy Sanchez

Prerequisites

It is recommendable to have studied or are studying Microbiology, Genetics, Molecular Biology and Genetics, Molecular Microbiology and Virology.

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

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Apply the principal techniques for the use of biological systems: recombinant DNA and cloning, cell cultures, manipulation of viruses, bacteria and animal and plant cells, immunological techniques, microscopy techniques, recombinant proteins and methods of separation and characterisation of biomolecules.
- Comply with ethical principles and legislation in the manipulation of biological systems.
- Identify the genetic, physiological and metabolic properties of microorganisms with potential for application to biotechnological processes and the possibility of manipulating microorganisms.
- Interpret experimental results and identify consistent and inconsistent elements.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Read specialised texts both in English and one's own language.
- Reason in a critical manner
- Search for and manage information from various sources.
- 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.
- Think in an integrated manner and approach problems from different perspectives.
- Work individually and in teams

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Comply with ethical principles and legislation in the manipulation of of microorganisms.
3. Describe the principal techniques associated with the genetic manipulation of microorganisms.
4. Identify the potential for manipulation of microorganisms.
5. Interpret experimental results and identify consistent and inconsistent elements.
6. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
7. Read specialised texts both in English and one's own language.
8. Reason in a critical manner
9. Search for and manage information from various sources.
10. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
11. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
12. Think in an integrated manner and approach problems from different perspectives.
13. Work individually and in teams

Content

The content of the course consists of the following topics:

Unit 1. DNA introduction systems in bacteria. Natural transformation in gramnegative and grampositive bacteria. State of competence. Molecular mechanisms associated with natural transformation. Induced transformation. Electrotransformation. Design and optimization of transformation systems in bacteria lacking natural transformation. Other Systems of DNA transference.

Unit 2. DNA vectors and cloning strategies in bacteria. Requirements of cloning vectors. Expression vectors. T-type vectors. Mobilizable vectors. Suicide vectors. Shuttle vectors. Integrational vectors. Genetic

characteristics of vector accepting cells. Construction of DNA libraries *in vitro* and *in vivo*. Cloning by complementation: anabolic or catabolic genes. Regulatory gene isolation methods. Obtaining virulence genes. Cloning of toxic genes.

Unit 3. Bacterial gene fusions. Transcriptional and translational fusions. Gene fusions in polycistronic units. Fusion vectors: general characteristics. Random gene fusions. Methods for the construction of gene fusions. Construction of gene fusions by PCR, OE-PCR and Gibson assembly. Applications and examples of gene fusions.

Unit 4. Mutagenesis in bacteria. Random mutagenesis *in vivo*. Use of chemical or physical methods. Criteria and methods for the selection and enrichment of mutants. Transposons. Minitransposons. Plasposons. Transposomes. Methods for the identification and confirmation of mutants. *In vitro* mutagenesis of cloned genes.

Unit 5. Gene substitution in bacteria and generation of knockouts. Obtaining mutants by gene disruption and by gene substitution. Lambda Red system. Obtaining scarless mutants. Counter selection systems. I-SceI system. Use of CRISPR/Cas9 technology to obtain mutants. Methods for the identification and confirmation of mutants. Systems for the reintroductionof altered genes in the bacterium of origin. Insertion into the chromosome of new genes or constructs.

Methodology

The course is organized in two modules:

Theoretical module: where participatory masterclasses 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.

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	2, 3, 4, 8
Seminars	12	0.48	2, 9, 5, 7, 12, 8, 13
Type: Supervised			
Tutorship	1	0.04	
Type: Autonomous			
Preparation of posters and questionnaires	34	1.36	2, 9, 4, 5, 7, 12, 8, 13

Reading recommended texts	20	0.8	7
Study and other autolearning activities	50	2	2, 9, 4, 5, 7, 12, 8, 13

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.

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 theaverage 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.

Single assessment

The evaluation of the theoretical module consists of a single test that will be the same as that of the type of continuous assessment, this test will account for 50% of the final grade for the subject and the same system of evaluation will be applied. recovery than for continued evaluation.

The evaluation of the activities of the seminar module will mean 50% of the final grade for the subject. The students who take advantage of the single evaluation may deliver all the evidence together (including the oral presentation) on the same day as the one set for the test. The single assessment test will be carried out coinciding with the same date set in the calendar for the last continuous assessment test.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Classroom and virtual classroom submissions	10%	0	0	1, 11, 10, 9, 6, 7, 12, 8, 13
Discussion and participation in the classroom	5%	0	0	1, 11, 10, 2, 3, 4, 5, 6, 12, 8
Poster	25%	0	0	2, 9, 3, 4, 5, 7, 12, 8, 13
Resolution of questionnaires	7.5%	0	0	2, 3, 4, 5, 12, 8
Written test (resolution of practical cases)	50%	3	0.12	3, 4, 5, 12, 8, 13
team-work or individual self-evaluation	2.5%	0	0	2, 9, 3, 4, 5, 7, 12, 8, 13

Bibliography

As reference bibliography of basic concepts it is recommended:

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

eBook available at Biblioteques UAB:

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

Software

Not applicable.