

**Genetic Engineering of Microorganisms**

Code: 100972  
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OT	4	0

### 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

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:

- Know how to identify different types of microbial vectors, recognize their applications and design new ones
- Know how to apply methodologies and strategies of cloning
- Recognize the implication of the characteristics of each microorganism (immunity systems, recombination capacity, codon usage, etc.) in the proposed experimental design
- Know how to choose the most appropriate genetic transfer technique in each proposed case
- Be able to design efficient strategies for obtaining, enriching and selecting mutants
- Know how to build gene fusions and recognize their possible applications
- Recognize the main characteristics of potential bacterial targets for drugs, vaccines, and diagnostic reagents development.

### Skills

- 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.
- Read specialised texts both in English and ones own language.
- Reason in a critical manner
- Search for and manage information from various sources.

- Think in an integrated manner and approach problems from different perspectives.
- Work individually and in teams

## Learning outcomes

1. Comply with ethical principles and legislation in the manipulation of microorganisms.
2. Describe the principal techniques associated with the genetic manipulation of microorganisms.
3. Identify the potential for manipulation of microorganisms.
4. Interpret experimental results and identify consistent and inconsistent elements.
5. Read specialised texts both in English and ones own language.
6. Reason in a critical manner
7. Search for and manage information from various sources.
8. Think in an integrated manner and approach problems from different perspectives.
9. Work individually and in teams

## Content

The content of the course consists of the following topics:

**Unit 1. Introduction of exogenous DNA in bacteria for transduction and conjugation.** Specialized transduction. Generalized transduction. High transduction frequency bacteriophages. Molecular mechanisms associated with conjugation. Mobilizable vectors and conjugative vectors. Conjugation biparental and triparental. Donor strains.

**Unit 2. Bacterial transformation.** Natural transformation. State of competition. Molecular mechanisms associated with natural transformation. Induced transformation. Electrotransformation.

**Unit 3. 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 4. Bacterial gene fusions.** Operon and protein fusions. Fusion constructing methods. Fusion vectors: general characteristics. Use of transposons and bacteriophages. Applications of gene fusions.

**Unit 5. 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 6. Random Mutagenesis for genetic modification of 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 7.** In vitro mutagenesis of cloned genes. Methods of introducing point mutations. Insertional mutagenesis: use of transposons. Non-polar mutagenesis of polycistronic transcriptional units. Systems of mutated genes reintroduction. Synthetic genes.

**Unit 8. Gene replacement in bacteria.** Molecular mechanisms of homologous recombination. Obtaining mutants by exchange of markers. Mechanisms of recombination based on bacteriophages. CRISPR Systems. Counter-selection systems, obtaining scarless mutants. Methods for the identification and confirmation of mutants.

## 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.

**Case study 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 as 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.

## Activities

Title	Hours	ECTS	Learning outcomes
<b>Type: Directed</b>			
Participatory master classes	30	1.2	1, 2, 3, 6
Seminars	12	0.48	1, 7, 4, 5, 8, 6, 9
<b>Type: Supervised</b>			
Tutorship	1	0.04	
<b>Type: Autonomous</b>			
Preparation of posters and questionnaires	30	1.2	1, 7, 3, 4, 5, 8, 6, 9
Reading recommended texts	20	0.8	5
Study and other autolearning activities	50	2	1, 7, 3, 4, 5, 8, 6, 9

## Evaluation

### 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 overcome 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 **second chance examination**. This test will have a maximum score of 8 points out of 10 and a score equal to or greater than 4 will be necessary to pass.

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.

### 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.

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.

A student who has participated in less than 50% of the scheduled assessment activities will receive a grade of Not Evaluable.

## Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Seminar module evaluation	50%	3	0.12	1, 7, 4, 5, 8, 6, 9
Theoretical module evaluation	50%	4	0.16	2, 3, 4, 8, 6, 9

## Bibliography

As reference bibliography of basic concepts it is recommended:

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.