Universitat Autònoma de Barcelona

Genetic Engineering of Microorganisms

2026/2027

Code: 100972
Credits: 6

Degree programme	Type	Course
Biotechnology	OP	4

Contact lecturer

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Group languages

You can consult this information at the end of the document.

Prerequisites

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

Objectives

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.

Learning outcomes

- CM31 (Work collaboratively in teams to solve problems and case studies in the field of applied biology.) Work collaboratively in teams to solve problems and case studies in the field of applied biology.
- KM31 (Explain the possibilities for manipulation of micro-organisms.) Explain the possibilities for manipulation of micro-organisms.
- KM32 (Describe the main techniques associated with the genetic manipulation of micro-organisms.) Describe the main techniques associated with the genetic manipulation of micro-organisms.
- SM31 (Use techniques for analysing genetic variability in domestic species.) Use techniques for analysing genetic variability in domestic species.

Contents

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.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Tutorship	1	0.04	KM31, KM32

Preparation of posters and questionnaires	34	1.36	CM31, KM31, KM32, SM31
Seminars	12	0.48	CM31, KM31, KM32, SM31
Study and other autolearning activities	50	2	KM32, SM31
Reading recommended texts	20	0.8	KM31, KM32
Participatory master classes	30	1.2	CM31, KM31, KM32, SM31

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.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Classroom and virtual classroom submissions	10%	0	0	CM31
Written test (resolution of practical cases)	40%	3	0.12	CM31, KM31, KM32, SM31
Poster	25%	0	0	CM31, KM31, KM32, SM31
team-work or individual self-evaluation	5%	0	0	CM31
Discussion and participation in the classroom	10%	0	0	CM31, KM31, KM32
Resolution of questionnaires	10%	0	0	CM31, KM31, KM32, SM31

Seminar Module Evaluation

Seminar evaluations are based on various activities related to a scientific article. The following aspects are assessed:

a) Independent assignments submitted via the Moodle platform and submissions during in-class working sessions. Maximum grade of 2 out of 10 points.

b) The poster and questionnaire associated with the chosen scientific article. Maximum grade of 5 out of 10 points.

c) The poster defense during the classroom presentation. Maximum grade of 1 out of 10 points.

d) Solving the questionnaires related to the presented seminars. Maximum grade of 2 out of 10 points.

e) Individual and working group self-assessment. Maximum grade of 1 out of 10 points.

To pass this evaluation module, the student must obtain a grade of 5 or higher.

Theory Module Evaluation

This activity is evaluated through a written individual exam that accounts for 80% of this module.

During the theory module sessions, evaluation activities may be carried out, contributing up to 20% of this module.

To pass this module, it is necessary to obtain a score of 5 points or higher.

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.

Uses of AI

For this subject, the use of Artificial Intelligence (AI) technologies is permitted exclusively in support tasks, such as bibliographic or information fencing, text correction or translations, etc. It takes time to clearly identify which parts have been generated by this technology, specify the aspects and include a critical reflection on how these have influenced the process and the final result of the activity. The non-transparency of the use of AI in this evaluable activity is considered a lack of academic honesty and may entail a partial or total penalty in the activity grade, or major sanctions in serious cases.

The commission of any irregularity in an evaluation activity (academic fraud, plagiarism, or improper use of AI, unless such use is expressly authorized in the course guide), which may lead to a significant variation in the grade, means that this activity will be graded with a 0. In the event that the course guide stipulates that obtaining a minimum grade in this evaluation activity is an essential requirement to pass the course, or if several irregularities occur in the evaluation activities of the same course, the final grade for the course is 0.

Regardless of this, a disciplinary proceeding may be initiated against the student who incurs any of these irregularities.

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.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	44	Spanish	second semester	morning-mixed
(SEM) Seminars	441	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	442	Catalan/Spanish	second semester	morning-mixed