63104 - Cell and Organism Biotechnology: experimental methodology

Información del Plan Docente

Academic Year	2018/19
Subject	63104 - Cell and Organism Biotechnology: experimental methodology
Faculty / School	100 - Facultad de Ciencias
Degree	572 - Master's in Quantitative Biotechnology
ECTS	4.0
Year	1
Semester	Second semester
Subject Type	Optional
Module	---

1.General information

1.1.Aims of the course

The major objective of this course is to introduce the student to the use of several *in vivo* models that are currently used in modern biotechnology. The student will learn to choose the correct model, to manipulate it and to study it using several modern molecular, genetic and cell biology techniques.

1.2.Context and importance of this course in the degree

The major objective of this course is to learn the use of advanced techniques for the utilization of cells in culture and animal models in biotechnology. Advances with *in silico* and *in vitro* techniques often require at the end experimentation in living beings, either unicellular culture models or experimental animals and, finally, humans. This course will provide the student with the knowledge required for the execution of advanced experiments in cells and organisms related to the utilization of bioactive molecules mainly for therapeutic purposes.

1.3.Recommendations to take this course

Continuous work by the student is highly recommended, analyzing suggested bibliography and consulting with teachers any questions that may arise, either personally during classes, tutoring hours or permanently through the Digital Teaching Ring or by e-mail.

2.Learning goals

2.1.Competences

After finishing this course the student will be able to:

- select the microorganism, cellular model of pluricellular organism most adequate for each type of project or experiment.

- use different methods of cell culture, in prokaryotes as well as in eukaryotes, and manipulate the most commonly used animals in research in the fields of biochemistry, molecular biology, cell biology and biotechnology

63104 - Cell and Organism Biotechnology: experimental methodology

- apply current legislation related to safety and work risks relative to the use of microorganisms, cell cultures and living beings in general, as well as legislation related to animal wellbeing euthanasy and genetically modified organisms.

- use the most common techniques for cell analyses: microscopy, cytometry and spectrometry.

- use several techniques to evaluate the different effects of experimental interventions from microorganisms to animals: viability, toxicity, efficacy.

- apply the major genetic manipulation techniques from microorganisms to animals.

2.2.Learning goals

The students will learn the use of advanced techniques for the utilization of cellular and animal models in Biotechnology, as well as basic legislation regulating it. They will be able to perform advanced experiments in model cells and organisms related to the use of bioactive molecules with therapeutic purposes. There will be magisterial lessons, practical training and seminars.

2.3.Importance of learning goals

In modern biotechnology it is essential to understand the molecular and cellular mechanisms underlying phenotypic manifestations of genetic information, and the effects of its alterations on human health as well as for therapeutic intervention when physiologic homeostasis is altered. Biotechnology related, for instance, to human nutrition (transgenic organisms that improve desired characters in animals or plants), relies also in experiments in model organisms before manipulating the final desired organisms.

Advances with experiments carried out in the test tube very often require further assays in model organisms to validate discoveries in a more complex environment, where not always the results obtained will match those obtained *in vitro*. Toxicity and efficacy effects of a drug, for instance, can only be adequately assayed in *in vivo* models.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

A written exam with questions that require short answers or those that require a more extensive explanation of the subject. The former are intended to screen the general knowledge of the student, whereas the latter are intended to evaluate their abilities to express and defend argumentations, as well as critical judgments. The written exam will be based on the programmed learning activities. This will account for 50% of the total qualification.

Practical classes in the laboratory or computer room. The performance of the student during the practical class will be evaluated: the student should be able to work autonomously following protocols and good laboratory practices. The student must also present a written memory of the experiments performed, which will also be evaluated. This will account for 30% of the total qualification.

Workshops where each student should formulate at least one question to be discussed with teachers. The number of interventions and the interests of questions will be valuated. This will account for 10% of the total qualification.

Seminars. The student must prepare, present in public and defend a work related to the subject of the course for up to 15

minutes. The quality of the elaboration, presentation and debate will be evaluated. This will account for 10% of the total qualification.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as:

Lectures using PowerPoint, or similar, presentations, with animations and videos.

Problems that will be handled mainly in class and through the virtual platform Moodle.

Preparation of seminars and public presentations and defense by the students.

Laboratory practices or workshops at the computer room.

Workshops and debates about state-of-the-art techniques or novel developments that will allow the students to express their opinions about the subject.

4.2.Learning tasks

The course includes the following learning tasks:

- Lectures: 20 hours. The lecturer will explain the theory and the students are expected to participate actively.

- Worshops and discussions: 10 hours. Discussion of a relevant research or technology development topics between the teacher and the students.

- Practice sessions in the laboratory or computer room: 5 hours.

- Worshops and discussions via virtual platform Moodle: 5 hours.

-Autonomous work: 60 hours.

4.3.Syllabus

The course will address the following topics:

A) Lectures (20 h.)

63104 - Cell and Organism Biotechnology: experimental methodology

Topic 1. Cell culture techniques (3 h.)

- Bacterial cultures. Species, strains and applications.

- Yeast cultures. Species, strains and applications.

- Insect cells. Protein expression using baculovirus.

- Mammalian cells. Monolayer and suspension cultures.

- Cell culture in three dimensions. Embryoid bodies, neurospheres and cell aggregates.

- Cell culture by continuous perfusion. Microfluidics chips: design and applications.

Topic 2. Determination of metabolic parameters: photosynthesis and respiration (1 h.)

Topic 3. Cytometry and advanced spectrometry in live cells (1 h.)

- Flow cytometry

- Biomolecule interactions in live cells. FRET, fluorescence complementation, ...

Topic 4. Advanced microscopy (6 h.)

- Multidimensional optical microscopy.

- Confocal microscopy.

- Electron microscopy.

Topic 5. Functional evaluation in animals (1 h.)

- Advanced techniques in fluorescence and luminescence in animals.

- Methods for behavioral studies in animals.

63104 - Cell and Organism Biotechnology: experimental methodology

Topic 6. Genetic manipulation (6 h.)

- Gene delivery into cells. Transformation, transfection and viral transduction.

- Gene modification by CRISP-Cas9

- Antisense RNA technology.

- Transgenesis methods in animals.

- Advanced techniques in genetic manipulation of microorganisms.

Topic 7. Stem cells and regenerative medicine (2 h.)

- Embryonic stem cells (ESCs).

- Induced pluripotent stem cells (iPSCs).

- Cell therapy and regenerative medicine.

B) Workshops and discussion (face-to-face sessions) (10 h.)

- Adipocyte differentiation.

- 3D cell cultures.

- Advanced microscopies.

- Artificial organs.

- Novel imaging techniques in animals.

63104 - Cell and Organism Biotechnology: experimental methodology

C) Practice sessions (5 h.)

- Multidimensional optical microscopy.

- Basics of microscopy image analysis.

- Ultracentrifugation.

4.4.Course planning and calendar

This course will be taught from February 12th to June 1st, on Wednesdays and Thursdays from 9 to 11 hours. If changes in this time schedule are required they will be announced in advance. Examination will take place at the beginning of June and will be announced in advance.

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We will start with lectures and then practical sessions, workshops, seminars and debates will be included.

4.5.Bibliography and recommended resources

Bibliographic references will be given to the students by individual teachers during their presentations. Some other references are given below:

Transmission Electron Microscopy. David B. Williams, C. Barry Carter. Springer 2009.

Physical Principles of Electron Microscopy, Ray F. Egerton, Springer 2005

Introduction to Conventional Transmission Electron Microscopy: Marc de Graef. Cambridge University Press 2002

Electron Energy Loss Spectroscopy, Rik Brydson, BIOS Scientific Publishers 2001

Manipulating the Mouse Embryo. A laboratory manual. Fourth edition (2014).

63104 - Cell and Organism Biotechnology: experimental methodology

Richard Behringer, Marina Gertsenstein, Kristina Nagy, and Andras Nagy

Cold Spring Harbor Laboratory Press

Transgenic Animal Technology: A Laboratory Handbook. Third Edition (2014).

Edited by Carl A. Pinkert

Elsevier Inc.

Advanced Protocols for Animal Transgenesis. An ISTT Manual. (2011)

Editors: Shirley Pease and Ph.D. Thomas L. Saunders.

Springer-Verlag Berlin Heidelberg.

Atomic Force Microscopy in Biomedical Research

Methods and Protocols

Series: Methods in Molecular Biology

by Pier Carlo Brag, Davide Ricci (Editors)

Humana Press 2011

Life at the Nanoscale: Atomic Force Microscopy of Live Cells

by Yves Dufrene (Editor)

Pan Stanford 2011

CRISPR 101: A desktop resource
(http://info.addgene.org/download-addgenes-ebook-crispr-101-2nd-edition?hsCtaTracking=def26d9c-3f9c-4d7b-b065-3e0d0e24

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