

# 63104 - Métodos experimentales en Biotecnología celular y de organismo

## Información del Plan Docente

**Año académico:** 2019/20

**Asignatura:** 63104 - Métodos experimentales en Biotecnología celular y de organismo

**Centro académico:** 100 - Facultad de Ciencias

**Titulación:** 572 - Máster Universitario en Biotecnología Cuantitativa

**Créditos:** 4.0

**Curso:** 1

**Periodo de impartición:** Segundo semestre

**Clase de asignatura:** Optativa

**Materia:** ---

## 1. Información Básica

### 1.1. Objetivos de la asignatura

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. Contexto y sentido de la asignatura en la titulación

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. Recomendaciones para cursar la asignatura

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. Competencias y resultados de aprendizaje

### 2.1. Competencias

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
- 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 euthanasia 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. Resultados de aprendizaje

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. Importancia de los resultados de aprendizaje

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.Evaluación

#### 3.1.Tipo de pruebas y su valor sobre la nota final y criterios de evaluación para cada prueba

A written exam with two parts: test questions and questions that require a more extensive explanation of the subject by the student. 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. Nevertheless, it is necessary to pass both parts of the theoretical examination in order to pass the subject, that is, to obtain at least 5 out of 10 points in each part (at least 1.25 points in each part, out of the total 5 points of the theoretical examination). If one of the two parts of the final theoretical examination (test or extensive answer questions) is suspended, the mark appearing in the minutes will be a 4.9 (over 10). If both are suspended, the highest grade will appear. The multiple-choice questions consist of four possible answers, each question is scored with 1 point and each wrongly answered question discounts 0.25 points. The total is then prorated over 2.5 points. Wrongly answered short-answer questions do not count negatively. Each is scored with one point and then prorated over 2.5 points.

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 valued. 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.Metodología, actividades de aprendizaje, programa y recursos

#### 4.1.Presentación metodológica general

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

Problems that will be handled mainly presentially in class and through the Teaching Digital Ring.

Preparation of seminars and public exposition and defense by the student.

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.Actividades de aprendizaje

Lectures by the teacher where theory will be explained and with the student expected to participate actively. 20 hours.

Worshops and debates. Discussion of a relevant research or technology development topic between the teacher and the students. 10 hours.

Practical classes at the laboratory or computer room. 5 hours.

Worshops and debates through the Teaching Digital Ring. 5 hours.

Work by the student. 60 hours.

#### 4.3.Programa

##### **LECTURES (20 H.)**

##### **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.

## **Determination of metabolic parameters: photosynthesis and respiration (1 h.)**

### **Cytometry and advanced spectrometry in live cells (1 h.)**

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

### **Advanced microscopy (6 h.)**

- Multidimensional optical microscopy.
- Confocal microscopy.
- Electron microscopy.

### **Functional evaluation in animals (1 h.)**

- Advanced techniques in fluorescence and luminescence in animals.
- Methods for behavioral studies in animals.

### **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.

### **Stem cells and regenerative medicine (2h).**

- Embryonic stem cells (ESCs).
- Induced pluripotent stem cells (iPSCs).
- Cell therapy and regenerative medicine.

### **WORKSHOPS AND DEBATES (PRESENTIAL) (10 h.)**

- Adipocyte differentiation.
- 3D cell cultures.
- Advanced microscopies.
- Artificial organs.
- Novel imaging techniques in animals.

### **PRACTICAL SESSIONS (5 h.)**

- Multidimensional optical microscopy.
- Basics of microscopy image analysis.
- Ultracentrifugation.

### **WORKSHOPS AND DEBATES (THROUGH TEACHING DIGITAL RING) (5 h.)**

### **INDIVIDUAL WORK BY THE STUDENT (60 h.)**

## **4.4. Planificación de las actividades de aprendizaje y calendario de fechas clave**

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 time. Evaluation will take place at the beginning of June and will be announced in time.

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

#### **4.5. Bibliografía y recursos recomendados**

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).

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-b065-3e0d0e2>).

Image J (<https://imagej.nih.gov/ij/>)