

## Recombinant DNA: Basics and Advanced Applications

2014/2015

Code: 42895

ECTS Credits: 9

Degree	Type	Year	Semester
4313794 Bioquímica, Biologia Molecular i Biomedicina	OT	0	A

### Contact

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### Use of languages

Principal working language: català (cat)

Some groups entirely in English: No

Some groups entirely in Catalan: Yes

Some groups entirely in Spanish: No

### Teachers

Joaquín Ariño Carmona

Josep Antoni Biosca Vaqué

Inmaculada Ponte Marull

Salvador Ventura Zamora

Jaume Piñol Ribas

Nerea Roher Armentia

Irantzu Pallarés Goitiz

Alicia Roque Cordova

### External teachers

José Enrique Pérez Ortín

Nuria Sánchez Coll

### Prerequisites

For graduates in Biochemistry, Biology, Biomedical Sciences, Genetics, Microbiology, Chemistry, Computer Science, Physics, Veterinary Medicine and Pharmacy

In any case, it is recommended to learn the basic techniques of recombinant DNA.

### Objectives and Contextualisation

The main goal of the course is to provide an advanced and rigorous training about a diversity of recombinant DNA techniques, both basic and advanced. So, at the end of the module the student will have achieved a solid knowledge of different techniques involving the manipulation of recombinant DNA currently used in research laboratories as well as profits and limitations.

After completing this module, students will be able to:

1. Understand the methodological procedures and identify current instrumental tools based on recombinant DNA technology to address key issues in many research areas, such as the structure of DNA, the structure and function of chromatin, the evaluation of the expression and regulation, translation, and the subcellular localization of proteins, etc...
2. Design and conduct experiments using the most appropriate for each specific objective experimental recombinant DNA techniques.
3. Analyze and properly interpret and critically evaluate both, own and published in the scientific literature, experimental data.
4. Defining and understanding the specific techniques for specific organisms used as experimental models in research laboratories as well as profits and limitations.

## Skills

- Analyse and correctly interpret the molecular mechanisms operating in living beings and identify their applications.
- Analyse research results to obtain new biotechnological or biomedical products to be transferred to society.
- Apply techniques for modifying living beings or parts of these in order to improve pharmaceutical and biotechnological processes and products or develop new products.
- Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
- Continue the learning process, to a large extent autonomously.
- Develop critical reasoning within the subject area and in relation to the scientific or business context.
- Identify and propose scientific solutions to problems in molecular-level biological research and show understanding of the biochemical complexity of living beings.
- Integrate contents in biochemistry, molecular biology, biotechnology and biomedicine from a molecular perspective.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.
- Use scientific terminology to account for research results and present these orally and in writing.
- Work individually and in teams in a multidisciplinary context.

## Learning outcomes

1. Analyse research results to obtain new biotechnological or biomedical products to be transferred to society.
2. Analyse, correctly interpret and critically assess both one's own experimental data and those published in the scientific literature.
3. Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
4. Continue the learning process, to a large extent autonomously.
5. Decide on the most appropriate organism to use for each specific need.
6. Design and conduct experiments using the most appropriate experimental techniques of recombinant DNA for each particular objective.
7. Develop critical reasoning within the subject area and in relation to the scientific or business context.
8. Distinguish the bases of the most commonly used standard techniques in molecular biology.
9. Make the necessary changes to improve performance.
10. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.

11. Understand methodological procedures and the advantages and limitations of currently-used instruments for conducting research in this field (chromatin structure, gene expression and its regulation, mRNA processing, etc.).
12. Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.
13. Use scientific terminology to account for research results and present these orally and in writing.
14. Work individually and in teams in a multidisciplinary context.

## Content

The content of this module is as follows:

1) Introduction to basic molecular biology techniques.

1.1. Principles of gene cloning and DNA analysis.

- Amplification, labeling and detection of nucleic acids.
- Type of vectors, DNA molecular cloning strategies and gene libraries of DNA.
- DNA-directed mutagenesis.

1.2. Applications of gene cloning and DNA analysis for the study of gene expression.

- Techniques for studying gene expression based on DNA microarrays and massive sequencing of DNA (RT-PCR, Run On, microarrays and DNA footprinting, promoter analysis using reporter genes, mRNAs massive sequencing December, ChIP-Seq, GRO-Seq, etc.)..

2) Characteristics of commonly used model organisms.

3) Techniques for the study of epigenetic mechanisms that regulate chromatin structure and its role in the replication, transcription and repair of eukaryotic DNA.

- Determination of heterochromatin and euchromatin regions (microscopic / sensitivity to nucleases / density gradients / chromatin precipitation curves, etc.)...
- Modifications of histones (histone code). ChIP, ChIP-chip, ChIP-seq and others.
- DNA methylation. Identification of methylation in a sequence. Characterization of the degree of methylation at CpG islands. Building the methyloma.
- Methods for characterizing high and low resolution nucleosome positioning and identification of sites of hypersensitivity to nucleases (End labeling, in vivo footprinting, LM-PCR, etc.).
- Methodology for the study of chromatin remodeling complexes.

4) Modification of genomes and gene silencing (RNA antisense techniques, KO, ribozymes, GM, using adjustable promoters, etc.)..

5) Protein Expression. Characteristics of various protein expression systems (types of vectors, promoters, organizations, etc.). Study of the intracellular localization of proteins.

6) Detection of protein-protein interaction (double hybrid protein chips, FRET, etc.) and Interactomics.

7) Applications of recombinant DNA technology in industry and medicine (diagnosis, antibody engineering, metabolic, etc.).

8) Presentation and defense of a bibliographic work.

## Methodology

Part of the teaching will be in the classroom and will comprise lectures, laboratory work and assistance in the defense of bibliographical works as detailed below. It is excluded the attendance at scheduled seminars, part of Module 2 Advanced seminars in Biochemistry and Molecular Biology.

Face class / Dirigidas (52 h)

- Lectures and seminars 32 h
- Laboratory work 16 h
- Presentation and defense of bibliographical 4 pm

Another part will be self-study by students, including the execution of tests and exercises throughout the course.

Autonomous (120 h)

- Student Self Study: 93 pm
- Theoretical and practical tests throughout the course (resolution of cases and problems): 25h

The preparation by the students of a bibliographic work is the main activity supervised.

## Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Classroom lectures	32	1.28	2, 5, 7, 8, 11, 9, 4
Laboratory teaching	16	0.64	2, 6, 8, 11, 10, 3, 4, 14, 12
Supervised	4	0.16	1, 2, 7, 8, 11, 10, 4, 14, 12, 13
Type: Supervised			
Preparation of a bibliographic work	55	2.2	1, 2, 7, 8, 11, 10, 4, 14, 12, 13
Type: Autonomous			
Autonomous learning	67.5	2.7	1, 2, 5, 7, 6, 8, 11, 10, 4, 14, 12
Theoretical and practical tests throughout the course (resolution of cases and problems)	25	1	2, 5, 7, 6, 8, 11, 9, 10, 3, 4, 14, 12

## Evaluation

The evaluation system described is subject to an attendance of at least 80% of face classes.

33% of the grade comes from attendance at classes. Attendance of at least 80% provides maximum score. The note will decrease proportionally decreasing attendance.

The rest of the evaluation module will be based on:

1. - Possibly solving problems presented by the teachers, as well as theoretical and practical tests throughout the course (25%)
2. - The bibliographic research exercise presented and defended by the student (33%)
3. - The realization and participation in practices (9%)

## Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Completion of laboratory sessions	10	0	0	1, 2, 5, 6, 8, 11, 9, 10, 3, 4, 14
Exercises eventually presented by teachers and theoretical and practical tests throughout the course	40	0.5	0.02	1, 2, 5, 7, 6, 8, 11, 9, 10, 3, 4, 14, 12, 13
Oral presentation of the bibliographic work	50	25	1	1, 2, 5, 7, 6, 8, 11, 10, 14, 12, 13

## Bibliography

\* Molecular Cloning: A Laboratory Manual.

John J. Sambrook, David David William Russell.

Cold Spring Harbor Laboratory Press; 4th edition. 2012.

\* Current Protocols in Molecular Biology

Ausubel et al.

J. Willey, 2003

\* Gene Cloning and DNA Analysis: An Introduction.

A. Brown.

Wiley-Blackwell; 6<sup>th</sup> edition, 2010.

\* Lewin's GENES XI.

Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick.

Jones & Bartlett Learning; 11<sup>th</sup> edition, 2012.

\* Molecular Biotechnology: Principles and Applications of Recombinant DNA.

Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten.

Recombinant DNA: Basics and Advanced Applications 2014 - 2015

ASM Press; 4th edition. 2009.

\* Next-Generation DNA Sequencing Informatics.

Stuart M. Brown

Cold Spring Harbor Laboratory Press, 2013.

\* Diverses revisions en revistes com: Current Opinion in Structural Biology, Trends in Biochemical Sciences, Trends in Biotechnology, Nature Biotechnology, Nature Methods, etc.