COURSE DATA

DATA SUBJECT

Code: 33048
Name: Molecular methods in biology
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Facultat de Ciències Biològiques	2	Second quarter
1106 - Degree in Biology	Facultat de Ciències Biològiques	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1100 - Degree in Biology	Molecular and genetic basis of living beings	COMPULSORY
1106 - Degree in Biology	Bases moleculares y genéticas de los seres vivos	COMPULSORY

COORDINATION

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SUMMARY

The subject Molecular Methods in Biology is taught in the second year of the Degree in Biology and is compulsory. It is a primarily methodological subject and it is part of the core subject "Molecular Basis of Living Beings", which also includes the subjects Genetics and Biochemistry that are taught in second grade.

The main objective of Molecular Methods in Biology is to provide students with the basic knowledge and methodological tools required for DNA manipulation. Thus, protocols and experimental designs discussed in this course constitute the basis for the molecular analysis of genes and genomes and gene transfer between species that are primary in Biotechnology.

An additional objective of the course is to convey to students that the methodology introduced in

this course can be applied to fields such as Biomedicine, Agriculture and Farming and several aspects of the professional activity of biologists.

DUE TO THE IMPLEMENTATION OF THE NEW CURRICULUM FOR THE BACHELOR'S DEGREE IN BIOLOGY, THIS SUBJECT IS BEING DISCONTINUED FROM THE OLD CURRICULUM AND IS THEREFORE OFFERED EXCLUSIVELY AS A NON-TEACHING (ND) COURSE IN THAT CURRICULUM. THIS MEANS THAT IT WILL NOT HAVE ANY FACE-TO-FACE TEACHING ACTIVITIES ASSOCIATED WITH IT AND THAT THE SUBJECT WILL BE ASSESSED SOLELY THROUGH A THEORETICAL AND PRACTICAL EXAM.

STUDENTS WHO DO NOT PASS THIS COURSE IN ANY OF THE 2025-26 OR 2026-27 ACADEMIC YEARS WILL BE REQUIRED TO ADAPT TO THE NEW CURRICULUM TO CONTINUE THEIR BACHELOR'S DEGREE IN BIOLOGY.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

There are no specified enrolment restrictions with other subjects of the curriculum, but it is recommended to have previously taken the subjects Genetics and Biochemistry that are part of the core subject " Molecular Basis of Living Beings".

COMPETENCES / LEARNING OUTCOMES

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Capacidad de aprendizaje autónomo.

Capacidad de búsqueda de información y análisis crítico de textos científicos.

Capacidad de comunicación oral y escrita.

Capacidad de manejar el inglés como vehículo de expresión científica.

Capacidad de razonamiento crítico.

Capacidad de resolución de problemas.

Capacidad de trabajar en equipo.

Capacidad de utilizar las nuevas tecnologías de información y comunicación.

Capacidad para diseñar experimentos y aproximaciones multidisciplinares para la resolución de problemas concretos.

Capacidad para presentar, discutir y extraer conclusiones de los resultados de los experimentos científicos.

Capacidad para trabajar correctamente en los laboratorios de Bioquímica, Genética y Biología Molecular, incluyendo seguridad, manipulación, eliminación de residuos y registro anotado de actividades.

Capacidad para utilizar la instrumentación básica en los laboratorios de Bioquímica, Genética, Biología Molecular y Celular.

Comprender el método científico.

Conocer la estructura y función de las biomoléculas.

Conocer las bases biológicas del desarrollo.

Conocer las metodologías de análisis global estructural y funcional de genomas y procesos celulares.

Conocer los conceptos básicos y las aplicaciones de la tecnología del DNA recombinante y de la Ingeniería Genética.

Conocer los mecanismos de la herencia biológica.

Conocer los mecanismos de replicación, transcripción, traducción y modificación del material genético.

Saber hacer análisis de datos científicos.

Skills in analysis and synthesis.

Tener una visión integrada de las técnicas y métodos utilizados por la Bioquímica, Genética y Biología Molecular.

DESCRIPTION OF CONTENTS

1. Introduction

Objectives and scope of molecular biology methods.
Development of recombinant DNA technology.
Areas of application of recombinant DNA technology.

2. Molecular cloning

General scheme of the process of molecular cloning.
Basic elements in this technology.
Enzymes commonly used: restriction enzymes.
Cloning Methods.

3. Cloning in bacteria

Plasmid and phage vectors.
Vectors for cloning large fragments.
Expression vectors.
Transformation methods.

4. PCR amplification of DNA

General scheme of the method.
Parameters to be considered.
Types and applications.
Quantitative PCR.
Cloning vector for PCR products.

5. Gene transfer to animal cells

Methods of transfection in mammalian cells.
Methods of selection and marker genes.
Most common vectors.
Obtaining transgenic animals.
Obtaining cloned animals.

6. Gene transfer to vegetal cells

Methods of gene transfer to vegetal cells.
Transformation with *Agrobacterium*.
Cloning vectors.

7. Obtaining and identification of clones of specific genes.

Molecular hybridization. Probes: types, methods of obtaining and labeling. Factors affecting hybridization. Most common methodologies.

Libraries. Genomic and cDNA libraries. Construction, titering and screening.

DNA sequencing. Sequencing methods. Basis of the Sanger sequencing method. Basic methodology in automatic sequencing. New methodologies. Sequencing strategies.

8. Modification of DNA sequences

Mutagenesis by PCR and using oligos.
Mutagenesis by homologous and site-specific recombination.
Generation of knockout organisms.
Precision genome editing.
Other approaches to modify DNA sequences.
Gene silencing.

9. Analysis methods of gene expression

mRNA detection and quantification.
Use of reporter genes in prokaryotes and eukaryotes.
Analysis of differentially expressed genes.
Analysis of DNA-Protein Interactions.
Identification of Protein-protein interactions.
Silencing and over expression.

10. Structural genomics. Functional genomics. Proteomics

Structural genomics. Gene mapping using molecular markers. Genetic and physical maps. Genome projects. Human Genome Project: shotgun sequencing versus hierarchical sequencing.

Functional genomics: Transcriptomics. Microarrays and DNA chips. Definition. General and experimental scheme of the process. Types of microarrays and applications. RNA-seq.

Functional genomics: Proteomics. Objectives of proteomics. Differential proteomics. Protein microarrays.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	3,00
Theory	26,00
Laboratory	18,00
Computer classroom practice	5,00
Classroom practices	8,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	12,00
Independent study and work	30,00
Preparation of lessons	28,00
Preparation for assessment activities	20,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

For the development of theoretical activities expository method or lecture is used, but with active participation of students.

For practical work the methodology of solving questions and problems developed in the classroom, bioinformatics class or lab is used, always trying to put into practice previous knowledge. Teamwork is encouraged, since in the activities carried out in the laboratory, as well as in the bioinformatics class and in the sessions dedicated to questions and problems resolution, students work in groups.

The course is developed with the following structure of class work:

A. Two lectures per week of one hour duration. **A total of 24 hours** will be necessary to cover this teaching resource.

B. One-hour session per week (8 weeks) to work on different kinds of **problems and questions** related to the lectures.

C. Nine sessions of two hours (during 9 weeks) to perform **laboratory practices**.

D. Two sessions of two hours and another of one hour to perform **bioinformatics practices**.

E. Three group tutorial sessions of one hour on applications of recombinant DNA technology.

NOT APPLICABLE DUE TO THE IMPLEMENTATION OF THE NEW STUDY PLAN

EVALUATION

The evaluation of knowledge and skills acquired by students will consider all aspects of the teaching of this subject: theoretical, practical (laboratory and bioinformatics classroom), resolution of problems and

questions.

The numerical rating of the degree of knowledge and skills acquired by students will be obtained from different tests related to the different teaching activities carried out.

A. Assessment of theoretical knowledge. At the end of the course there will be a test to evaluate the knowledge acquired in lectures. The value of this test will account for **60% of the final course grade**.

B. Assessment of practical skills.

B.1. Evaluation of experimental work in the laboratory. The student's ability to design, implement and critically analyze experiments will be evaluated.

Assistance to laboratory practices is an absolute requirement to pass the course.

Once the laboratory practices have been carried out, the student should write a report in which the degree of knowledge acquired by the student should be demonstrated, including a description of the main objective of the practice, the experimental procedure, the results obtained and specially, a discussion of the results obtained. **To hand in the laboratory report at the end of the laboratory practices will be mandatory**.

The laboratory practices final grade will be the result of adding the grade obtained in the laboratory report (50% ofthe final grade) plus the grade obtained in an exam at the end of the course (50% of the final grade).

The value of the experimental work in the laboratory will be **15% of the final grade of the subject**.

B.2. Evaluation of problems and questions. The student's ability to solve problems and questions will be evaluated continuously. At the end of the course, there will be a final exam to evaluate this issue, which will represent **10% of the final grade of the subject**.

B.3. Evaluation of knowledge acquired in the bioinformatics class. The value of this part will represent **10% of the final grade of the subject**. Assistance to the bioinformatics sessions and the assignments handed in after each session will be evaluated.

C. Evaluation of the tutorial groups. The tutorial groups activities will represent **5% of the final grade of the subject**. Assistance to the sessions will be evaluated as well as participation in the activities prepared for each session, and if it applies, the resolution of exercises related with them. Questions related to these activities can be included in the theortetical exam.

A. Theory	up to 60 p
B. Practical skills (laboratory, problems and bioinformatics)	up to 35 p
C. Group Tutorials	up to 5 poi

Other considerations:

The subjects final grade will be the result of adding all the points obtained by the student, taking into account that it is required to obtain 5 points or more (out of 10) in the laboratory practices. In order to pass, it will be necessary to obtain a final grade of at least 5 points out of 10.

Those students that do not hand in any of the parts of the final exam (theory, laboratory, problems or questions) will be graded as NOT PRESENTED.

The students that fail in the first examination call of the course will be able to be examined in the second call, of any of the exam parts (theory, laboratory, problems and questions) that the student decides to obtain a final grade of at least 5 points out of 10.

Grades obtained in the corresponding parts of the subject in sections A, B2, B3, and C will not be saved for the following academic course. Only the grades obtained in the corresponding parts of the subject in sections B1, concerning laboratory practices. In the case of the grade obtained in the laboratory practices will be saved for three academic courses.

It will not be possible to resign the grade obtained in any part of the subject, either related to teaching activities in class, exams or assignments handed in.

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REFERENCES

BASICS

- Brown, T.A. (2021). Genomas. 3ª ed. Ed. Médica Panamericana. ISBN: 978-950-06-1448-1

- Green MR y Sambrook, J. (2012). Molecular cloning. A laboratory manual. 4ª ed. Cold Spring Harbor Laboratory Press. (3 Volúmenes). ISBN 978-1-936113-41-5.

- Izquierdo M. (2014) Curso de Genética Molecular e Ingeniería Genética. Ed. Pirámide. ISBN 978-84- 368-3123-8

- Pascual LF y Silva JF. (2017). Principios básicos de Genética. Ed. Síntesis ISBN: 978-84-9171-106-3 978-84-9171-106-3

- Real MD, Rausell C y Latorre A. (2017). Técnicas de Ingeniería Genética. Ed. Síntesis ISBN: 978-84- 9171-071-4

- Watson, JD; Caudy AA; Myers, RM y Witkowski JA. (2007) Recombinant DNA: Genes and Genomes, a short course. W.H. Freeman and Company. Cold Spring Harbor Laboratory Press.

COMPLEMENTARY

- Departamento de Genética. http://www.uv.es/genetica

- DNA interactive. www.dnai.org/b/index.html

- DNA learning center. Cold Spring Harbor Laboratory: http://www.dnalc.org/resources/animations/

- National Human Genome Research Institute (NHGRI). https://www.nih.gov/news-events

- Scitable. https://www.nature.com/scitable/ebooks/cntNm-16570330/