

Molecular Biology and Biotechnology of Plants

Code: 100763
ECTS Credits: 6

Degree	Type	Year	Semester
2500250 Biology	OT	4	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Jordi Moreno Romero
Maria del Mar Marquès Bueno

Prerequisites

There are no mandatory prerequisites.

Objectives and Contextualisation

The general goal of this subject is to provide the required knowledge to understand the molecular bases of plant biology, as well as the techniques and basic aspects of plant biotechnology, with important social implications as well as the use of transgenic plants or Genetically Modified Organisms (GMOs).

At the end of this subject, students should be able to have their own criteria on issues of plant biotechnology with social repercussion, based on contrasting knowledge.

The topics that will be addressed in the subject can be seen in the content section.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Analyse and interpret the development, growth and biological cycles of living beings.
- Be able to analyse and synthesise
- Be able to organise and plan.
- Isolate, identify and analyse material of biological origin.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Perform genetic analyses.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.

- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Understand heredity mechanisms and the fundamentals of genetic improvement.
- Understand the processes that determine the functioning of living beings in each of their levels of organisation.

Learning Outcomes

1. Analyse a situation and identify its points for improvement.
2. Be able to analyse and synthesise.
3. Be able to organise and plan.
4. Critically analyse the principles, values and procedures that govern the exercise of the profession.
5. Describe diagnoses in plant biotechnology and identify plant varieties by analysing genetic markers.
6. Describe the characteristics and organisation of the genome of the different organelles of the plant cell, and also the coordinated expression of this genome and the functions that derive from it.
7. Describe the molecular bases of development in plants.
8. Describe the molecular bases of processes related to post-embryonic growth and to plants' communication with the external environment.
9. Describe the molecular bases of the processes of environmental adaptation, including responses to biotic and abiotic stress.
10. Detect DNA polymorphisms in plant samples.
11. Detect food ingredients deriving from genetically modified plants.
12. Evaluate the applications of transgenic plants to plant improvement.
13. Interpret European Union legislation on plant biotechnology.
14. Isolate, purify and analyse plant DNA.
15. Know the different methods for obtaining transgenic plants.
16. Propose new methods or well-founded alternative solutions.
17. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
18. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
19. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
20. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
21. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
22. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
23. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.

Content

The subject will be organized in two sections: a first section in which theoretical knowledge will be imparted and a second one in which students will learn by the resolution of different scientific problems.

In relation to the first section of the subject, students will learn the following concepts and knowledge:

- Structure of a plant gene: from the transcription to the functional protein.
- Plant transformation: via *Agrobacterium tumefaciens*, via bio-ballistics, via chemical mutations.
- Generation of transgenic plants by over-expression of a gene of interest (with the promoter 35S), or repression with the technique of RNAi.
- Gene-editing using the CRISPR-Cas technique.
- Mutants: what they are, why they are used for, how are they generated, the importance of mutant collections.
- Arabidopsis thaliana* as a model organism and its comparison with other plants.
- Use of bioinformatics platforms for molecular biology studies.
- omics techniques for the study of the regulation of gene expression.

In relation to the second section of the subject, students will have to solve proposed problems in the field of plant molecular biology.

The theoretical content will be evaluated with an exam that will be the main body of the final mark.

Methodology

Methodology

The formative activities will be: theory, seminars and laboratory.

Theory

Teachers will explain the contents of the subjects using material available on the Internet. These lectures will be the first part of the subject. The knowledge of some parts of the subjects will have to be also developed by the students, by means of autonomous learning. To facilitate this task, we will provide information on textbooks, web pages, scientific articles related to the topic ...

Seminars

The seminars will be given by the students, individually or in groups, depending on the number of students and the availability of time.

The students will have to present in 10 minutes a current problem of plant molecular biology and emphasize the objectives for its resolution.

The topics that will cover the seminars will be decided at the beginning of the course. The aim of these sessions is to deepen the knowledge given in the lectures, as well as to have discussion on topics of special interest for the students.

The seminars will be evaluated, with an impact on the final mark.

Laboratory

The practical classes of laboratory will consist of 3 sessions of 4 hours each one. The protocols used will be provided at the beginning of the academic year. During these sessions, experimental skills in some of the basic

issues of plant biotechnology will be acquired.

The practices will be evaluated, having an impact on the final mark.

*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities."

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
laboratory training	12	0.48	14, 5, 11, 10, 2, 3
lectures	28	1.12	15, 8, 7, 9, 6, 13, 12
seminars	12	0.48	13, 2, 3, 12
Type: Supervised			
Examination (seminars and theory)	7	0.28	15, 5, 8, 7, 9, 6, 2, 3, 12
tutoring	5	0.2	23, 22, 4, 1, 15, 8, 7, 9, 6, 16, 2, 12
Type: Autonomous			
elaboration of practical report	5	0.2	5, 11, 10, 2, 3
seminar elaboration	5	0.2	13, 2, 3
studies	69	2.76	15, 5, 8, 7, 9, 6, 13, 2, 3, 12

Assessment

Laboratory practices, seminars and the acquisition of knowledge corresponding to the subject explained and worked in theoretical classes will be evaluated separately. Attendance to the laboratory sessions is mandatory. Failure to meet this requirement will imply that the student loses the right to be evaluated in the rest of the evaluation parts. Students missing more than 20% of programmed sessions will be graded as "No Avaluable".

Once the practices have been approved, it will not be necessary to do them again, even if the student may enroll in this subject again. The following aspects will be evaluated: 1) attitude and participation; 2) experimental results obtained; 3) final report. The report, with a length of between 5 and 10 pages, will consist of a presentation of the results obtained and in the elaboration and critical discussion of these results. The maximum mark for laboratory practices is 2 points.

The seminar corresponds to the elaboration and a brief exposition of a research project in the presence of the whole class. The maximum possible mark for the seminars is 1 point.

The acquisition of knowledge corresponding to the subject explained in the theoretical classes will be evaluated by means of:

An exam in the middle of the teaching period, which will be qualified with a maximum mark of 4 points.

An exam at the end of the teaching period, which will be qualified with a maximum mark of 3 points.

The final mark of the subject will be obtained by the sum of all the marks obtained in the different parts (laboratory, seminars and theory). Approving the subject will involve obtaining a minimum of 5.0 total points. In addition, to approve the subject, the sum of the marks of the theory exams may not be under 3 points, with a maximum of 7.0 points. Otherwise, the subject will be suspended, although the sum of the different notes gives a score of 5.0 or more.

Students who have not passed the subject will have the option to be re-evaluated of the theoretical part. 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. Thus, the student will be graded as "No Avaluable" if the weighting of all conducted evaluation activities is less than 67% of the final score"

The students who wish to improve their mark will have also access to the retake process. In this case it is understood that they renounce the previously obtained theory mark.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
design research project and oral presentation	10	1.5	0.06	23, 22, 4, 1, 16, 2, 3
final exam	50	3	0.12	14, 15, 5, 8, 7, 9, 6, 11, 10, 13, 21, 20, 19, 17, 18, 2, 3, 12
practical courses	15	0	0	14, 5, 2, 3
seminar	10	1.5	0.06	23, 22, 4, 1, 16, 2, 3, 12
test of concepts	15	1	0.04	15, 8, 7, 2, 3

Bibliography

1. Biochemistry and Molecular Biology of Plants (Buchanan, Gruissem and Jones) ASPP.
2. Biology of Plants (Raven, Evert, and Eichhorn) Worth publishers, Inc.
3. Plant Physiology (Salisbury and Ross) Wadsworth Publishing Company
4. Plants, Genes, and Agriculture (Chrispeels and Sadava). Jones and Bartlett Publishers
5. Fundamentos de Fisiología Vegetal. Joaquín Azcón-Bieto y Manuel Talón (2000). McGraw-Hill Interamericana y Edicions de la Universitat de Barcelona.
6. Huellas de DNA en genomas de plantas (Teoría y protocolos de laboratorio). Ernestina Valadez Moctezuma y Günter Kahl (2000). Mundi-Prensa México.
7. Biotecnología Vegetal. Manuel Serrano García y M. Teresa Piñol Serra (1991). Colección Ciencias de la Vida. Editorial Síntesis. Madrid.
8. ARTÍCULOS Y REVISIONES DE DIFERENTES REVISTAS CIENTÍFICAS DEL CAMPO. PRÁCTICAMENTE LA TOTALIDAD DE ESTE TIPO DE BIBLIOGRAFÍA ES EN INGLÉS.

Student will find all the required theory information through the online tools that are available at the University.

Software

The required websites will be provided during the courses.