

**Molecular Biology and Biotechnology of Plants**

Code: 100913  
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	OT	4	1

## Contact

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## Teaching groups languages

You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

## 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.

## Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Analyse and explain normal physiological processes and alterations in them on the molecular scale, using the scientific method.

- Apply the principal techniques used in biological systems: methods of separation and characterisation of biomolecules, cell cultures, DNA and recombinant protein techniques, immunological techniques, microscopy techniques, etc.
- Collaborate with other work colleagues.
- Integrate scientific and technological knowledge.
- Interpret experimental results and identify consistent and inconsistent elements.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Manage bibliographies and interpret the information in the main biological databases, and also know how to use basic ICT tools.
- Read specialised texts both in English and one's own language.
- Show initiative and an entrepreneurial spirit.
- Stay abreast of new knowledge of the structure, organisation, expression, regulation and evolution of genes in living beings.
- 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.
- Use ICT for communication, information searching, data processing and calculations.

## Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Apply European Union legislation on plant biotechnology.
3. Collaborate with other work colleagues.
4. Contribute scientific knowledge to the public discussion on transgenic crops and foods.
5. Describe genetic determiners and the molecular mechanism of the transformation of plants by *Agrobacterium*, and its applications in the generation of transgenic plants.
6. Describe the principal molecular tools available for studies in plant genetics.
7. Detect DNA polymorphisms in plant samples using the RAPDS technique.
8. Detect food ingredients that come from genetically modified plants.
9. Explain the use of mutants and their applications in gene isolation.
10. Interpret experimental results and identify consistent and inconsistent elements.
11. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
12. Make use of bibliography and databases to prepare seminars.
13. Perform the isolation, purification and analysis of plant DNA.
14. Read specialised texts both in English and one's own language.
15. Show initiative and an entrepreneurial spirit.
16. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
17. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
18. Use ICT for communication, information searching, data processing and calculations.
19. Use data-analysis software (detection of polymorphisms in DNA of plant samples).

## Content

The subject will consist in two parts: a first part about concepts on Plant Molecular Biology and Biotechnology, and a second part in which students will learn tools in Cell Biology and Molecular Biology. Knowledge will be imparted through theoretical classes and problem solving.

In relation to the first part of the subject, students will learn the following concepts:

- Structure of a plant gene. From transcription to functional protein.
  - Transformation of plants: via Agrobacterium, via bio-ballistics, via chemical mutations and others.
  - Generation of transgenic plants by over-expression of a gene of interest or repression with the RNAi technique.
  - Plant in vitro culture.
  - Gene editing using the CRISPR-Cas technique.
  - Mutant plants: what they are, why they are useful, how they are produced, importance of existing collections.
  - Arabidopsis thaliana as a model organism and comparison with other models.
  - Use of bioinformatics platforms for molecular biology studies.
  - Massive techniques for studying the regulation of gene expression.
- In relation to the second part of the subject.
- Cell biology tools in plant biotechnology and plant molecular biology.
  - Generation of transgenic plants (from cloning to selection).
  - Techniques for the detection of protein-protein interaction.
  - Social and economic impact of transgenic crops.

## **Methodology**

The training activities will consist of theoretical classes, seminars and laboratory.

### Theoretical classes

The teachers will explain the content of the subject with the support of material accessible to the internet. These expository sessions will constitute the main part of the course. The connections of some parts of the subject matter have to be an object of in-depth study by the students, through autonomous work. To facilitate this task, information will be provided from textbooks, web pages, scientific articles related to the subject...

### Seminars

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

The students will have to explain in a period of 10 minutes the resolution of a case study in the molecular biology of plants and propose some objectives aimed at its resolution. In addition, apart from the seminar and the question-and-answer discussion, the students will have to deliver a poster.

The seminars will be subject to evaluation, having an impact on the final grade.

### Practical laboratory classes

The practical laboratory classes will consist of 3 sessions of 4 hours each. The protocols for carrying out the practices will be made available to students at the beginning of the academic year. During these sessions, some of the basic topics of plant biotechnology will be explored at an experimental level.

The practices will be mandatory and subject to evaluation, having an impact on the final grade.

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	18, 3, 8, 7, 10, 14, 13, 15, 19
lectures	28	1.12	18, 4, 5, 6, 9, 14
seminars	12	0.48	18, 2, 4, 3, 14, 12, 15
Type: Supervised			
Examination (seminars and theory)	7	0.28	18, 2, 4, 3, 5, 6, 9, 10, 14, 12, 15
tutoring	5	0.2	1, 17, 16, 4, 5, 6, 9, 10, 11, 14, 12, 15
Type: Autonomous			
Parctical case preparation	8	0.32	18, 5, 6, 9, 14, 19
Personal study	61	2.44	18, 2, 4, 3, 6, 9, 10, 14, 12, 15
elaboration of practical report	5	0.2	18, 3, 6, 8, 7, 10, 14, 13, 15, 19
seminar elaboration	5	0.2	18, 2, 4, 3, 5, 6, 10, 14, 12, 15

## Assessment

Laboratory practices, seminars and the acquisition of knowledge corresponding to the subject explained and worked on in the theoretical classes will be evaluated separately.

Attendance at practical classes is mandatory. failure to meet this requirement will mean that the student loses the right to be assessed in the other parts. Students will be graded "Not Assessable" when the absence is greater than 20% of the scheduled sessions. Once the practicals have been approved, it will not be necessary to do them again, even if the student must register for this subject in another academic year. The following concepts will be evaluated: 1) attitude and participation during the development of the classes; 2) the experimental results obtained; 3) the memory. The report will consist of a presentation of the results obtained personally and the elaboration and critical discussion of these results.

The maximum possible grade corresponding to laboratory practices is 2 points out of 10 finals.

The grade for the seminars (development of a project and oral presentation) is 1 point out of 10 finals. The project will have to be briefly presented orally in the presence of the whole class.

The acquisition of knowledge corresponding to the subject explained in the lectures will be assessed through:

- The first part of the subject will be evaluated in the middle of the teaching period with a written test (First part) that will be graded with a grade of 1.5 points and a delivery of a practical case that will be graded with a grade of 2.5 points from 10 ends

- The second part of the subject will be assessed with a written test at the end of the teaching period, which will be graded with a maximum mark of 3 points out of 10.

The final mark of the subject will be obtained by adding up the marks obtained in the different parts (practices, seminars, theory, practical case). Passing the subject will involve obtaining a minimum of 5.0 total points. In addition, to pass the subject, the sum of the two theory exams cannot be less than 5 points (out of 10). Otherwise, the subject will be suspended, even if the sum of the different grades gives a score of 5.0 or higher.

To participate in the recovery exam, students must have previously been assessed in a set of activities, the weight of which is equivalent to a minimum of two-thirds of the subject's total grade. Therefore, the student will obtain the qualification of "Not Assessable" when the assessment activities carried out have a weighting of less than 67% in the final qualification.

Students can also take the recovery exam to raise their grade in the theoretical part, even if they have passed the subject. In this case, they lose the previous theory grade.

### Single assessment

Students who take the single assessment must do the laboratory practices (PLAB) in face-to-face sessions.

The single assessment consists of a single summary test (with test-type questions and a topic/s to develop). The grade obtained in the synthesis test (which incorporates the first and second parts of the theory) is 70% of the final grade of the subject. The practice report will be 20%. The presentation of the poster (creation of the poster and recording of its defense) will be the remaining 10%. The practice report, the poster and its recording may be delivered on the dates set for the continuous assessment or be delivered to coincide with the date of the single synthesis test.

The single assessment test will coincide with the same date fixed in the calendar for the last continuous assessment test.

The minimum grade for the synthesis test will be 5 points (70% of the grade). To pass the subject you must obtain a minimum final grade of 5 points out of 10.

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st Part Test	15%	1	0.04	5, 6, 9, 10
2on Part test	30%	3	0.12	4, 5, 6, 9, 14
Laboratory training	20%	0	0	3, 6, 8, 7, 10, 13, 15, 19
Poster presentation	10%	3	0.12	1, 17, 16, 18, 2, 4, 3, 10, 11, 14, 12, 15
Practical case	25%	0	0	18, 5, 6, 9, 11, 14, 19

## Bibliography

1. Biochemistry and Molecular Biology of Plants (Buchanan, Grissem and Jones) 2015 ASPP.
2. Biology of Plants (Raven, Evert, and Eichhorn) 2012 Worth publishers, Inc.
3. Plant Physiology (Salisbury and Ross) 1992 Wadsworth Publishing Company
4. Plants, Genes, and Agriculture (Chrispeels and Sadava) 1994 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. Papers and reviews from different scientific journals. Practically all of them in english.

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.