Universitat Autònoma de Barcelona

2021/2022

Plant Molecular Biology and Plant Genetic Engineering

Code: 43864
ECTS Credits: 6

Degree	Type	Year	Semester
4316231 Plant Biology, Genomics and Biotechnology	OB	0	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: David Caparros Ruíz

Email: David.Caparros@uab.cat

Use of Languages

Principal working language: english (eng)

Teachers

David Caparros Ruíz

External teachers

Albert Ferrer Prats

Narciso Campos

Teresa Altabella

Prerequisites

Although there are no official prerequisites for studying this module, it is recommended to have previously acquired basic knowledge in Biochemistry, Molecular Biology and Genetics, preferably in the area of plants.

Objectives and Contextualisation

The overall objective of this module is to train specialists with solid and updated skills in Biology and Plant Biotechnology, to be competents in the knowledge of relevant aspects of plant molecular biology and Genetic Engineering, and their application in research, encouraging at the same time an active participation of the students and their critical spirit.

The specific objectives of the module are:

- To understand and to be able to identify the main characteristics of the plants which are applied in plant molecular genetic studies.

- To understand the main characteristics of plant gene structure and expression.

- To describe the techniques of manipulation and production of genetically modified plants.

- To understand the process of genetic transformation of plants and the related concepts of cisgenesis and transgenesis.

- To understand and to be capable of using tools for the study of the genome, proteome, transcriptome and metabolome.

- To integrate the acquired knowledge to solve practical subjects on the context of a laboratory of Molecular Biology and Genetic Engineering

Competences

- Analyze research results to obtain new products or processes, evaluating their industrial and commercial viability for transfer to society.
- Apply knowledge of plant molecular genetics in different scientific and industrial areas.
- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
- Explain the processes of obtaining genetically modified plants and their use.
- Identify and explain social and ethical responsibility in the obtainment and use of genetically-modified plants and recognise the relevant legal aspects of this.
- Identify and use Bio-Computer Science tools to be applied to the genetic, evolutionary and functional study of plants.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Synthesize, and analyze alternatives and debate critically.
- Use and manage bibliographical information and computer resources in the area of study.
- Work in a multidisciplinary team.

Learning Outcomes

1. "Process ""omic"" plant data using bioinformatic tools."
2. Analyze research results to obtain new products or processes, evaluating their industrial and commercial viability for transfer to society.
3. Communicate and advise efficiently in the interpretation of data obtained from specific bioinformatic databases and tools for plants.
4. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
5. Communicate the characteristics of genetically-modified plants efficiently.
6. Design transgenic plants and adapt the transformation processes to the needs arising during professional development.
7. Propose bioinformatic solutions to problems deriving from research into the molecular biology of plants.
8. Propose innovative entrepreneurial solutions in plant genetic engineering.
9. Propose, improve and defend research projects based on new technologies.
10. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
11. Synthesize, and analyze alternatives and debate critically.
12. Use and manage bibliographical information and computer resources in the area of study.
13. Use legal regulations in research with transgenic plants.
14. Work in a multidisciplinary team.

Content

The subject is divided into two parts. the first one (genetic transformation of plants), is constituted of more theoretical concepts related to functional tools, and it is given just before the subject of Plant Genomics. The rest of the course is given after Plant Genomics.

The general concept of the first block of the subject corresponds to the functional tools of plant genetic transformation:

-Nuclear transformation: the biology of agrobacterium, agrobacterium as a transformation vector, bombardment transformation, stable transformation to transient, selection of transformant plants and regulation of transgene expression (constitutive, specific and inducible promoters)

-Transformation of plastids: integration of exogenous DNA in the genome of the plastid, vectors and genetic design (genetic markers), nuclear transformation to plastid, applications.

The second part of the course consists of the following parts:

-A first session of general knowledge is carried out, all of them related to molecular techniques or tools.

-A bioinformatics session is held in the computer classroom of the faculty. This session aims to introduce students to computer programs related to molecular biology. We don't deal with -omics.

-There is an internship exercise in the classroom. It is based on working with mutants and GMOs. How to make them, which ones are appropriate and which ones are not. Several phenotypes will be given and it is necessary to discuss which alterations are logical and which are not. This exercise is a good complementation of what it is given in the first part of the course.

-Familiarity with molecular biology techniques related to ChIP-Seq, ChIP-QPC, RNA-Seq and QPCR. Students work in groups and have to elaborate an experiment.

-Finally, students are provided with an article with the disorganised figures and the introduction. In this exercise, students must identify the key words of the introduction and find a logical order of presentationof the results, adding titles. Then, based on the results that the students have elaborated and titling, they have to develop a project to follow.

Methodology

Training activities include the following elements:

- Lectures. Classroom lectures developing the theoretical contents will be performed. Graphic material (class presentations) will be available to students through the Virtual Campus tool. Additionally, students will have to search bibliographic information about the contents presented in order to supplement their training.

- Solving practical cases. Study cases drawn from recent research articles will be analyzed in detail, working hypothesis will be formulated, how these hypothesis have been addressed, achievements and possible shortcomings, future work, etc.. The aim of this activity is to promote through a proactive attitude, the participation and critical thinking of students, at both individual and teamwork levels.

- Bioinformatics sessions in which practical cases will present in order to get training in the used of the main bioinformatics tools applied to the area of the plants. This activity will take place in the computer rooms of the Faculty of Biosciences on schedule, although significant independent work will be required.

- Preparation and presentation of a seminar by each student in relation to module contents. The seminar will include an oral presentation, using graphic material and computer facilities, and will be given to the professor and the students. The seminar will be followed by a debate where suggestions, questions and doubts will be formulated in order to enrich the overall activity.

- Autonomous activities include autonomous comprehension and study of the module contents, bibliography research and preparation of a seminar.

*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			
Bioinformatics sessions in computer room	6	0.24	3, 7, 1
Debate portfolio/seminar	6	0.24	11
Lectures/expositive class	18	0.72	6, 8, 10
Solving practical cases	3	0.12	2, 7, 8, 10, 11, 14, 12
Type: Supervised			
Personal and grupal tutorship	10	0.4	2, 3, 7, 8, 11
Presentation of a portfolio/seminar	6	0.24	5, 9, 4, 11, 14
Type: Autonomous			
Autonomous study	40	1.6	2, 6, 7, 8, 10, 11
Preparation of a portfolio/seminar	20	0.8	6, 9, 10, 14, 12, 13
Search and read related bibliography	30	1.2	11, 12

Assessment

The assessment of this module will take the form of continuous assessment in order to encourage the efforts of the student throughout the module, allowing to monitor their level of understanding and integration of content.

The evaluation activities are:

- Lectures, through a written exam of the contents covered in the lectures of theory.

- Portfolio/Seminar, which assess both the scientific content and the quality of the exhibition, and the defense and answer of the questions posed by the teacher and other students.

- Solving practical cases from scientific articles and bioinformatics data. This activity will require considerable autonomous preparation work, as classroom exercises will be proposed , corrected and evaluated.

- Proactive attitude, class participation, scientific rigor of contributions, etc. These items will be assessed continuously throughout the module.

Compulsory attendance of at least 80% of classroom activities id required for the evaluation of the module. It is necessary to obtain a final 5 or higher to pass the module.

*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Preparation of portfolio/seminar/practical cases	20%	4	0.16	2, 7, 8, 10, 1, 14, 12, 13

Presentation defense and debate of a portfolio/seminar/practical cases	25%	2	0.08	3, 5, 9, 4, 11
Proactive attitude, class participation, scientific rigor in contributions, etc	20%	3	0.12	2, 3, 5, 9, 4, 14
Written exam of lecture contents	35%	2	0.08	5, 6, 8, 10

Bibliography

All the reccomended bibliography is avaliable at the UAB library.

- Biotechnology and plant disease management. Editor(s): Z.K. Punja, S.H. De Boer and H. Sanfaçon. Wallingford: CABI, 2007, ISBN: 9781845932886.

- Handbook of Plant Biotechnology Online. Editors-in-chef Paul Christou, Harry Klee. John Wiley and Sons, 2005. Online ISBN: 9780470869147; DOI: 10.1002/0470869143.

- Plant Biochemistry (Fourth Edition). Editor(s): Hans-Walter Heldt and Birgit Piechulla. London Academic, 2010. ISBN 9780123849861.

- Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. Editor(s): Nigel G. Halford. John Wiley & Sons, 2006, Print ISBN: 9780470021811, Online ISBN: 9780470021835, DOI: 10.1002/0470021837.

- Plant biotechnology and genetics: principles, techniques, and applications. Editors: C. Neal Stewart. Wiley, 2008. ISBN 9780470043813.

- Plant Biotechnology and Molecular Markers. Editors: P.S. Srivastava, Alka Narula, Sheela Srivastava. Kluwer Academic Publishers, 2004. ISBN: 978-1-4020-1911-1 (Print) 978-1-4020-3213-4 (Online).

Journals in the area of Molecular Biology and Biotechnology of Plants (the 10 journals with highest impact factor in the area of "Plant Sciences" of the Journal Citation Reports):

- ANNUAL REVIEW OF PLANT BIOLOGY, Publisher: ANNUAL REVIEWS. ISSN:1543-5008.

- TRENDS IN PLANT SCIENCE. Publisher: ELSEVIER SCIENCE LONDON. ISSN: 1360-1385

- ANNUAL REVIEW OF PHYTOPATHOLOGY. Publisher: ANNUAL REVIEWS. ISSN: 0066-4286

- PLANT CELL. Publisher: AMER SOC PLANT BIOLOGISTS. ISSN: 1040-4651

- CURRENT OPINION IN PLANT BIOLOGY. Publisher: CURRENT BIOLOGY LTD. ISSN: 1369-5266

- NEW PHYTOLOGIST. Publisher: WILEY-BLACKWELL. ISSN: 0028-646X

- PLANT JOURNAL. Publisher: WILEY-BLACKWELL. ISSN: 0960-7412

- PLANT PHYSIOLOGY. Publisher: AMER SOC PLANT BIOLOGISTS. ISSN: 0032-0889

- PLANT BIOTECHNOLOGY JOURNAL. Publisher: WILEY-BLACKWELL. ISSN: 1467-7644

- MOLECULAR PLANT. Publisher: OXFORD UNIV PRESS. ISSN: 1674-2052

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.