Universitat Autònoma de Barcelona

Molecular Genetics of Plants 2016/2017

Code: 42879
ECTS Credits: 9

Degree	Type	Year	Semester
4313771 Plant Biology and Biotechnology	OB	0	1

Contact

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Use of languages

Principal working language: english (eng)

External teachers

David Caparrós Ruiz

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 important aspects of plant molecular genetics and their application in research, encouraging at the same time an active participation 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 used in plant molecular genetic studies.

- To describe the techniques of manipulation and production of genetically modified improved plants with biotechnological purposes.

- 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 in the context of a laboratory of Molecular Genetics.

Skills

- Analyse research results to obtain new products or processes, assessing their industrial and commercial viability with a view to transferring them to society.
- Apply knowledge of plant molecular genetics to different areas of science and industry.

- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
- Explain the processes for obtaining genetically-modified plants and their use.
- Identify and use bioinformatic tools to study plant genetics, evolution and functioning.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Synthesise, weigh up alternatives and engage in critical discussion.
- Use and manage bibliography and IT resources in the field of study.
- Work in a multidisciplinary team.

Learning outcomes

1. Analyse research results to obtain new products or processes, assessing their industrial and commercial viability with a view to transferring them to society.
2. Apply knowledge of theoretical molecular mechanisms to the study of cell division and hormone-regulated plant development.
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. Identify the genetic and hormonal regulation processes that govern plant-cell division and plant development.
8. "Process ""omic"" plant data using bioinformatic tools."
9. Propose bioinformatic solutions to problems deriving from omic research in plants.
10. Propose, improve and defend research projects based on new technologies.
11. Propose innovative, enterprising solutions in plant molecular genetics.
12. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
13. Synthesise, weigh up alternatives and engage in critical discussion.
14. Use and manage bibliography and IT resources in the field of study.
15. Work in a multidisciplinary team.

Content

- Item 1. Plants as a model in research on Molecular Genetics. Regulation of gene transfer to plant genomes.

- Item 2. Obtaining genetically modified plants with biotechnological purposes: cisgenesis versus transgenesis. Methods of plant transformation: Agrobacterium infection, biolistics, insertion of transgenes into chloroplast. Stable transformation and transient transformation. Transformation of monocotiledoneous plants.

- Item 3. Regeneration and selection of transgenic plants. Selection markers: resistance to antibiotics, herbicides and metabolic markers. Elimination of the transgene from the plant genome. Regulation of the expression of the transgene: constitutive, specific and inducible promoters.

- Item 4. Detection of transgenes in plant organisms and in raw food materials. Relevant legislation. Features of the main GM crops.

- Item 5. Introduction to Genomics, Transcriptomics, Proteomics and Metabolomics.

- Item 6. Use of bioinformatic tools for the collection and processing data in omics research. Cases of study.

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.

- Problem solving and 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 the research project to be undertaken during the master program. This activity will require a preliminary discussion with the tutor of the project to determine the main points, followed by a bibliographic search related to the topic. The seminar will include hipothesis, objectives and methodology. An oral presentation, using graphic material and computer facilities, in front of the instructor and the students will be performed, followed by a debate where suggestions, questions and doubts will be formulated in order to enrich the overall activity.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Lectures	24	0.96	1, 2, 13, 6, 7, 9, 11, 12, 14
Practice in computer room	6	0.24	15, 9, 12, 8
Solving problems and practical cases	15	0.6	1, 2, 13, 15, 6, 9, 11, 12
Type: Supervised			
Seminars	10	0.4	1, 3, 13, 5, 10, 11, 12, 4
Tutorial sessions	2	0.08	1, 13, 15
Type: Autonomous			
Autonomous practice in Bioinformatics	40	1.6	3, 13, 15, 9, 8, 14
Seminar performance	20	0.8	13, 5, 12, 4, 14
Stating and solving problems and practical cases	30	1.2	13, 15, 6, 11, 12, 14
Study	70	2.8	1, 2, 13, 7, 14

Evaluation

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 weight and type of each assessment activities are:

- Theory (35%), through a written examination of the material covered in the lectures of theory.

- Seminar (15%), which assessed both the scientific content of the seminar and the quality of the exhibition, and the defense and answer the questions posed by the teacher and other students.

- Problem solving and practical cases from scientific articles and data bioinformatics (30%). This activity will require considerable preparation work independently, as classroom exercises to be proposed and evaluated and corrected.

- Proactive attitude, class participation, scientific rigor, contributions, etc.. (20%). These items will be assessed continuously throughout the development of the module.

Compulsory attendance of at least 80% of classroom activities is necessary to evaluate this module. It is necessary to obtain a final 5 or higher to pass the module.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Bioinformatic Practice	0.08	2	0.08	3, 13, 15, 9, 8, 14
Lectures	0.12	3	0.12	2, 13, 5, 6, 7, 11, 12, 14
Problem solving and case studies	0,08	2	0.08	1, 13, 15, 11, 12, 4
Seminar	0.04	1	0.04	13, 10, 11, 4

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