Universitat Autònoma de Barcelona

2021/2022

Problem-Based Learning in Plant Biology

Code: 43872
ECTS Credits: 6

Degree	Type	Year	Semester
4316231 Plant Biology, Genomics and Biotechnology	OT	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

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Use of Languages

Principal working language: english (eng)

Teachers

Merce Galbany Casals

Maria del Mar Marquès Bueno

Martí Bernardo Faura

External teachers

Igor Flórez Sarasa

Nicolas Bologna

Prerequisites

Knowledge of previous subjects of the master:

- *Plant Physiology and Metabolism*

- *Plant Molecular Biology and Genetic Engineering*

- *Plant Genomics*

- *Agricultural Biotechnology*

Objectives and Contextualisation

Each student will design a methodological approach to a problem on plant biology raised by the course coordinator. The students will develop their subjects with the guidance of a personal tutor. At the end of the course, the students will present their work as a written report and orally in a seminar.

Competences

- Apply knowledge of functional mechanisms of various different organizational levels in plants to the characterization of growth and development processes of the whole plant organism.

- 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.
- Continue the learning process, to a large extent autonomously.
- Develop critical reasoning in the area of study and in relation to the scientific and business environment.
- Explain the processes of obtaining genetically modified plants and their use.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Propose and analyze ad hoc solutions derived from plant research, in accordance with the situations and needs of each case.
- 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.
- Use scientific terminology to argue the results of research and present them in English both orally and in writing in an international environment.

Learning Outcomes

1. Apply genomic information to the improvement of fruit quality.
2. Apply knowledge of genomics in order to design programmes to improve fruit quality.
3. Apply knowledge of the defence strategies of plants in order to improve productivity.
4. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
5. Continue the learning process, to a large extent autonomously.
6. Develop critical reasoning in the area of study and in relation to the scientific and business environment.
7. Explain how to obtain and use genetically-modified plants as biofactories.
8. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
9. Propose and analyse biotechnological solutions based on the modulation of plant development.
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 scientific terminology to argue the results of research and present them in English both orally and in writing in an international environment.

Content

Problem-based Learning in Plant Biology is a multidisciplinary subject that integrates previous knowledge of other subjects of the master. The problems to be solved by the students can be, among others, on the following topics:

- Genomic tools in plant breeding

- Metabolic engineering in plants

- Modulation of plant development for biotechnological purposes

- Phylogenetics, molecular dating and biogeography

- Plant adaptation to the environment

*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

In the first two sessions of the course, the subject coordinator will introduce the problems to be solved, from which the students will choose. In the next few weeks, the students will prepare their methodological approach to the problem. They will have several preparative sessions with their tutor, who will guide them and will evaluate the work performed. The students will also receive training on the analysis of ***omic*** databases through bioinformatics sessions done at the computer. At the end of the course, the students will present a written report on their project and will defend it orally in a seminar given to the rest of the class. So, the subject's methodology will consist on the following activities:

- Lectures

- Computer sessions

- Tutored sessions

- Personal study

- Preparation of a written report

- Seminars

*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			
Computer sessions	8	0.32	6, 8, 10, 5, 11, 12
Lectures	2	0.08	6, 8, 11
Seminars	14	0.56	3, 2, 1, 6, 7, 9, 8, 4, 5, 11, 13
Tutored sessions	6	0.24	6, 9, 8, 10, 11, 12
Type: Supervised			
Preparation of the written report	44	1.76	6, 7, 8, 10, 4, 5, 11, 12, 13
Type: Autonomous			
Personal study	44	1.76	6, 8, 10, 5, 11, 12
Seminar preparation	32	1.28	6, 8, 10, 4, 5, 11, 12, 13

Assessment

The coordinator and tutor will evaluate the student's work in the preparative sessions and the written report. These two aspects together will account for 45 % of the subject qualification. The oral presentation of the project (seminar given by the student) will be evaluated by the coordinator and will account for another 45 %. The remaining 10 % will be agreed by the subject coordinator and the tutor, on the basis of the student's interest and questions in the preparative sessions and other students' seminars.

*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
Seminar given by the student and collective discussion with the other students and the teacher	45 %	0	0	3, 2, 1, 6, 7, 9, 8, 4, 5, 11, 13
Student's participation in class activities (continuous evaluation)	10 %	0	0	6, 8, 11, 12, 13
Written report	45 %	0	0	6, 7, 8, 10, 4, 5, 11, 12, 13

Bibliography

The bioinformatic sessions can be complemented with the following bibliography:

- Introductory course on statistics for molecular biology: http://www.bioinformatics.babraham.ac.uk/training.html#rstats

- Robinson, M.D. and Oshlack, A. (2010). A scaling normalization method for differential expression analysis of RNA-seq data. Genome Biology 11, R25

- Ritchie ME, et al. (2015) limma powers differential expression analyses for RNA-sequencing and microarray studies. Nucleic Acids Res 43(7):e47-e47.

- https://www.bioconductor.org/packages/devel/bioc/vignettes/edgeR/inst/doc/edgeRUsersGuide.pdf

- http://rpsychologist.com/d3/cohend/

Depending on the particular project to develop by the student, useful bibliography can be chosen form the following list:

- Anderson J.T. et al (2011). *Evolutionary genetics of plant adaptation*. Trends in Genetics: 27:258-266.

- Boualem A., et al (2015) *A cucurbit androecy gene reveals how unisexual flowers develop and dioecy emerges*. Science 250:688-691.

- Dodds P.N. & Rathjen J.P. (2011) *Plant immunity: towards an integrated view of plant-pathogen interactions*. Nature Reviews Genetics 11:539-548.

- Hörandl, E. & Appelhans, M. (eds.) (2015) *Next-Generation Sequencing in Plant Systematics*. Regnum Vegetabile v. 158. Koeltz Botanical Books.

- Laitinen R. (ed.) (2015). *Molecular mechanisms in plant adaptation*. John Wiley & Sons.

- Lemey, P., Salemi, M. & Vandamme, A.M. (eds.). 2009. The phylogenetic handbook. A practical approach to phylogenetic analysis and hypothesis testing. 2nd Ed. Cambridge University Press.

- Lomonossoff G.P. & Daoust M.A. (2016). *Plant-produced biopharmaceuticals: A case of technical developments driving clinical deployment*. Science 353:1237-1240.

- Soyk S., et al (2017) *Bypassing Negative Epistasis on Yield in Tomato Imposed by a Domestication Gene*. Cell 169:1-14.

- Tang J. & Chu C. (2017) MicroRNAs in crop improvement: fine-tuners for complex traits. Nature Plants 3 :17077. doi: 10.1038/nplants.2017.77

- Tschofen M., et al (2016). *Plant Molecular Farming: Much More than Medicines*. Annual Review of Analytical Chemistry 9:271-294.

- Yu S., et al (2015). *Plant developmental transitions: the role of microRNAs and sugars*. Current Opinion in Plant Biology 27:1-7.

- Zhu J.K. (2016) *Abiotic Stress Signaling and Responses in Plants*. Cell 167:313-324.

Software

Before the bioinfomatic sessios, students will receive instruccions to install the following programs:

- The language of scripting R: https://cran.r-project.org/mirrors.html

- The integrated programming environment Rstudio: https://www.rstudio.com/products/rstudio/download/ (Desktop version)

- The data visualitzation packages "Points of view": http://blogs.nature.com/methagora/2013/07/data-visualization-points-of-view.html

- The packages of R limma and NOISeq