

Course guide

390353 - GMG - Genomics and Breeding

Last modified: 11/03/2025

Unit in charge: Barcelona School of Agri-Food and Biosystems Engineering
Teaching unit: 745 - DEAB - Department of Agri-Food Engineering and Biotechnology.

Degree: BACHELOR'S DEGREE IN BIOSYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Casals Missio, Joan

Others: Lozano Luis, Lidia
Simó Cruanyes, Joan

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE-SB-20. Biochemistry: bio-molecules, enzymology and metabolism. Molecular biology and biotechnological tools. Microbiology and microbial metabolism. Biotechnological basis for obtaining and propagation of organisms.
 CE-BC-9. Identification and characterization of vegetal species.

Transversal:

04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
 06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

*

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	40,0	26.67
Hours small group	20,0	13.33

Total learning time: 150 h

CONTENTS

A. Principles of plant breeding

Description:

Molecular basis of heredity. Phenotype vs. genotype. Quantitative and qualitative traits. Genotype-by-environment interaction. Epistatic interaction. Recombination, linkage and genetic distance. Genetic analysis for qualitative and quantitative traits. Mapping populations (from introgression libraries to MAGIC population). Linkage disequilibrium. Genetic maps.

Full-or-part-time: 43h

Theory classes: 11h

Laboratory classes: 6h

Self study : 26h

B. Plant breeding methods

Description:

History of plant breeding, from phenotypic selection to biotech breeding. Plant genetic resources and germplasm banks. Plant breeding: autogamous, allogamous and asexual propagated crops.

Full-or-part-time: 39h

Theory classes: 11h

Laboratory classes: 4h

Self study : 24h

C. Methods to generate new variability and use of molecular markers in plant breeding programs

Description:

Techniques to generate variability: site-directed mutagenesis (Tilling, Ecotilling), somaclonal variation, polyploidization, transgenesis and cisgenesis, genome editing. Marker assisted selection: design of primers, development of molecular markers

Full-or-part-time: 33h

Theory classes: 9h

Laboratory classes: 4h

Self study : 20h

D. Genomics and epigenetics

Description:

DNA sequencing techniques, from Sanger technology to massive sequencing tools. Sequencing vs. resequencing. Bioinformatics. Databases and synteny studies. The -omics revolution, from phenomics to transcriptomics. Genomic applications for vegetable plant breeding: genome-wide association studies (GWAS) and genomic selection. Epigenetics.

Full-or-part-time: 35h

Theory classes: 11h

Laboratory classes: 4h

Self study : 20h



ACTIVITIES

name english

Full-or-part-time: 40h

Theory classes: 40h

*

Full-or-part-time: 2h

Theory classes: 2h

*

Full-or-part-time: 4h

Laboratory classes: 4h

*

Full-or-part-time: 8h

Laboratory classes: 8h

*

Full-or-part-time: 2h

Laboratory classes: 2h

*

Full-or-part-time: 4h

Laboratory classes: 4h

GRADING SYSTEM

BIBLIOGRAPHY

Basic:

- Cubero Salmerón, José Ignacio. Introducción a la mejora genética vegetal. 2a ed. rev. y ampli. Madrid: Mundi-Prensa, 2003. ISBN 8484760995.
- Sadava, David E; Fernández Castelo, Silvia. Vida : la ciencia de la biología. 8a ed. Buenos Aires [etc.]: Médica Panamericana, cop. 2009. ISBN 9789500682695.
- Harlan, Jack R. Crops & man. 2nd ed. Madison, Wisconsin: American Society of Agronomy : Crop Society of America, 1992. ISBN 0891181075.
- Klug, William S.. Concepts of genetics. Twelfth edition, global edition. New York, NY: Pearson, 2020. ISBN 9781292265322.
- Stadler, Tanja. Decoding genomes : from sequences to phylodynamics [on line]. First edition. [Lloc de publicació no identificat]: [editor no identificat], 2024 [Consultation: 11/03/2025]. Available on: https://discovery.upc.edu/permalink/34CSUC_UPC/18e7aks/alma991005264550006711. ISBN 9783907363522.

Complementary:

- Montoliu, Lluís. ¿Por qué mi hijo tiene una enfermedad rara?. Primera edición. Pamplona: Next Door Publishers, febrero 2023. ISBN 9788412630008.
- Montoliu, Lluís; Romero Márquez, Jesús. Genes de colores. Primera edición. Pamplona: Next Door Publishers, abril 2022. ISBN 9788412489422.
- Hao, N.; Han, D.; Huang, K; Du, Y.; Yang, J.; Zhang, J.; Wen, C.; Wu, T.. "Genome-based breeding approaches in major vegetable crops". Theoretical and Applied Genetics [on line]. [Consultation: 11/03/2025]. Available on: <https://doi.org/10.1007/s00122-019-03477-z>.
- Fernie, A.; Yan, J.. "De Novo Domestication: An Alternative Route toward New Crops for the Future". Molecular Plant [on line]. [Consultation: 11/03/2025]. Available on: <https://doi.org/10.1016/j.molp.2019.03.016>.
- Kang, Y.; Lee, T.; Lee, J.; Shim, S.; Jeong, H.; Satyawat, D.; Kim, M.; Lee, S.. "Translational genomics for plant breeding with the genome sequence explosion". Plant Biotechnology Journal [on line]. [Consultation: 11/03/2025]. Available on: <https://doi.org/10.1111/pbi.12449>.