Universidad Zaragoza

Academic Year of Degree: 2026/27

28418 - Quantitative and molecular genetics in animal breeding

Teaching Plan Information

Academic year: 2026/27
Subject: 28418 - Quantitative and molecular genetics in animal breeding
Faculty / School: 105 - Facultad de Veterinaria
Tipo de enseñanza: In person
Ambit: Veterinary science
Degree: 451 - Degree in Veterinary Science
ECTS: 6.0
Year: 2
Semester: Second semester
Subject type: Compulsory
Module:

1. General information

The objective of the subject is to know and use the strategies of animal genetic improvement and conservation of genetic resources, to be able to give genetic counselling in pathologies of hereditary origin and to know the possibilities of transgenesis and gene therapy in veterinary medicine.

It is advisable that the student has acquired the competences related to the basic training subjects of the first year and the first four-month period of the second year. Those corresponding to Genetics and Statistics are considered especially necessary for the subject´s correct follow-up

2. Learning results

- To understand the fundamentals of animal breeding developed from productive, genealogical and molecular information.
- To know the genetic analysis of the traits involved in selection objectives and criteria.
- To be able to construct and interpret results of genetic evaluation models of selection candidates using genealogical, phenotypic and molecular information.
- To discern between basic alternatives oriented to the design of improvement plans for cattle breeds and selection schemes for specialized genetic lines.
- To know the appropriate measures to estimate and control inbreeding levels.
- To be able to give genetic counselling in pathologies of hereditary origin.
- To know the methodological basis and applications of gene transfer in veterinary medicine.
- By taking this course, the student will acquire, in whole or in part, the following “Day One” competencies defined by the European Association of Establishments for Veterinary Education (Annex 2 of the ESEVT SOP 2023 https://www.eaeve.org/fileadmin/downloads/SOP/ESEVT_SOP_2023_adopted_by_the_36th_GA_in_Leipzig_on_8_June_2023.pd 1.1; 1.8; 1.11; 1.13; 1.26; 1.33 and 1.38 are the main abilities targeted by this subject.

3. Syllabus

BLOCK 1. INTRODUCTION

Unit 1. An approach to animal breeding. Objectives and selection criteria.

BLOCK 2. GENETIC STRUCTURE OF A QUANTITATIVE TRAIT

Unit 2. Values, means and variances.

Unit 3. Genetic relationship and inbreeding.

Unit 4. Resemblance between relatives, heritability and repeatability.

BLOCK 3. SELECTION

Unit 5. Response to selection and correlated response.

Unit 6. Selection indexes.

Unit 7. Best Linear Unbiased Predictor (BLUP)

BLOCK 4. MOLECULAR GENETICS AND SELECTION.

Unit 8. Linkage disequilibrium and detection of Quantitative Trait Loci (QTL)

Unit 9. Gene and marker assisted selection.

Unit 10. Genomic selection.

BLOCK 5. CROSSBREEDING

Unir 11. Heterosis and complementarity.

Unit 12. Crossbreeding designs.

BLOCK 6. CONSERVATION

Unit 13. Inbreeding depression and effective population size.

Unit 14. Conservation genetics.

BLOCK 7, BREEDING PROGRAMS

Unit 15. Introduction to breeding programs in non-prolific species: ruminant and horses.

Unit 16. Introduction to breeding programs in prolific species: pigs, poultry, rabbits and fish.

BLOCK 8. INHERITANCE OF DISEASES IN DOMESTIC ANIMALS

Unit 17. Hereditary diseases associated with single copy genes and a multigenic inheritance.

Unit 18. Control and eradication of hereditary diseases.

BLOCK 9. GENOME MODIFICATION IN ANIMAL BREEDING

Unit 19. Transgenesis as a tool in Veterinary sciences.

Unit 20. Therapies based on the genetic modification and its applications in animal breeding.

4. Academic activities

1. Theoretical classes. 30 sessions of 1 hour to develop key concepts.
2. Types of problems. 12 sessions of 1 hour to solve theoretical situations.
3. Practical classes. 9 sessions of 2 hours supported by freely available simulation programs (https://sites.google.com/a/unizar.es/pqgen/), with free statistical analysis software (www.r-project.org) and through access to on-line databases

5. Assessment system

The student must demonstrate achievement of the intended learning results through the following assessment activities:

1. Theoretical exam: Multiple choice questions and open questions for 90 minutes. Wrong answers in multiple choice tests will discount thw equivalent to the value of the question divided by the number of wrong answers. 60% of the final evaluation.

2. Problems and practical questions exam. Multiple choice questions and problems resolutionfor 90 minutes. Examen de problemas y cuestiones prácticas: Wrong answers in multiple choice tests will discount the equivalent to the value of the question divided by the number of wrong answers. 40% of the final evaluation. 40% of the final evaluation

5.1. Academic fraud prevention

The use of unauthorised electronic materials or devices during the assessment may result in immediate exclusion from the examination and a fail mark (a numerical mark of ‘0’ for the assessment).

Furthermore, the lecturer in charge may complete the grade report and submit it to the General Inspectorate of Services, so that it may, where appropriate, consider initiating disciplinary proceedings against the student for academic fraud.

In the case of a continuous assessment exam [continuous assessment cannot continue, unless otherwise specified in the academic guide.]

In the case of a regular or extraordinary exam session, the initiation of disciplinary proceedings will result in the grade ‘pending resolution’ until the proceedings are concluded.

6. Sustainable Development Goals

3 - Good Health and Well-being
12 - Responsible Consumption and Production
15 - Life on land

7. Bibliography

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BOURDON, R. M. Understanding animal breeding. 2nd ed. [s. l.]: Pearson, 2014. ISBN 9781292040035.

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Falconer, D. S.. Introducción a la genética cuantitativa / D. S. Falconer, Trudy F. C. Mackay ; [traducción realizada por Armando Caballero Rúa... (et al.)] . 1a. ed. en español, traducción de la 4a. ed. inglesa, 1a. reimp. Zaragoza : Acribia, 2006

Gutierrez, J. P.. Iniciación a la valoración genética animal: Metodología adaptada al EESS.. Editorial Complutens, 2010

Nicholas, F.W.. Introducción a la genética veterinaria / F.W. Nicholas ; [traducción a cargo de Alfredo Ruiz Panadero,Arcadio Navarro Cuartiellas, Esther Beltrán Paula] . Zaragoza : Acribia, 1998

Oldenbroek, K, van der Waaij, L.. Animal Breeding and genetics for BSc students. . Wageningen University, 2014

American Society of Gene and Cell Therapy
[http://www.asgct.org/]

European Society of Gene & Cell Therapy
[http://www.esgct.eu/]

Gen-Ética-Naukas
[https://montoliu.naukas.com/]

Jackson Laboratory
[http://www.jax.org/]

NCBI National Center for Biotechnology Information
[https://www.ncbi.nlm.nih.gov/]

Programa PQGEN
[https://sites.google.com/a/unizar.es/pqgen/]

Transgénesis mamíferos
[http://wwwuser.cnb.csic.es/~transimp/]