Universitat de Lleida

DEGREE CURRICULUM

# GENETICS

Coordination: PENA SUBIRÀ, RAMONA NATACHA

Academic year 2019-20

## Subject's general information

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|---|---|
| **Subject name** | GENETICS |
| **Code** | 100309 |
| **Semester** | 1st Q(SEMESTER) CONTINUED EVALUATION |
| **Typology** | |

| Degree | Course | Character | Modality |
|---|---|---|---|
| Double bachelor's degree: Bachelor's Degree in Veterinary Medicine and Bachelor's Degree in Science and Production | 2 | COMMON | Attendance-based |

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| **Course number of credits (ECTS)** | 6 |
| **Type of activity, credits, and groups** | |

| Activity type | PRALAB | | PRAULA | TEORIA |
|---|---|---|---|---|
| Number of credits | 0.8 | 0.6 | 1 | 3.6 |
| Number of groups | 4 | 2 | 2 | 1 |

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|---|---|
| **Coordination** | PENA SUBIRÀ, RAMONA NATACHA |
| **Department** | ANIMAL HUSBANDRY |
| **Teaching load distribution between lectures and independent student work** | On-site hours: 60<br>Off-site hours: 90 |
| **Important information on data processing** | Consult this link for more information. |
| **Language** | Catalan: 50%<br>Spanish: 30%<br>English: 20% |
| **Office and hour of attention** | 9-17 cita prèvia |

| Teaching staff | E-mail addresses | Credits taught by teacher | Office and hour of attention |
|---|---|---|---|
| CASALI TABERNET, ANDREU | andreu.casali@udl.cat | 2 | |
| MARTÍNEZ ROYO, ALBERTO | alberto.martinez@udl.cat | 3,2 | |
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## Learning objectives

The course aims to initiate students to the basics of gene inheritance in animals, so that he/she is in possession of the scientific basis necessary for proper management of animal resources, especially those aspects related to animal breeding programs.

**Objectives of Knowledge**

The course intends that the student knows the structure of the genetic material, as well as the mechanisms of gene expression, control and regulation; the principles of inheritance of traits affecting animal reproduction, growth and health; and, finally, genetic properties of animal populations, as well as the causes of evolution and change. To know the rules of inheritance that explain animal traits and behavior. To know how to calculate and use basic genetic parameters used in selection schemes.

**Objective of capacity**

**Block 1**

1. To be able to interpret the table of the genetic code and to transcribe sequence of DNA to RNA and to protein.
2. To be able to gather information on genetic mutations and variants of a given gene through the use of databases available on the Internet.
3. To be able to use on line restriction enzyme databasis to determine the targets existing in a DNA sequence, as well as making the choice of primers to amplify a specific sequence by PCR.
4. To retrieve data available on the internet about genome projects, and the organization and structure of a particular genomic locus in different species.

**Block 2**

1. To apply the laws of inheritance to predict expected descendants in directed crosses.
2. To Interpret and write technical reports in relation to the genetic basis of domestic animals

3. To know how to perform genetic diagnosis of hereditary diseases in animals

**Block 3**

1. To be able to estimate genotype and allelic frequencies in an animal population and predict the effects caused by mutation, migration, selection and genetic drift.
2. To know how to calculate the inbreeding coefficient of an animal and the relationship between two animals.
3. To be able to calculate the effective population number and predict the evolution of inbreeding in the course of generations.
4. To be able to interpret the concepts of breeding value and heritability.

## Competences

**BASIC SKILLS**

CB1, CB2, CB3, CB4 and CB5

**GENERAL SKILLS**

CG2 Individual or collective prevention, diagnosis and treatment as well as the fight against animal diseases, whether considered individually or in groups, particularly zoonoses.

CG3 Control of breeding, management, welfare, reproduction, protection, and animal feed, as well as the improvement of their productions.

**SPECIFIC SKILLS**

CE3. Identify and apply the principles and bases in morphology, bionomics and systematics of plants and animals of veterinary interest

CE7. Understand the principles and molecular and genetic bases of biological processes and to identify the basic principles of biotechnology genetics and population genetics

**TRANSVERSAL SKILLS**

CT1. Acquire a proper understanding and oral and written expression of Catalan and Castilian

CT2. Acquire a significant mastery of a foreign language, especially English

CT3. Acquire training in the use of new technologies and information and communications technology

CT4. Acquire basic knowledge of entrepreneurship and professional environments

CT5. Acquire essential notions of scientific thought

## Subject contents

**TABLE OF CONTENTS - TOPICS**

**Introduction**. Animal genetics and breeding

## SECTION 1. THE HEREDITARY MATERIAL

### Topic 1. Nucleic acids: structure and chemical components.

Structure and organization of genes in prokaryotes and eukaryotes. Nuclear DNA and mitochondrial DNA. Maintenance and replication of genetic information

### Topic 2. Mechanisms of gene expression.

Transcription in prokaryotes. Eukaryotic transcription. Processing and maturation of mRNA in eukaryotes. Translation. The genetic code.

### Topic 3. Regulation and control of gene expression.

Regulation in prokaryotes: the Operon model. Regulation in eukaryotes: chromatin structure and gene regulation. Control levels: transcriptional, translational and post-translational. Gene regulation and cell differentiation.

### Topic 4. Mechanisms of genetic change.

Gene mutation and repair. Recombination. Mobile genetic elements. Chromosomal mutations. Variability and genetic polymorphism.

### Topic 5. Genetic engineering and modification.

Molecular analysis techniques. Polymerase chain reaction (PCR). Cloning: cloning vectors. DNA sequencing. Mechanisms of gene transfer. Transgenic animals.

## SECTION 2. PRINCIPLES OF INHERITANCE

### Topic 6. Mendelian Inheritance

The chromosomes. Kariotypes. Laws of inheritance. Monohybridism and polyhybridism. Family trees. Probability and statistical verification.

### Topic 7. Complex Inheretance

Relationship between alleles: dominance, codominance and overdominance. Allelic series. Lethal alleles. Interaction between genes: epistasis, gene modifiers and suppressors. Phenotypic expression: pleiotropy, penetrance and expressivity.

### Topic 8. Inheritance of sex.

Sex determination. Gender-related traits, influenced by sex and limited to one sex. Extranuclear inheritance.

**Topic 9. Recombination and linkage**

Recombination frequency. Distance genetics. Linkage groups. Linkage maps. genetic maps

**Tema 10. Genetic diagnosis**

Genetic abnormalities in domestic species. Inheritance patterns and analysis of family trees. Using markers. Interpretation of genetic tests.

**SECTION 3. Quantitative and Population Genetics**

**Topic 11. The genetic constitution of a population**

Gene frequencies and genotype. The ideal population. The Hardy-Weinberg equilibrium.

**Topic 12. Changes in gene frequencies in an infinite population**

Systematic events of mutation, migration and selection. Reproductive fitness. Particular cases of selection in one locus.

**Topic 13. Inbreeding and kinship**

Non-random mating. Inbreeding coefficient. Effect of inbreeding on genotypic frequencies. Coefficient of kinship. Calculation of the coefficients of inbreeding and kinship in family trees.

**Topic 14. Finite Populations**

The concept of genetic drift. Change in allelic frequencies by genetic drift. Inbreeding in finite populations. Effective number of a population. Inbreeding and genetic drift.

**Topic 15. Modeling quantitative traits**

The continuos variables. Genotypic value and environmental value. The genotypic model: additive, dominant and epistatic values. The concept of breeding value. Decomposition of genotypic variance. Heritability of a trait.

**PRACTICAL CONTENTS**

**Seminar 1** (2h). The Genome. Genome projects in domestic animals.

**Seminar 2** (2h). Hereditary diseases in animals. Omia Database

**Practice 1** (4h). Handling animal genomic databases

**Practice 2.1** (2h) Simulation of matings in Drosophila and determination of the genetic basis of four mutant phenotypes ..

**Practice 2.2** (2h). Mendelian genetics problems.

**Practice 3.1** (2h). Problems of population genetics.

**Practice 3.2** (2h) Case study: estimating the breeding value of a gene marker

**Practice 4** (8h): Polymorphisms and molecular markers: DNA isolation from blood samples and laboratory determination of allelic variants of two genotype mutations following two different protocols (each student will process a different animal sample) .

## Methodology

The teaching is divided into theoretical and practical sessions, according to the time schedule included in the Development Plan in this Course Guide.

1. Lectures. The lectures are based on theory sessions and aim to present the subject on each Topic. Each 2-hour session corresponds to a topic.

2. Practical classes. The practical sessions consist of problem classes, computer lab sessions, problem-solving, laboratory sessions and seminars. Ocassionally there might be some invited conference. It is **MANDATORY** that students have the following personal protective equipment (PPE) in the course of teaching practices: Laboratory coat. Students failing to bring the PPE described or not complying with the general security rules will be denied access to the lab.

The problem-solving sessions aim to discuss problems and exercises that students must must have work beforehand; sessions in computer labs are used to introduce students in the use of databases of interest in genetics, as well as to analyze simulated cases of animal population genetics; Finally, the laboratory sessions will be used to solve a case study of two genes, which will be used to introduce students to protocols specific to molecular genetics.Written Reports must be submitted after each practice sessions. During the course there will be two seminars that address issues of specific interest or state-of-the-art topics related to animal genetics.

Students will have the teaching resources of the course in the Course electronic dossier. Each practical activity will be complemented with a detailed protocol of the objectives and procedures to be used.

## Development plan

On-site activities (2,4 ECTS, 60 h): 36 h (single group) and 24 h (practice groups). Each block is composed of 12 h of theory and 4 h of practice. There will be two seminars (4 h) and a lab practice (8 h).

- Assigned timetable: Wednesday (15-17h), Friday (17-19h). Some Practices will take place at midday (12-14h). See "Schedule of activities" file in RESOURCES to check for specific days.
- Students can access the temporal programming of the course activities in the "Schedule of Activities" in the RESOURCES folder of the course.
- Practice 4 - morning timetable, highlighted in red in the "Schedule of Activities"

- **Classroom: ETSEA - Building 3, room 3.0.01.**
- **Lab: Vet School Buiding, Ground floor, lab SHV.0.01**
- **Computer Labs: will be assigned during the course of the year.**

## Evaluation

Continuous assessment of the Course will be carried out in accordance with the following criteria:

1. Exams (60%).

At the end of each part there will be a test, which will account for 60% of the final mark (20% + 20% + 20%). The exam will be done during the last session of each block and can consist, according to the block, in a questionnaire of questions type test (two statements, a correct answer, a mistake remains a point); Theoretical questions of short answer, questions of reasoning or numerical problems. Practical reports will only be considered in case the average grade of exams is greater than 4.5.

2. Practical reports (28%).

Presentation of a report with the resolution of the questions raised during the practical sessions (problems and cases) of each block (8% + 12% + 8%). The reports will be presented in groups of two students and will be delivered by the date assigned by the lecturer. Attendance to practical sessions is a necessary condition for the report to be taken into account for evaluation purposes.

3. Laboratory work (12%)

The laboratory work will be evaluated based on the practice book, in which it will be necessary to present and discuss the results obtained, as well as respond to a series of questions related to the activities carried out during Practice 4. Attendance to ALL SESSIONS of Practice 4 is a necessary condition for the work to be taken into account for evaluation purposes.

Students can request a tutorial session to review the marks of each block, which will be agreed with the person in charge of each block. Without exceptions, questions regarding the evaluation will not be discussed outside the assigned sessions or by email.

In the event that following these criteria, a student does not reach the minimum grade of 5.0, he may submit to an extraordinary recovery test, which will be done during the semester's assessment period. To qualify for the extraordinary test, the average grade of the three exams completed during the course must be at least 3.5. The extraordinary test will consist of the resolution of questions of type test (30%) and theoretical questions of short answer, questions of reasoning or numerical problems (70%) of the three blocks of the subject. The final mark of recovery will be the result of pondering the mark of this exam (60%), if it exceeds 4, with that of the reports and practices of the course (40%).

The final score of the course will be as resulting from the indication above, with the following particularities: a) The presentation to the remedial test may be an additional requirement to opt for the qualification of "with honors"; B) Students who pass the subject in the remedial test will have a final grade of 5 maximum; In case they fail, the final score will be the average of the course score and the one of the remedial test; C) the qualification of "Not Presented" is reserved by the students who have participated in a maximum of one evaluation activity of the course.

## Bibliography

**RECOMMENDED READING**

BENJAMIN, FALCONER , D S, MACKAY, TFC, 2001. Introducción a la genética cuantitativa. Editorial Acribia.

CABALLERO, A, 2017. Genética Cuantitativa. Editorial Síntesis, DL 2017

PIERCE, BA 2014. Genetics : a conceptual approach. W. H. Freeman and Co

PIERCE, BA. 2015. Genética.Médica Panamericana. Madrid

LEWIS, B. 2010. Genes VII. Oxford University Press

NICHOLAS, F W. 1998. Introducción a la Genética veterinaria. Editorial Acribia (en versió inglesa, Nicholas, F. W. 2009. Introduction to Veterinary Genetics. Blackwell Publishing)

**SUPPORTING INFORMATION**

BUXADÉ, C. (Ed). 1995. Zootecnia: bases de la producción animal. Tomo IV: Genética, patología, higiene y residuos animales. Editorial Mundi-prensa

DORIAN, G, RUVINSKY, A. (Eds.). 2015. The Genetics of Cattle. CABI Publishing.

OSTRANDER, E, RUVISNKY, A 2012. The genetics of the Dog. CABI Publishing.

PIPER, L, RUVINSKY, A. (Eds.). 1997. The Genetics of Sheep. CABI Publishing.

ROTHSCHILD, M F, RUVINSKY, A (Eds). 2011. The genetics of the pig. Wallingford: CAB Internacional