Universitat Autònoma de Barcelona

2023/2024

Population Genetics

Code: 101959
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	OB	2	2

Contact

Name: Marta Puig Font

Email: marta.puig@uab.cat

Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Prerequisites

There are no official prerequisites but knowledge of Genetics and Statistics is presupposed, as well as a basic level of reading comprehension of English.

Objectives and Contextualisation

Population Genetics is the study of genetic differences that occur naturally among organisms. Genetic differences between organisms of the same species are called polymorphisms whereas the differences that have accumulated between different species constitute genetic divergence. Population Genetics is the study of polymorphism and divergence.

Population Genetics is one of the few biological sciences that combine theory, empirical information and experimentation. For this reason it is an enormously formative science. The theory of Population Genetics has developed considerably since the time of Fisher, Haldane and Wright, the founders of this science. In this respect, this course can be considered introductory and the mathematical level necessary to follow the lessons is quite elementary.

The Population Genetics course is in the 2nd year of the Genetics Degree (2nd semester) and aims to provide students with the basic fundamentals of this science. The syllabus of the course consists of several lessons that include: (1) a description of the variation that has been detected in the natural populations through different techniques; (2) an explanation of the expected characteristics in an ideal population of infinite size and random mating; (3) a review of factors influencing the genetic makeup of a population; and (4) a treatment of Molecular Population Genetics which includes an explanation of the Neutralist Theory of Molecular Evolution.

The main training objectives of the subject are: the understanding of the probabilistic aspects of the hereditary transmission in the populations, understanding the origin and maintenance of populations of genetic variation, understanding the effect of the different factors considered on the genetic constitution of populations, as well as the ability to reason and contrast theoretical models through empirical observations and experimentation.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Apply knowledge of theory to practice.
- Apply scientific method to problem solving.
- Be able to analyse and synthesise.
- Describe and interpret the principles of the transmission of genetic information across generations.
- Develop self-directed learning.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Measure and interpret the genetic variation in and between populations from a clinical, conservational and evolutionary perspective, and from that of the genetic improvement of animals and plants.
- Reason critically.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Use and interpret data sources on the genomes and macromolecules of any species and understand the basics of bioinformatics analysis to establish the corresponding relations between structure, function and evolution.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Apply knowledge of theory to practice.
3. Apply scientific method to problem solving.
4. Be able to analyse and synthesise.
5. Define genetic conservation strategies for endangered populations.
6. Develop self-directed learning.
7. Enumerate and describe the forces that modulate genetic variation in populations in isolation or in conjunction.
8. Infer how the genetic variation of populations is maintained by Mendelian inheritance.
9. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
10. Reason critically.
11. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
12. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
13. Use genomic information to infer the evolutionary processes of genes, genomes and organisms.

Content

GENETIC VARIATION

Lesson 1. Genetic variation
Lesson 2. Hardy-Weinberg equilibrium
Lesson 3. Linkage disequilibrium
Lesson 4. Inbreeding

MECHANISMS OF EVOLUTIONARY CHANGE

Lesson 5. Natural selection
Lesson 6. Genetic drift
Lesson 7. Mutation
Lesson 8. Migration

MOLECULAR POPULATION GENETICS

Lesson 9. Molecular evolution
Lesson 10. Detection of natural selection

Methodology

Teaching methodology includes three types of activities: theory lessions, problem-solving classes, and tutorial sessions.

Theory lessons will provide the student the basic concepts and information needed to learn autonomously later on. Powerpoint presentations used in class will be available through the Virtual Campus.

Problem-solving classes, which will be done in two reduced groups, will be used to answer questions and learn to reason and apply the adquired knowlegde to the resolution of problems. Weekly problems will be available for the student to work on and they will be solved later in class.

Tutorial sessions can be individual or in small groups for those students that wish to do so. They can be done online or in person. This tutorial sessions are useful to gauge the advance in the comprehension of the subject and to provide help with the most difficult concepts.

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			
Problem-solving seminars	15	0.6	3, 2, 6, 10, 4
Theory classes	30	1.2	5, 7, 8, 4, 13
Type: Supervised			
Individual tutorials	3	0.12	5, 7, 8, 4, 13
Type: Autonomous			
Lesson study	50	2	5, 7, 8, 4, 13
Problem solving	45	1.8	3, 2, 6, 10, 4

Assessment

The evaluation of the subject will be based on problem assignments and participation in problem-solving seminars (30%), and on exam scores (1st partial exam 35%, 2nd partial exam 35%, recovery of partial exams 70%).

Problem assignments

At certain moments along the course, a list of problems will be delivered to the students to work on their own or in groups. Students must individually submit the solved problems to the teacher through the Virtual Campus. The set of problems turned in by each student will be evaluated and the grade obtained will represent 30% of the final grade.

Exams

There will be a partial examination of the first part of the subject and another partial examination of the second part of the subject. Each partial examination will include a multiple-choice test and problems to be solved by the student. Each of the partial exams will account for 35% of the final score.

Students who pass a partial exam (grade of 5 or higher) will release this part of the subject. Students who get a grade equal to or greater than 4 can compensate (and therefore release the corresponding part of subject) if the average grade with the other partial exam is equal to or higher than 5. Students who fail or do not present themselves to a partial exam, should attend the final exam to pass the subject.

The final exam will follow the format of the partial exams and will also include a multiple-choice test and problems to be solved by the student. The grade obtained in the recovery exam will account for the same weight as the partial exams. In order to calculate the weighted average of the exams and the problem assignments, the student must obtain a minimum score of 4 in the problem answers.

To be eligible for the reexamination process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, thestudent will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score.

Single evaluation

The students that choose for the single evaluation option, must do a single exam where all the contents of the course program will be evaluated. The exam will include a multiple-choice test and problems to be solved by the student. The grade of this exam will represent 70% of the final grade of the course. This exam will be on the same date fixed for the last exam of the continuous evaluation option and a reexamination oportunity will apply in the same way that in the continuous evaluation case.

The students that choose for the single evaluation option will have an available set of problemes to be solved. The answers to these problems will be delivered on the same day fixed for the exam. This work will represent the remaining 30% of the final grade of the course.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st parcial exam	35%	3	0.12	1, 12, 11, 3, 5, 7, 8, 9, 10, 4, 13
2nd parcial exam	35%	3	0.12	1, 12, 11, 3, 5, 7, 8, 9, 10, 4, 13
Problem assignments	30%	1	0.04	1, 12, 11, 3, 2, 6, 9, 10, 4

Bibliography

The basic textbooks for this subject are:

Hartl, D.H. A Primer of Population Genetics. Sinauer (3rd ed.) 2000.
Hamilton, M. D. Population Genetics. Wiley-Blackwell (1st ed.) 2009.
Nielsen and Slatkin. An introduction to population genetics, Sinauer. 2013.

Other useful reference books are:

Hartl, D. H. and A. G. Clark. Principles of Population Genetics (4th ed.) Sinauer. 2007.
Hedrick, P. W. Genetics of Populations (4th ed.) Jones & Bartlett. 2009.

Useful links:

UAB Virtual Campus: https://cv.uab.cat/

Software

Excel (spreadsheet) will be used during this course to solve problems.