Universitat Autònoma de Barcelona

2021/2022

Population Genetics

Code: 101959
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	OB	2	2

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: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

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

- 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.
- 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.
- 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. Apply knowledge of theory to practice.
2. Apply scientific method to problem solving.
3. Be able to analyse and synthesise.
4. Define genetic conservation strategies for endangered populations.
5. Develop self-directed learning.
6. Enumerate and describe the forces that modulate genetic variation in populations in isolation or in conjunction.
7. Infer how the genetic variation of populations is maintained by Mendelian inheritance.
8. Reason critically.
9. Use genomic information to infer the evolutionary processes of genes, genomes and organisms.

Content

GENETIC VARIATION

Lesson 1. Types of genetic variation
Lesson 2. Estimation of genetic variation
Lesson 3. Hardy-Weinberg equilibrium
Lesson 4. Linkage disequilibrium
Lesson 5. Inbreeding

MECHANISMS OF EVOLUTIONARY CHANGE

Lesson 6. Natural selection
Lesson 7. Genetic drift
Lesson 8. Mutation
Lesson 9. Migration

MOLECULAR POPULATION GENETICS

Lesson 10. Molecular evolution
Lesson 11. Detection of natural selection

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

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.

This methodoly is subject to change depending on the restrictions to in-person 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			
Problem-solving seminars	15	0.6	2, 1, 5, 8, 3
Theory classes	30	1.2	4, 6, 7, 3, 9
Type: Supervised			
Individual tutorials	3	0.12	4, 6, 7, 3, 9
Type: Autonomous			
Lesson study	50	2	4, 6, 7, 3, 9
Problem solving	45	1.8	2, 1, 5, 8, 3

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

A list of problems will be delivered weekly 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 before the next problem-solving seminar. 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 each of the two items. In case the student's grade in the exams is less than 4, that will be their final grade.

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, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score.

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
1st parcial exam	35%	3	0.12	2, 4, 6, 7, 8, 3, 9
2nd parcial exam	35%	3	0.12	2, 4, 6, 7, 8, 3, 9
Weekly problem assignments	30%	1	0.04	2, 1, 5, 8, 3

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.

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.
Antonio Fontdevila and Andrés Moya. Introducción a la Genética de Poblaciones, Síntesi. 2000.

Useful links:

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

Software

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