UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Genetics

2122-2-E0201Q068

Aims

The course aims at providing students with the basic knowledge of classical, molecular and population genetics, exploring the structure of genes, mutations, recombination and control of gene expression. The mechanisms that control the transmission of hereditary traits will be studied both from a formal and a molecular point of view, with particular regard to sexually reproducing organisms, including humans, and their repercussions at the population level.
Knowledge and understanding. At the end of the course the student will be able to identify hereditary transmission models, to make predictions about the progeny of a cross and to formulate simple models about the evolutionary processes.
Applying knowledge and understanding. At the end of the course the student will be able to apply the knowledge acquired in solving problems and in evaluating the effects of genetic variations on cellular processes.
Making judgements. At the end of the course the student will be able to elaborate the acquired knowledge to identify situations and problems in which the genetic methods can be used.
Communication skills. At the end of the course the student will be able to use an appropriate vocabulary in the description of the issues addressed.
Learning skills. At the end of the course the student will be able to analyze, apply and connect the knowledge acquired with that of other courses with particular regard to cellular, molecular and biochemical disciplines.

Contents

1. Basic knowledge of the laws and mechanisms of classical inheritance and of the factors that determine gene frequencies in populations.
2. Genetic inheritance in microorganisms.
3. Mutations, recombination, repair and control of gene expression in prokaryotes and eukaryotes.

Detailed program

1. Basis of inheritance. Structure and replication of DNA. RNA structure and transcription.
Characteristics of the genetic code and translation.
2. Transmission of the genetic material in eukaryotes with sexual reproduction. Mitosis, meiosis and biological cycles.
3. Mutations and their consequences on proteins and phenotypic effects. Real reversals and suppression. Mechanisms for repairing DNA damage.
4. Segregation and independent assortment of hereditary traits. F1, F2, test-cross. Monohybrids, dihybrids, trihybrids. Genealogical trees and mendelian inheritance in man.
5. X-linked inheritance
6. Extensions of Mendelian analysis. Gene interactions. Epistasis.
7. Complementation; complementation tests. Penetrance. Multiple alleles. Codominance. Blood groups, AB0 system.
8. Statistical processing of the segregation data of a Mendelian analysis. Chi-square test.
9. Linkage, crossing-over and genetic maps. Recombination frequency and map distance.
10. Genetics of Mendelian populations. Genic and genotype frequencies. Hardy-Weinberg's law and balanced population concept. Evolutionary factors that cause variations in gene frequencies: mutation, selection, migration, genetic drift. Origin of the species. Natural selection and evolution. Inbreeding.
11. Transmission of the genetic material in microorganisms. Conjugation, transformation and transduction in bacteria. Tempered and virulent viruses: recombination and transduction.
12. Changes in the structure of eukaryotic genomes. Chromosome structure variations: deletions, duplications, translocations, inversions. Variations in the number of chromosomes: euploidy, aneuploidy, polyploidy.
13. Mechanisms of regulation of gene expression in prokaryotes and eukaryotes. Positive and negative regulation of the transcription: functional analysis of the regulation elements in cis and of the regulation factors in trans. Examples of post-transcriptional regulation (Lac operon and Trp operon). Feedback regulation.
14. Applications of classical genetics for the selection of animal and plant species of biotechnological interest: programmed crossings, heterosis, changes of ploidy and their consequences.
15. Forensic genetics.

Prerequisites

Background: none
Specific prerequisites: none
General prerequisites: Students can take the exam only after passing the exams of Institutions of Biology, General and inorganic chemistry Mathematics, and Foreign Language.

Teaching form

Classroom lessons supported by Powerpoint presentations. Teaching language: italian.

Textbook and teaching resource

Learning material (slides) is available at the e-learning platform of the course.

Recommended textbooks:
- G. Binelli e D. Ghisotti, "Genetica", EdiSES, 2017
- P.J. Russel, “Genetica”, Pearson Italia, Terza Edizione, 2014

- D. P. Snustad e M. J. Simmons, “Principi di Genetica”, EdiSES, quarta edizione, 2014
Recommended textbook for exercises:
- D. Ghisotti e L. Ferrari "Eserciziario di Genetica" PICCIN 2015

Semester

First semester

Assessment method

Written examination (2 h) proposes problems and open questions aimed at verifying the knowledge of Mendelian genetics, the genetics of microorganisms and the genetics of populations. An oral evaluation can be carried out on request.

Office hours

Contact: on demand, upon request by mail to lecturer