UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Applied Molecular Biology

2122-1-F0802Q039

Aims

The course is organized in two modules dealing with chromatin organization and some of the processes involved in the control of gene expression. Particular emphasis will be devoted to methods and biotechnological applications.

Knowledge and understanding.
Students will learn chromatin organization and the molecular mechanisms of gene expression and epigenetic regulation in eukaryotic organisms. They will learn the organization of complex genomes, the methods of their analysis and manipulation, as well as, the transformation of animal and plant cells.

Applying knowledge and understanding.
Students will be able to apply the acquired knowledge in other courses and in laboratory experiences and to use the comprehension skill in subsequent studies and/or research activities.

Making judgments.
Students will be able to process what they have learned and be able to recognize situations and problems in which the acquired knowledge can be used.

Communication skills.
At the end of the course, students will be able to express themselves appropriately in the description of issues related to the molecular biology and its applications by using language properties, as well as, self-confidence.

Learning skills
At the end of the course, students will be able to survey the scientific literature related to the topics covered and will be able to analyze, apply and integrate the acquired knowledge with what learned in related courses.

Contents

Gene expression analysis and differential gene expression identification.
Chromatin organization and gene expression.
Low and high resolution analysis techniques for studying chromatin organization.
Transformation of plant cells and transgenic plants.
Transformation of animal cells, transgenic animals and knock-out.
Mechanisms of silencing (iRNA, ribozymes, etc.).
Molecular biology of mitochondria and chloroplasts.

Detailed program

First module- Prof. Marina Vai
1. Gene expression analysis and differential gene expression identification. Competitive RT-PCR. Real Time PCR (sybr green and fluorescent probes). Melting curves. DNA arrays (oligos and cDNA): analysis and applications to Red Biotechnology (microarray-based diagnostic/prognostic tests) and Green Biotechnology (genomics approach to discover rose scent-related genes).
2. Chromatin organization and gene expression. The nucleosome. Chromatin modifications. The histone code. Histone modifications and transcription. The SAGA complex. Silencing: a model for silent chromatin assembly in yeast. Altered gene silencing/chromatin remodelling and disease. Deacetylases and cancer. CpG islands and transcription. DNA methylation in disease (fragile X, Rett syndrome).
3. Low and high resolution analysis techniques for studying chromatin organization. Methylation-sensitive restriction enzymes. Bisulfite-based methods: Methylation Specific PCR, Methyl-Light. Chromatin Immunoprecipitation (ChIP).ChIP on chips. Methylated DNA immunoprecipitation. DNA methylation arrays.

Second Module- Prof. Enzo Martegani
1. Plant cell transformation. Plasmids of Agrobacterium and their use for plant transformation, biolistic method and transformation of chloroplasts. Gene expression in plants, transgenic plants and their applications.
2. Expression in higher eukaryotes. Transformation of mammalian cells.Viral and retroviral vectors. Recombinant proteins in mammalian cell cultures. Transgenic animals. Knock-out and knock-in in mouse. Genome targeting and modification: use of Zinc-finger nucleases, TALEN and CRISP-Cas9.
3. Gene expression silencing. Antisense oligonucleotides, Ribozymes and interferent RNA. Molecular basis for RNA interference.
4. Molecular biology of organelles. Genomes in mitochondria and chloroplasts. Gene expression in mitochondria. RNA editing. Mitochondrial derived diseases.
5. Genomics and bioinformatics. Organization and sequencing of genomes. The human genome. Repetitive sequences in the genome of higher eukaryotes (LINE and SINE). Origin and evolution of introns. Use of Database of nucleic acids and proteins.

Prerequisites

Background: basic notions of Molecular Biology.
Prerequisites: none

Teaching form

Classroom lectures supported by slides.

Teaching language: italian.

Textbook and teaching resource

Selected scientific papers and slides will be available at the e-learning platform of the course

Recommended textbooks:

- B. Lewin et al. “Il gene” Zanichelli
- R.F. Weaver “Biologia Molecolare” McGraw-Hill.
- J.W. Dale, M. von Schantz “Dai geni ai genomi” EdiSES
- R.J. Reece “Analisi dei geni e genomi” EdiSES
- G. Valle et al. “Introduzione alla Bioinformatica” Zanichelli

Semester

Second semester

Assessment method

Oral examination. Students will be asked to discuss a scientific paper on one of the topics covered during the course, followed by a conventional query on the course content. The ability to appropriately describe the scientific results, as well as their critical analysis will be positively evaluated.

Office hours

Contact. On demand, by telephone or e-mail request to the lecturers.