UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Functional Analysis of Genes

**2223-3-E0201Q057**

## Aims

The course aims to provide students with knowledge of classic and molecular genetics methodologies for the study of gene functions in eukaryotes and their implications in problems of biotechnological interest. Some aspects of gene regulation in both prokaryotes and eukaryotes will also be discussed, as well as the genetic bases and the consequences of transposition and the biology and the functions of noncoding RNAs in either physiological and pathological conditions.
Knowledge and understanding. At the end of the course the student will know the principal genetic and molecular methodologies to study the function of genes in different model systems and their use for the study of some biological processes.
Applying knowledge and understanding. At the end of the course the student will be able to identify the most appropriate molecular-genetics methodologies to study the function of essential and non-essential genes in different experimental contexts and design simple experiments to study the function of these genes.
Making judgment. At the end of the course the student must be able to elaborate the acquired knowledge and recognize situations and problems in which the genetic methods acquired can be used.
Communication skills. At the end of the course the student will be able to properly describe and discuss the topics addressed with language properties and specific terminology.
Learning skills. At the end of the course the student will be able to analyze, apply and integrate the course-related knowledge with other knowledge related to the study of biological processes.

## Contents

Gene inactivation and other genetic methodologies for the study of gene function in yeast and in multicellular eukaryotes. Transposable elements, their effects on genetic variability and their applications. Aneuploidy and chromosomal aberrations, evolutionary advantages and consequences on human health. Examples of complex gene regulation in prokaryotes and eukaryotes. Non-coding RNAs and their deregulation in human diseases.

## Detailed program

Introduction to functional genetic analysis. Gene inactivation methodologies in yeast and multicellular eukaryotes and other genetic methodologies for the study of gene function. Genetic manipulation in model organisms (D. melanogaster, C. elegans). Gene manipulation for the creation of animal models of human diseases. Genetic manipulation in model organisms (D. melanogaster, C. elegans). Gene manipulation for the creation of animal models of human diseases Transposons and retrotransposons. Transposition mechanisms. Transposons and genetic variability. Mutagenesis induced by transposons and applications. Aneuploidy and chromosomal aberrations, cytogenetic analysis for the detection of chromosomal aberrations, mechanisms of formation of chromosomal abnormalities, effects of aneuploidies: evolutionary advantages and consequences on human health. Gene regulation in prokaryotes and eukaryotes. Examples of post-transcriptional regulation. Regulation of the choice between lytic cycle and lysogenic cycle in the lambda bacteriophage. Splicing and alternative splicing: the determination of sex in Drosophila melanogaster.
Non-coding RNAs and their functions. Functions and maturation of micro-RNA (miRNA) and small interfering RNA (siRNA). Long non-coding RNAs (lncRNA) and their role in gene regulation.

## Prerequisites

Background: Basic knowledge of genetics and molecular biology.
Specific prerequisites: Genetics.
General prerequisites: Students can take the exams of the third year after passing all the exams of the first year of the course.

## Teaching form

Classroom lessons supported by PowerPoint presentations. The problems, the genetic methodologies that can be tackled to investigate them, and the possible applications of biotechnological interest and for human health will be explored through appropriate examples and experiments. Original research articles will also be presented and discussed.
Teaching language: italian.

## Textbook and teaching resource

Learning material (slides of the lessons, and scientific publications described during the classes) is available at the e-learning web page of the course.

Recommended textbooks:

- Hartwell L. H, “Genetica: dall’analisi formale alla genomica”, McGraw-Hill
- Russel P.J., “Genetica, un approccio molecolare”, Pearson
- Lewin B., “Il gene VIII”, Zanichelli
- Strachan T., Read A., "Genetica molecolare umana", Zanichelli

## Semester

first semester

## Assessment method

Oral examination. In particular, the student will have to discuss the genetic methodologies and approaches learned during the lessons and to prove that he/she knows how to apply them to the study of genes and their functions or to biological processes through concrete examples.

## Office hours

Contact: on demand, upon request by mail to lecturer, or at the end of each lecture.

## Sustainable Development Goals

GOOD HEALTH AND WELL-BEING