UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Molecular Biology I

2021-2-E0201Q008

Aims

The course aims to provide students with basic knowledge about the structure and function of biological macromolecules (DNA, RNA and proteins) and their biosynthesis (DNA replication, transcription and translation).

Knowledge and understanding.
The student will have to know the structure, function and mechanisms of biosynthesis of DNA, cellular RNAs and proteins. He must be able to understand the role played by these macromolecules in a living system. He will also have to know the main differences in the mechanisms of biosynthesis between a prokaryotic and a eukaryotic system.
Applying knowledge and understanding.
Students must be able to apply the knowledge acquired in point 1 in subsequent courses and in laboratory experiences and to use the ability to understand for the purposes of subsequent study and / or research activities.
Making judgments.
Students must be able to process what he has learned and be able to recognize situations and problems in which the learned knowledge can be used.
Communication skills.
At the end of the course, students will be able to appropriately describe the issues concerning molecular biology, with the most appropriate language.
Learning skills
At the end of the course, students will be able to consult the literature of similar disciplinary content and will be able to analyze, apply, integrate and connect the acquired knowledge with the content of related courses.

Contents

1) DNA structure, chemical-physical characteristics of DNA. DNA topology. DNA replication, replication fork and origins of replication.
2) RNA and transcription: stable RNA and labile RNA. Bacterial RNA polymerase. Promoters and bacterial terminators. Elements of regulation of transcription in bacteria. The RNA polymerase and eukaryotic promoters. Transcriptional regulation in eukaryotes; Structure and biosynthesis of cellular RNAs.
3) Ribosomes and protein synthesis. Activation of amino acids. Genetic code. Phases and mechanism of protein synthesis in prokaryotes and eukaryotes; examples of translational regulation.

Detailed program

1) Biological macromolecules and living systems. Structure of macromolecules and their characteristics (weak bonds, specific interactions, catalysis, cooperative transitions). History of Molecular Biology and discovery of DNA as a genetic material. DNA structure and replication: primary and secondary structure of DNA, the double helix B, A and Z, chemical-physical characteristics of DNA (density, viscosity, intercalation, etc.), denaturation and renaturation kinetics. Hybridization of nucleic acids. Restriction enzymes. Separation and analysis of DNA fragments. DNA topology, topoisomers and topoisomerase type I and II; chromatin and chromosome organization. DNA replication, replicative fork and replicons. Enzymes involved in replication (DNA polymerase, DNA ligase, helicase, primase, etc.). The replisoma in prokaryotes and eukaryotes; origins of replication in bacteria and eukaryotes. Centromeres and telomeres. Methods for evaluating DNA synthesis in vivo (Marking index with tritiated thymidine, flow cytometry, etc.). DNA amplification (PCR).
2) RNA and transcription: chemical-physical characteristics, purification, separation and analysis of cellular RNAs. Stable and labile RNA. Structure and properties of RNA polymerase of prokaryotes. Identification and analysis of bacterial promoters and terminators. Elements of regulation of transcription in bacteria. RNA polymerases and promoters in eukaryotes. Transcriptional regulation in eukaryotes; basal transcription factors and transactivators, enhacers and UAS; regulation of the GAL system in yeast. Structure and biosynthesis of tRNA, ribosomal RNA and messenger RNA. Introns and exons: mechanisms of splicing and introns of group I and II.
3) Ribosomes and protein synthesis: structure and evolution of ribosomes. Systems of protein synthesis in vitro. Activation mechanisms of amino acids. Genetic code and codon-anticodon interactions. Phases and mechanism of protein synthesis in prokaryotes and eukaryotes; Start, elongation and end reaction. Mechanism of action of the puromycin and identification of sites A and P on ribosomes. Examples of translational regulation. Protein synthesis inhibitors and their mechanism of action.

Prerequisites

Background: Introductory Biology; Organic Chemistry
Specific prerequisites: Organic chemistry
General prerequisites: Students can take the exams of the second year after passing the examinations of Introductory Biology, General and inorganic Chemistry, Mathematics, and Foreign Language.

Teaching form

Classroom lectures supported by slides, tutorial movies and diagrams.
Teaching language: italian.

All the lectures will be registered and available on the e-learning site

Textbook and teaching resource

Learning material (slides of the lessons, movies and diagrams) is available at the e-learning platform of the course.

Recommended textbooks:
- Capranico et al. "Molecular Biology", Edises 2016
- Weawer et al. "Molecular Biology" Mc-Grow Hill 2005
- Amaldi et al "Molecular Biology" Ed. Ambrosiana 2014
- Watson et al. "Molecular Biology of the Zanichelli gene" 2012

Semester

First semester

Assessment method

Writtten + oral examination. A two-hour written examination is based on 5 open questions (each question is worth 6 points). The minimum requirement for taking the oral examination is the correct and comprehensive answer to at least 3 questions, reaching a mark of at least 18/30. The oral examination consists of a discussion on the issues of written examination and, possibly, on further issues from the whole course content.

Office hours

Contact: Monday from 2pm to 4pm or anytime, upon request to lecturer