UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Biology

2425-1-I0303D002-I0303D007M

Aims

The student will learn:
? The fundamental properties of cells
? the structure and function of the main cellular macromolecules;
? the structure of cell membranes and their function in cellular transport and communication.
? the molecular and cellular bases of the expression and regulation of genetic information;
? the molecular and cellular mechanisms that control cell division, differentiation, proliferation and cellular interactions;
? the mechanisms that can give rise to phenotypic variants in humans.

Contents

The course aims to provide the student with the knowledge of the structure and function of pro/eukaryotic cells, thanks to the tools provided by the integration of the most current and advanced concepts of molecular and cellular biology.

Detailed program

Monza
? The organization of prokaryotic and eukaryotic cells.
? Structure and functions of proteins and nucleic acids.
? DNA duplication and repair mechanisms.
? Chromatin structure and organization of the human genome.
? Structure of eukaryotic genes.

? Transcription of RNAs.
? Genetic code and protein synthesis.
? Regulation of gene expression
? DNA mutations and polymorphisms.
? Signal transduction.
? Cell cycle and its genetic control.
? Mitosis

Bergamo

? Characteristics of living organisms. Cellular theory, the cell as a structural and functional unit of life.
? Chemistry of life. Macromolecules: carbohydrates, lipids, proteins and nucleic acids (structure and function).
? Prokaryotic and eukaryotic cells. Classification and main structural differences.
? Organization of the eukaryotic cell. Organelles and cellular compartments, structure and function.
? Plasma membrane. The fluid-mosaic model of the plasma membrane. Main functions of membrane proteins and their topological organization in the lipid bilayer. Modes of transport of ions and small molecules across the plasma membrane (simple diffusion, facilitated diffusion, active transport).
? Compartmentalization in the eukaryotic cell. The cytoplasm and the endocellular membrane system: structure and function of the endoplasmic reticulum, Golgi apparatus and lysosomes. Notes on peroxisomes. Mitochondria and chloroplasts. Structure and function of mitochondria and chloroplasts as energy generators. Notes on glycolysis, fermentation and cellular respiration.
? Cytoskeleton, cell adhesion and motility. The cytoskeleton. Structure and function of intermediate filaments, microtubules and actin filaments. Molecular motors. Cellular structures that determine the shape, polarity and motility of the cell. Interactions between cells and their environment. Adhesion molecules and the extracellular matrix.
? Nuclear sector. Nuclear envelope, nucleolus, organization and different levels of chromatin condensation, chromosomes.
? Molecular bases of hereditary information. Structure and function of DNA. Identification of DNA as genetic material. Molecular mechanism of DNA replication, telomeres and telomerase. Notes on DNA repair mechanisms.
? Structure and function of RNA. Main types of RNA present in prokaryotic and eukaryotic cells. RNA transcription and RNA processing in eukaryotic cells, with a focus on the maturation of messenger RNAs. Role of non-coding RNAs.
? Protein synthesis. Ribosomes: structure and biological role, differences between prokaryotic and eukaryotic ribosomes. Properties of the genetic code, general characteristics of translation and biological implications.
? Post-synthetic fate of proteins. Post-translational modifications and fate of proteins after synthesis. Signals and mechanisms of protein sorting to organelles and the secretory pathway. Functions of the endoplasmic reticulum in protein sorting (signal and stop sequences). Role of the endoplasmic reticulum and Golgi apparatus in protein glycosylation.
? Vesicular traffic. Mode of transport of proteins between different cellular compartments. Endocytosis (pinocytosis, phagocytosis, receptor-mediated endocytosis); autophagy; constitutive and regulated exocytosis.
? Control of gene expression. Functional organization of the eukaryotic genome. Control at the transcriptional level in prokaryotic and eukaryotic cells. Role of the condensation state of chromatin, histone code and degree of DNA methylation (epigenetic modifications). Main post-transcriptional and post-translational control strategies.
? Mitosis and Meiosis. Principles in the dynamics of chromosomes during mitosis and meiosis, differences between the two processes. Genetic consequences of meiosis, importance of meiosis as a source of genetic variability. Molecular mechanisms of genetic recombination. Concept of haploidy and diploidy. Homologous chromosomes. Characteristics of sexual and asexual reproduction.
? Communication between cells in multicellular organisms. General principles of cell signaling, chemical signals and receptor proteins. Main signal transduction pathways. Nuclear receptors.
? Cell cycle and mechanisms of cell death. Cell cycle, cycle phases and control of progression along the cell cycle as a result of the interaction between intracellular mechanisms and extracellular signals. The role of cyclin-dependent kinases. Basic knowledge of the processes of apoptosis, necrosis and autophagy.

Prerequisites

Teaching form

11 frontal lessons of 2 hours carried out in attendance
1 interactive lesson of 2 hours carried out in attendance

Textbook and teaching resource

Solomon, Berg, Martin. Elementi di Biologia. EdiSES
Bonaldo, Duga, Pierantoni, Riva, Romanelli. EdiSES

Semester

First semester

Assessment method

Monza
The Biology written test will consist of 15 multiple choice questions to check preparation on the exam programme.

Bergamo
Written test consisting of 31 multiple choice questions to check preparation on the exam program and oral test to evaluate communication skills in a disciplinary context.

Office hours

By appointment required by mail

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION