UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Cell and Molecular Biology I

2425-1-H4102D002-H4102D006M

Aims

The course will provide the essential theoretical knowledge of cellular and molecular biology, also focusing on the possible future application in the medical field. The subjects of the course will provide the necessary knowledge to understand the vital processes, both at the cellular and molecular level.

Contents

Structure and function of the most important cellular macromolecules; structure and organisation of the eukaryoric cell; DNA duplication and repair mechanisms; transcription and RNA processing; translation and protein sorting; transcriptional and post-transcriptional regulation; signal transduction pathways; molecular and cellular mechanisms which control the cell cycle, cellular growth and differentiation, cell death, as well as cell-to-cell interactions. Introduction to cancer: general concepts, molecular features, notes on patients treatment. Molecular biology techniques applied to medicine.

Detailed program

CELL STRUCTURE AND FUNCTION: prokaryotic and eukaryotic cells; the cell membranes; solute transport; endoplasmic reticulum; Golgi apparatus; lysosomes and peroxisomes; mitochondria; the nucleus.
CYTOSKELETON: functions of the eukaryotic cytoskeleton; structure of the cytoskeleton filaments: microfilaments, intermediate filaments, microtubules. Muscle contraction. Cell-cell junctions.
DNA REPLICATION: Molecular basis of DNA duplication; DNA replication phases; enzymes involved in the process; leading and lagging strand; telomers; DNA repair.
TRANSCRIPTION: the prokaryotic gene; factor sigma cycle; initiation, elongation, termination; the eukaryotic gene; the RNA polymerase complex; transcription factors; types of RNA transcript; mRNA maturation; alternative splicing.

TRANSLATION: the genetic code; tRNA; the ribosome; initiation of translation; steps of elongation; stop; translation control; post-translation modifications, folding;
TRAFFICKING: post-translational protein sorting to the ER, to the cell membrane, to organelles, to the nucleus. Sorting signals. Vesicle trafficking. Endocytosis, autophagy, phagocytosis. Protein glycosylation. Role of the Golgi complex. Proteasome and protein degradation.
CELL CYCLE: phases of the cell cycle; mitosis; regulation of the cell cycle; cyclin/CDKs; checkpoints; p53; Retinoblastoma.
APOPTOSIS: types of cell death; causes and functions of apoptosis; morphological changes; intrinsic and extrinsic pathways; caspases; Bcl-2 family;
SIGNAL TRANSDUCTION: Cell-cell communication; intracellular receptors; membrane receptors; mechanisms of signal transmission; feedback; auto-limitation of the signal; G protein coupled receptor pathways; receptor tyrosine kinase pathways; RAS/MAPK; cytokine signalling; nitric oxide signalling; Wnt pathway.
TUMORS: cancer as a genetic disease; darwininan evolution and heterogeneity of cancer cells; sporadic and hereditary tumors; oncogenes and tumor suppressors; targeted therapy; drug resistance
VIRUSES: classification of viruses; bacteriophages; life cycle of animal viruses; plant viruses; vaccines.
MOLECULAR BIOLOGY TECNIQUES: extraction of nucleic acids; PCR; quantitative PCR; Sanger sequencing; Next-Generation Sequencing; Southern, Northern, Western blotting; SDS-PAGE.

Prerequisites

Basic sciences

Teaching form

20 two-hour classes delivered in person.

Textbook and teaching resource

Bruce Alberts, Rebecca Heald, Alexander D. Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter. **Molecular biology of the cell**. Seventh edition. Garland Science, 2022;
H. Lodish, A. Berk, S.L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell. **Molecular cell biology**, Freeman, 2021

Course slides will be provided.

Semester

First semester

Assessment method

These subjects will be evaluated within the exam of the integrated course, as described in the Syllabus of the entire course.

Office hours

by appointment

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | GENDER EQUALITY