UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Cellular Biochemistry

2021-3-E0201Q063

Aims

The course aims to deepen topics and issues related to biochemical systems integrated into eukaryotic cells. The course will investigate the main mechanisms concerning signal transduction pathways, the regulation of cell growth, proliferation and cell cycle. The topics will be analyzed in-depth through original literature (scientific articles and reviews) that will be reported and discussed during the course.

1. Knowledge and understanding - the course will provide students with a knowledge of signal transduction, cell cycle and proliferation.
2. Applying knowledge and understanding - students will be able to apply the knowledge acquired to the understanding of the main processes concerning growth and proliferation.
3. Making judgements – at the end of the course, students will be able to understand the different cell processes described in the course and evaluate the consequences of their malfunctioning.
4. Communication skills – at the end of the course, students will acquire an adequate scientific language and the ability to describe orally the topics discussed in the course.
5. Learning skills - this course will provide students with the ability to understand and critically evaluate the experimental methods described in the scientific literature on the topic of cellular biochemistry.

Contents

Cell cycle regulation in eukaryotic systems

The regulation of cell cycle transitions in the unicellular eukaryotic model system Saccharomyces cerevisiae and in mammalian cells. The regulation of transcription of G1 phase and the control of G1/S transition, SBF/MBF in yeast,

pocket proteins and E2F in multicellular organism; the key components of the cell cycle, the cyclin-dependent kinase complexes and inhibitors, the degradation mechanisms of proteins mediated by the ubiquitin pathway (SCF and APC complexes; SCF:Skp1–Cullin–F-box protein; APC: Anaphase Promoting Complex); the control of mitosis.

Signal transduction of eukaryotic systems
The MAPK family (Mitogen-activated protein kinase) as mediators of responses to extracellular signals; the signal transduction pathway of PKA and Snf3-Rtg2; the protein kinase Snf1/AMPK kinase and the Warburg effect; Target Of Rapamycin (TOR) signaling, its regulation and comparison between unicellular and multicellular eukaryotic systems; autophagy and its regulation.

Detailed program

Introduction of the course.
Cell-cycle regulation in eukaryotic systems
The regulation of the cell cycle progression in the unicellular eukaryotic model Saccharomyces cerevisiae, the cyclin-Cdk complexes; the transcription factors SBF (SCB Binding Factor) and MBF (SCB Binding Factor); the cyclin Cln3 and its transcriptional regulation; the role of the repressor Whi5 in the transcriptional regulation of G1.
Sic1 and Far1: inhibitors of cyclin-Cdk complexes in the regulation of the G1/S transition; the “ubiquitin-dependent” degradation of proteins and SCF complexes (Skp1–Cullin–F-box protein) in the G1/S transition.
The regulation of the G1/S transition in multicellular eukaryotic systems; the cyclin/Cdk complexes; restriction point, retinoblastoma, pocket proteins and E2F transcription factors in the G1/S transition; the inhibitors of the cyclin/Cdk complexes belonging to the INK and CIP families.
The regulation of mitosis and APC (Anaphase Promoting Complex) in eukaryotic systems; the role of Cdc14 phosphatase in mitosis regulation.
Signal transduction in eukaryotic systems
The activation of the MAP (Mitogen-activated protein kinase) kinase cascade; the glucose sensing and the Gpr1/GPa2 complex; the PKA pathway and the Snf3- Rtg2-mediated transduction pathway.
The Snf1/AMPK protein kinase family: Snf1 in yeast and AMPK in multicellular eukaryotes: activation, function and targets in the regulation of cellular metabolism.
The Warburg effect; Target Of Rapamycin (TOR) signaling in yeast and in multicellular eukaryotes and regulation; the regulation of autophagy.

Prerequisites

Background: Basic knowledge of biochemistry and methodologies of biochemistry and molecular technologies.
Specific prerequisites: Biochemistry.
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.
Teaching language: italian.

Textbook and teaching resource

Learning material (slides of the lessons, scientific articles) is available at the e-learning web page of the course.

Recommended textbooks:
- Alberts B, Bray D, Lewis J, Raff M, Roberts K, Watson JD “Molecular biology of the cell” Garland Publishing, Inc.
- Voet D, Voet JD, Pratt CW “Fondamenti di biochimica” Zanichelli

Semester

First semester

Assessment method

Oral examination. Each exam takes 30 minutes, with 3-4 questions aimed to assess the overall knowledge of course content and student's ability to link different topics.

Office hours

Contact: on demand, upon request by mail to lecturer.