UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Cellular Biochemistry

2526-3-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 the control of cell cycle machinery and proliferation as well as the regulation and cellular metabolism. 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 the regulation of cell cycle, proliferation and metabolism.
2. Applying knowledge and understanding - students will be able to apply the knowledge acquired to the understanding the moleciular regulation of the main processes concerning the cellular coordination among cell cycle, proliferation and metabolism, as well as the integration of the main pathways involved in these processes.
3. Independent judgment - at the end of the course, students will be able to understand the various described cellular processes and identify the key regulatory points and the consequences of their malfunction. The development of these skills will also be supported by the analysis of experiments from scientific literature that have clarified the molecular mechanisms of the studied processes, as well as by journal clubs in which students will be required to analyze in detail a scientific article provided by the lecturers.
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

The regulation of cell cycle transitions; the key components of the cell cycle: the cyclins, the cyclin-dependent kinase complexes (CdK), their activation and inhibition during the events of cell division; the role of the Cdk inhibitors; the control of proteolysis during cell cycle and the degradation of cell-cycle regulatory proteins mediated

by the ubiquitin-proteasome pathway; the transcription regulation in G1 phase; the control of G1/S transition and the onset of S-phase; mitosis and cytokinesis. The control of proliferation and cellular metabolism: the kinases TORC1 (target-of- rapamycin) and AMPK (AMPprotein kinase); autophagy: a key player in cellular metabolism; selective autophagy of intracellular organelles. Cell death.

Detailed program

Introduction of the course. The cell-cycle control system at the three major regulatory transitions: restriction point in late G1, the G2/M phase transition and the metaphase-to-anaphase transition. The cyclin-dependent kinases (Cdks) and their main regulators: G1-cyclins, S-cyclins, M-cyclins. Mitogens stimulation of G1-Cdk and G1/S-Cdk activities. The regulation of Cdk activity by inhibitory phosphorylation and Cdk inhibitor proteins. Retinoblastoma, pocket proteins and E2F transcription factors and the transcriptional regulation in G1. The control of proteolysis by SCF complexes (Skp1–Cullin–F-box protein) and APC/C (anaphase promoting complex) during the cell cycle. Ubiquitination and the activity of proteasome during cell cycle. The regulation of the activity of M-Cdk complex: the role of Cdk-activating kinase (CAK), Cdk-inhibitory kinase (Wee) and the phosphatase Cdc25. Mitosis and cytokinesis. The coordination between division and cell growth. The role of the kinase TORC1 (target-of-rapamycin) in the stimulation of metabolic processes including protein synthesis. AMPK (AMP-protein kinase): guardian of metabolism homeostasis. The molecular mechanism of autophagy: a key player in cellular metabolism. The role of AMPK and TORC1 in the regulation of autophagy. Selective autophagy of intracellular organelles. Autophagy in human health and disease. Processes of accidental and programmed cell death.

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

19 lessons will be conducted as follows:

- the first part of each lesson (at least 1 h) will be delivered in an erogative format, aimed at presenting the main concepts through in-class lectures supported by PowerPoint presentations on the covered topics.
- the second part (at least 30 minutes) will follow an interactive format, allowing for discussion with students and further exploration of the topics introduced, based on experiments drawn from scientific literature.
  2 lessons will be conducted:
- in a fully interactive format: journal club sessions involving an in-depth discussion of a scientific article by students working in groups.

All lessons will take place in person.
The course is in Italian language.

Textbook and teaching resource

Learning material (PowerPoint presentations, scientific articles) is available at the e-learning web page of the course. The recordings of the lessons will not be made available.
Recommended textbooks:

- Alberts B, Bray D, Lewis J, Raff M, Roberts K, Watson JD “Molecular biology of the cell” Garland Publishing, Inc.
- Lodish H, Berk A., Kaiser CA, Krieger M, Scott MP, Bretscher A, Ploegh H, Matsudaria P. “Molecular biology of the cell” 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 contents and student's ability to link different topics. No in itinere evaluation are scheduled.

Office hours

Contact on demand, upon request by mail to lecturers: farida.tripodi1@unimib.it; elena.sacco@unimib.it.

Sustainable Development Goals

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