UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Cellular Biochemistry

2425-3-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 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. 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

La regolazione delle transizioni del ciclo cellulare; i componenti chiave del ciclo cellulare: le cicline, i complessi chinasi ciclina-dipendenti (CdK), la loro attivazione e inibizione durante gli eventi di divisione cellulare; il ruolo degli inibitori di Cdk; il controllo della proteolisi durante il ciclo cellulare e la degradazione delle proteine regolatrici del ciclo cellulare mediate dalla via ubiquitina-proteasoma; la regolazione della trascrizione in fase G1; il controllo della transizione G1/S e l'inizio della fase S; mitosi e citochinesi.
Il controllo della proliferazione e del metabolismo cellulare: le chinasi TORC1 (target-of-rapamycin) e AMPK (AMP-

protein kinase); autofagia: un attore chiave nel metabolismo cellulare; autofagia selettiva degli organelli intracellulari.

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 (Ckis) belonging to the INK and CIP families. 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.

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

Lessons will take place in person. They will be organized with a frontal part, in which the main concepts will be presented by the teacher, and an interactive part with the students for discussion and in-depth analysis. Some lessons will be fully interactive, in a journal club mode, with students discussing scientific articles. Classroom lessons are supported by PowerPoint presentations.
Teaching language: italian.

Textbook and teaching resource

Learning material (PowerPoint presentations, 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: paola.coccetti@unimib.it.

Sustainable Development Goals

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