UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Neurobiochemistry

2627-1-F0803Q064

Aims

The course aims to provide students with the fundamental tools to study brain function and the pathogenetic mechanisms underlying neurological and neurodegenerative disorders. To this end, the course provides advanced knowledge of 1) brain biochemistry, 2) molecular bases of neurodegenerative disorders linked to both genetic mutations and to age-related environmental factors, 3) experimental models (cellular and animal), and 4) biotechnological applications for the development of biomarkers and new drugs.

Knowledge and understanding:
At the end of the course, students will have to know mechanisms underlying development and function of the nervous system and the alterations occurring in pathological conditions, as well as the cellular/animal models used for the study of these mechanisms and the new biotechnological approaches for diagnostics and drug therapy.

Applying knowledge and understanding:
At the end of the course, students will have to be able to apply the acquired knowledge to elaborate the experimental approaches useful for basic biomedical or applied research studies.

Making judgments:
At the end of the course, students will have be able to use the knowledge acquired to recognize the molecular and cellular components involved in the physiological/pathological processes described during the course, to form a critical opinion of these processes also through links to other disciplines, and to critically identify/evaluate the best experimental approaches to answer specific scientific questions. This autonomy will be developed during the interactive teaching activities based on both critical analysis of summary schemes/pathways and on the discussion of scientific articles (student journal club in group work).

Communication skills:
At the end of the course, students will have acquired the appropriate terminology for effective description and discussion of the neuroscience topics addressed in the course. This competence can be fostered by journal club moments based on the description of scientific articles to course colleagues.

Learning skills:
At the end of the course, students will be able to understand and analyze the scientific literature related to the topics addressed in the course in order to effectively integrate the knowledge acquired with that deriving from new scientific developments and those learned in other teachings.

Contents

Biochemistry of the nervous system: neuronal differentiation/brain development, energy metabolism, biochemistry of neurotransmission, molecular mechanisms of neurodegenerative diseases and new biotechnological strategies for diagnosis and therapy.

Detailed program

Organization of the nervous system and properties of its cellular components (neurons and glial cells).
Brain metabolism: blood-brain barrier and energy metabolism; other brain metabolic pathways; neuro-metabolic coupling; biochemistry of aging.
Synaptic transmission; classes of neurotransmitters and their metabolism; neurotransmitter receptors and post-synaptic signaling; gliotransmission and tripartite synapse.
Brain development and aging; role of neurotrophic factor in regulating differentiation, neuronal death-survival (apoptosis and autophagy), maintenance of neuronal phenotype, homeostasis and neurotransmitter activity.
Biochemical-molecular basis, diagnosis and therapeutic strategies neurodegenerative diseases: Alzheimer, Parkinson, Multiple Sclerosis, Amyotrophic Lateral Sclerosis and Huntington. Role of misfolded proteins, neurotrophic support, oxidative stress, excitotoxicity and reactive gliosis.
Models of neurodegenerations: neurons and glial cells (2D and 3D cultures) as in-vitro experimental models; animal models (pharmacological, surgical and genetic models) of neuropathologies.
New biotechonological strategies for diagnostics and therapy: gene therapy, cellular therapy using stem cells, vaccines, recombinant human proteins, mimetic molecules and nanoparticles for drug delivery.

Prerequisites

Prerequisites: basic knowledge of cell biology and biochemistry, which will be adequately explained and described to make them understandable to all.
Propaedeutic exams: None

Teaching form

The course includes 21 lectures of 2 hours, all in presence, and carried out in a Delivery and Interactive mode. Specifically:
18 lessons are in Delivery mode but with some interactive features, so all students are invited and encouraged to participate and ask questions for further explanations and moments of discussion on summary schemes.
3 lessons are in total Interactive mode in a Journal club style with presentation of scientific articles on important topics agreed with the students, and with the intervention of all of them
The course is held in Italian.

The course can be delivered in English on student's request (at least 10% of students, or in the presence of students participating in International mobility programs Erasmus or double degree).

Textbook and teaching resource

Slides of the lessons uploaded on the e-learning platform of the course and available to all students.
Selection of scientific articles available on the e-learning platform of the course.
Recordings of the course made in previous academic years will be available on the e-learning platform.

Reference books:
PRINCIPI DI NEUROSCIENZE / E.R. Kandel – Schwartz - Jessel
NEUROCHIMICA / George J. Siegel ... [Et al.]

Semester

Second semester

Assessment method

Assessment will be based on a written midterm exam and a final oral exam.
The midterm exam will take place halfway through the course and will consist of a written test with three open-ended questions covering the first part of the syllabus. This exam will be graded on a 30-point scale. Students can choose whether to accept or reject their midterm grade; if accepted, it will be averaged with the final oral exam grade. The midterm grade is not a prerequisite for taking the final oral exam. Students may also choose to skip the midterm exam and sit only for the final oral exam, which, in this case, will cover the entire course syllabus.
The second assessment will be an oral exam at the end of the course, consisting of one topic chosen by the student and one question from the professor. For students who completed the midterm and accepted their grade, the oral exam will focus only on the topics of the second part of the syllabus. For students who did not take the midterm, or did not accept their grade, the exam will cover the entire syllabus.
The grading criteria are structured as follows:
18–21/30: Essential but partial knowledge, minimal preparation, and satisfactory presentation skills.
22–24/30: Fair knowledge, fair understanding of concepts, and fair presentation skills.
25–27/30: Good knowledge of the topics, ability to connect course contents, and appropriate use of scientific language.
28–30/30: Complete, in-depth, and integrated knowledge, alongside a rigorous, clear, and critical presentation.
30 cum laude: Excellent preparation, full mastery of the content, and an outstanding capacity for independent critical analysis.
The overall assessment will take into account knowledge of the content, integration and connection of the different course topics, and the appropriate use of scientific terminology.

Office hours

Contact: on demand by email to the teacher.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION