UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Neurobiochemistry

2526-1-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

Written and oral exams in two separate tests.
The first test will be carried out in itinere, around the middle of the course, in the form of essays on two open questions concerning the first part of the program.
The second test will be oral at the end of the course and will focus on a topic chosen by the student among those of the second part of the program, which will be followed by questions that require concise but exhaustive answers to assess the student's level of preparation on the contents of the course and the ability to critically interact on these contents.
The score of the written test will be in 30ths and does not constitute a barrier to access the second test. The student can decide to accept the grade (which will average with that of the second test), or not to accept and therefore attend directly the second oral test in which the preparation for the entire program will be evaluated. The student can also decide not to take the midterm test and only attend the second test in which he will be evaluated on the complete program.
This examination mode tries to meet the needs of students by allowing to develop their own personal exam plan.

Office hours

Contact: on demand by email to the teacher.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION