Use of languages
Principal working language: spanish (spa)

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Teachers
Antonio Armario García
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Jordi Ortiz de Pablo
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Guillermo García Alias
Roser Masgrau Juanola
Francesc Jiménez Altayo
Ruben Lopez Vales

External teachers
Bryen A. Jordan
Julio Morán Andrade

Prerequisites
Good level of English. Part of the classes and some of the materials will be given in English, so good level of this language is mandatory.

In case any of the students does not speak Catalan, classes will be given in Spanish and/or English, so knowledge of Spanish is also mandatory.

Students with a degree in the biosciences field or similar (Biology, biochemistry, biotechnology, microbiology, genetics, biomedical sciences, medicine, veterinary, pharmacy, psychology...
Knowledge about neuroanatomy is highly recommended. Background in biochemistry and physiology is expected.

Objectives and Contextualisation

The main goal of the module is to learn the chemical, cellular and functional characteristics of the central and peripheral nervous system in order to reach a basic knowledge of Neurosciences, to be able to understand any field in neurosciences and the bases of the pathologies of the nervous system.

Skills

Neurosciences

- Analyze the performance of the motor, sensory and autonomic systems and the brain integrative functions, and know the experimental techniques used to study.
- Continue the learning process, to a large extent autonomously
- Explain how the intermediary metabolism of the nervous system, chemical processes and pharmacology transmission based receptors, transporters and enzymes of the metabolism of neurotransmitters or their transduction mechanisms work.
- Explain the basis of treatments for pathologies of the nervous system.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Biochemistry, Molecular Biology and Biomedicine

- Analyse and correctly interpret the molecular mechanisms operating in living beings and identify their applications.
- Analyse and explain normal morphology and physiological processes and their alterations at the molecular level using the scientific method.
- Continue the learning process, to a large extent autonomously.
- Develop critical reasoning within the subject area and in relation to the scientific or business context.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.

Learning outcomes

1. Continue the learning process, to a large extent autonomously
2. Continue the learning process, to a large extent autonomously.
3. Describe the processes of synthesis and inactivation of neurotransmitters.
4. Describe the working and the regulation of motor circuits, circuits of the autonomous nervous system and sensorial circuits.
5. Develop critical reasoning within the subject area and in relation to the scientific or business context.
6. Distinguish the mechanisms of action of drugs that modulate the action of neurotransmitters.
7. Evaluate and implement improvements or changes, either in methods or parameters, in the clinical laboratory.
8. Explain electric phenomena in neurons, in molecular and ionic terms.
9. Explain the mechanism of action of drugs that are useful in the treatment of neurodegenerative processes.
10. Identify and describe the working of brain integration functions.
11. Recognise and explain the characteristics and special requirements of biochemical and genetic analyses in clinical laboratories
12. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
13. Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.

Content
PROGRAM OF THE SUBJECT

Molecular and Physiological Neurobiology (Module 2)

Generalities on neurotransmission and receptor pharmacology (Dr Ortiz). 2h

General characteristics of synapse and chemical neurotransmission
General concepts on receptor pharmacology: Specificity and multiplicity of neurotransmitter action
Agonists and antagonists
Interaction ligand-receptor and associated responses: affinity and EC50

Signal transduction mechanisms (Dra Masgrau). 4h

Receptors directly/indirectly linked to ionic channels
Structure and pharmacological sites of action
Receptors linked to G proteins
Receptors with tyrosine kinase activity

Excitatory and inhibitory aminoacid neurotransmission (Dr Miñano). 4h

Metabolism of glutamate and other excitatory amino acids
Pharmacology of glutamate receptors
Ionotrophic and metabotropic receptors
GABA metabolism, GABA receptors pharmacology
Glycine receptors

Serotonergic neurotransmission (Dr Jiménez Altaya). 1’5h

Metabolism of serotonin
Pharmacology of serotonin receptors
Monoaminergic hypothesis of depression

Noradrenergic neurotransmission (Dr Jiménez Altaya). 1’5h

Dopaminergic neurotransmission (Dra Clos). 1’5h

Cholinergic neurotransmission (Dra Clos). 1’5h

Metabolism of acetylcholine
Functional aspects of cholinergic neurotransmission
Pharmacology of cholinergic receptors

Histaminergic neurotransmission (Dr Ortiz). 2h

Metabolism of histamine
Pharmacology of histamine receptors
Purinergic neurotransmission (Dr Saura). 2h
Metabolism of adenosine and purine nucleotides
Pharmacology of purinergic receptors

Neuropeptides (Dr Armario). 2h

REDOX regulation in CNS (Dr Morán, external professor - UNAM, Mexico). 2h
Effect of Reactive Oxygen Species (ROS) on CNS
ROS as regulators of physiologic processes as synaptic plasticity
Mechanisms of action of ROS in CNS
Signaling pathways involved in ROS action

Synaptic function and dysfunction in Neurological Diseases (Dr Jordan, external professor - Albert Einstein College of Medicine, NY, US). 2h

Electrical phenomena of neurons (Dr Jiménez Farrerons). 2h
Ionic transport across cell membrane
Active transport, Ionic channels, transmembrane resting potential
Action potential: generation and propagation
Production of pulse trains. Stimulus / frequency relation

Somatosensory systems (Dr López Vales). 4h
Introduction to sensory physiology
Sensory receptors
Sensory pathways coding
Central integration and sensory information transduction
Somatic sensitivity to touch, kinesthesia, thermal, pain, and visceral

Motor systems (Dr García-Alias). 6h
Excitation and muscle contraction
Functional structure of striatal muscle fibers
Electrical phenomena. Neuro-muscular transmission
Mechanisms of muscle contraction in striatal and smooth fibers
Segmentary control of movement and posture
Motor Unit
Segmentary reflex
Gamma-motor system
Propiospinal control circuits
Suprasegmentary control of movement and posture
Motor cerebral cortex
Basal ganglia
Motor centers of brainstem
Cerebellum

"Autonomic nervous system (Dr Navarro). 3h"
Efferent systems
Hypothalamus. Functional organization and multi-systemic control
Limbic system and cerebral cortex
Autonomic regulation of visceral functions

"Special Senses (Dr Navarro). 3h"
Taste sensitivity: Receptors, sensations, pathways and central connections
Olfactory sensitivity: Receptors, sensations, pathways and central connections
Hearing sensitivity
Vestibular sensitivity
Optic sensitivity

"Integrative functions in the brain (Dr Navarro). 1h"
Electrical brain activity
Biological rhythms
Functional organization of neocortex
Language

"Practical sessions."
Nerve conduction and channels (Dr Jiménez Farrerons). 2h
Electromyography (Dr Navarro). 2h

"Integrative Seminars."
Dr José Rodríguez-Álvarez 2h (half group)
Dr Alfredo J. Miñano 2h (half group)
Dr Julio Morán (External professor - UNAM, Mexico) 4h (half group)
Dra Roser Masgrau 4h (half group)
Dr Guillermo García-Alias 8h (half group)
Dr Marcel Jiménez 2h
Methodology

Combination of theoretical lectures and working with scientific articles where the more relevant themes will be exposed. It is assumed that the student will complement these sessions with reading of papers and books. Autonomous study is required for the student to reach the knowledge required to pass the module.

Laboratory practices will be done where the student will learn through the practice of some of the theoretical concepts. These practical sessions will be evaluated by means of a group work or a short evaluation at the end of the session.

Integrative seminars will be performed where the students have to prepare some articles that will be discussed in a seminar class. To understand the articles, students must integrate the knowledge of the program and its application on research.

Activities

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<th>ECTS</th>
<th>Learning outcomes</th>
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Evaluation

To pass the module, students must get a minimum mark of 5 (to 10). Two written exams will amount 35% each of this mark (students need a minimum of 4 in each exam to average). The remaining 30% of the mark will be evaluated in the practical sessions (through a group work or a short evaluation at the end of the practical session) and in the integrative seminars (through the participation of the students and a short evaluation at the end of each session). The students that have been presented to the two partial exams (set of evidences greater than 2/3 of the continuous evaluation) can only be presented for recovery. Thus, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score".

Important: If plagiarism is detected in any of the works submitted, the student may fail the whole module.

Evaluation activities

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Bibliography


