UAB
Universitat Autònoma de Barcelona

Molecular Neurobiology and Physiology

Code: 42890
ECTS Credits: 9

2024/2025

Degree	Type	Year
4313794 Biochemistry, Molecular Biology and Biomedicine	OT	0

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Teachers

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Ruben Lopez Vales

Teaching groups languages

You can view this information at the end of this document.

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 (B2 or higher).

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.

Competences

- 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. Describe the processes of synthesis and inactivation of neurotransmitters.
3. Describe the working and the regulation of motor circuits, circuits of the autonomous nervous system and sensorial circuits.
4. Develop critical reasoning within the subject area and in relation to the scientific or business context.
5. Distinguish the mechanisms of action of drugs that modulate the action of neurotransmitters.
6. Explain electric phenomena in neurons, in molecular and ionic terms.
7. Explain the mechanism of action of drugs that are useful in the treatment of neurodegenerative processes.
8. Identify and describe the working of brain integration functions.
9. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
10. Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.

Content

Program:

Molecular and Physiological Neurobiology (Module 2)

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

General characteristics of synapse and chemical neurotransmission

General concepts on receptor pharmacology: Specificity and multiplicity of neurotransmitter action

Agonists and antagonists. Efficacy.

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

Ionotropic and metabotropic receptors

GABA metabolism, GABA receptors pharmacology

Glycine receptors

¨ Serotoninergic neurotransmission (Dr Gemma Manich). 1'5h

Metabolism of serotonin

Pharmacology of serotonin receptors

Monoaminergic hypothesis of depression

¨ Noradrenergic neurotransmission (Dr Gemma Manich). 1'5h

¨ Dopaminergic neurotransmission (Drs Gil/Ortiz). 1'5h

¨ Cholinergic neurotransmission (Dra Solé). 1'5h

Metabolism of acetylcholine

Functional aspects ofcholinergic 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

¨ 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 Penas). 4h

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 Alfredo J. Miñano

Dra Roser Masgrau

Dr Enrique Claro

Dr Guillermo García-Alías

Dr Clara Penas

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Integrative seminars	11	0.44	
Laboratory practicals	4	0.16	
Theoretical classes	42	1.68	
Type: Autonomous			
Autonomous study	106	4.24	
Integrative seminars preparation	42	1.68	
Work preparation	15	0.6	

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.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evaluation of Integrative seminars	15	0.8	0.03	1, 2, 3, 4, 5, 6, 9, 10
Evaluation of Practical sessions	15	0.2	0.01	1, 6, 9, 10
Writen exam 1st Part	35	2	0.08	2, 3, 5, 6, 7, 8, 9
Writen exam 2nd Part	35	2	0.08	2, 3, 5, 6, 7, 8, 9

To pass the module, students must get a minimum mark of 5 (to 10). Two writen 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.

Bibliography

-Kandel E. Principles of Neural Science. Sixth edition, McGraw Hill, 2021.

-Purves D. Neuroscience, Oxford University Press USA, 2017.

-Waxman S. Molecular Neurology. Academic Press, Last edition 2014 (eBook).

-Cooper JR. The Biochemical Basis of Neuropharmacology, 8th ed. Oxford Univ Press, 2002.

-Pratt WB, P Taylor. Principles of Drug Action. Churchill Livingstone, New York 1990.

-Siegel GJ. Basic Neurochemistry, 8th ed. Academic Press, 2012.

- Carpenter RHS. Neurophysiology, 5th ed. Taylor & Francis Ltd. 2012.

- Cardinali. Neurociencia aplicada: sus fundamentos. Ed Panamericana, Buenos Aires, 2007

- Matthews GG. Neurobiology. Ed Blackwell Science, 2001.

- Squire LR et al. Fundamental Neuroscience. 4th ed. Academic Press, 2014.

Software

If you need specific additional software, it will be provided by the corresponding teaching staff.

Language list

Name	Group	Language	Semester	Turn
(PLABm) Practical laboratories (master)	1	Catalan/Spanish	first semester	morning-mixed
(PLABm) Practical laboratories (master)	2	Catalan/Spanish	first semester	morning-mixed
(SEMm) Seminars (master)	1	English	first semester	morning-mixed
(SEMm) Seminars (master)	2	English	first semester	morning-mixed
(TEm) Theory (master)	1	English	first semester	morning-mixed