Universitat Autònoma de Barcelona

2023/2024

Neurochemistry

Code: 101918
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OT	4	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Teachers

Jose Rodriguez Alvarez

Belen Ramos Josemaria

Prerequisites

There is no official requirements, but it is recommended that students have completed most of the subjects of the first three courses of the Biomedical Sciences or Biochemistry Degrees.

Objectives and Contextualisation

In the context of molecular physiology, the Neurochemistry course is designed to understand the bases of function, physiology and pathology of the central and pheripheral nervous system. This course includes the study of different cell types and regions involved in the function of the adult brain. The subject emphasizes the teaching of biochemical and cellular processes involved in the function and relationships of cells in the brain. A central point of the agenda is the knowledge of the different types of neurotransmission and molecular mechanisms that regulate the release of neurotransmitters and postsynaptic action (neuronal plasticity and gene expression). It focuses in molecular processes involved in metabolism, regulation and release of the major neurotransmitters (glutamate, GABA, acetylcholine, catecholamines, serotonin, neuropeptides and others), as well as their mechanisms of action in the postsynaptic cell. Finally, we will focus on the biochemical and pathophysiological mechanisms involved in brain diseases such as mental disorders and neurodegenerative diseases. The final objective is to examine the biochemical and molecular aspects of brain function in physiological and pathological conditions so that the student can develop critical reasoning about the nervous system.

The specific aims of this course are:

1. To understand the anatomical organization of the nervous system.

2. To understand the cellular organization of the nervous system.

3. Acquiring a global view of the cellular mechanisms involved in differentiation and function of cells in the nervous system

4. Understanding the importance of the blood-brain barrier and cellular compartmentalization in the context of the metabolism of nervous system.

5. To underrstand the molecular and electrical fundaments responsible for the transmission of nerve impulses.

6. To know the molecular events at synapses and neurotransmitter storage, release and inactivation

7. To know the molecular structure and function of ion channels and membrane receptors for neurotransmitters

8. To know the basis of the metabolism and action of the main neurotransmitters

9. To understand the biochemical mechanisms involved in some diseases of the nervous system

10. Develop critical reasoning to deepen into scientific issues related to biochemistry of the nervous system

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Describe biomedical problems in terms of causes, mechanisms and treatments.
- Display knowledge of the basic life processes on several levels of organisation: molecular, cellular, tissues, organs, individual and populations.
- Display knowledge of the concepts and language of biomedical sciences in order to follow biomedical literature correctly.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Analyse and identify the functional alterations, at the level of the nervous system, nerve cells and neurotransmitters, that are caused by various types of pathologies.
3. Correctly use the terminology of neuroscience and its text and reference books.
4. Describe the principal experimental techniques in neuroscience and their use in basic and applied research.
5. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
6. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
7. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
8. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
9. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
10. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
11. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
12. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
13. Understand the basic mechanisms of cell and tissue physiology.
14. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

CONTENT OF THE COURSE

CHAPTER I: BASIC FUNDAMENTS OF THE NERVOUS SYSTEM

1. ANATOMICAL ORGANIZATION OF THE NERVOUS SYSTEM

Organization of the central and peripheral nervous system.

2. CELLULAR ORGANIZATION OF THE NERVOUS SYSTEM

Morphological, molecular and functional cell types of the nervous system: neurons and glial cells.

3. HOMEOSTASIS OF THE NERVOUS SYSTEM

Cellular compartmentalization and metabolism. Blood brain barrier. Cerebrospinal fluid.

CHAPTER II: OVERVIEW OF NEUROTRANSMISSION

4. NEUROTRANSMISSION IN THE NERVOUS SYSTEM

Types of neurotransmission: chemical and electrical synapses. Structure and function of synapses. Calcium-dependent and -independent neurotransmitter release. Structure and cycle of synaptic vesicles. Structure and function of neurotransmitter receptors: ionotropic and G protein-coupled receptors and effectors. Desensitization of neurotransmitter receptors. Molecular mechanisms of synaptic plasticity

CHAPTER III: BASIS OF THE NEURONAL EXCITABILITY

5. BIOCHEMICAL AND ELECTRICAL BASES OF NEURONAL EXCITABILITY

Electric transmission signal. Resting potential. Action potential.

Function and structure of ion channels. Local potential and neuronal integration.

CHAPTER IV: MAIN NEUROTRANSMITTERS

6. TYPES OF NEUROTRANSMITTERS

Neurotransmitter systems: acetylcholine, catecholamines, serotonin, histamine, amino acids, neuropeptides and others. General principles: neurotransmitter metabolism, storage, inactivation, receptors and brain pathologies associated with neurotransmitter systems.

CHAPTER V: NEUROCHEMICAL AND PATHOLOGICAL MECHANISMS OF NEURODEGENERATIVE DISEASES

7. BIOCHEMICAL AND PATHOLOGICAL ASPECTS OF NEURODEGENERATIVE DISEASES

Alzheimer's disease (AD). Parkinson's disease (PD). Huntington'sdisease (HD).Amyotrophic lateral sclerosis (ALS).

Methodology

The TEACHING METHODOLOGY consists of: 1) Theoretical classes include both theoretical content classes and research seminars; 2) Commented self-learned exercises; 3) Seminars; and 4) Laboratory practices.

1. Master classes will be taught in the form of lectures to the group, in which the Professor will also comment on the material available for other activities, including materials for self-learning. Teaching material for the different activities will be provided basically through the UAB Virtual Campus.The teaching of the theoretical classes will in person, and only in exceptionally ocasions could be changed via Teams.

2. Self-learned exercises: At the end of each chapter, the students will solve some theoretical-practical cases, called "Self-learned exercises", which will be written in English to the teacher in advance and will be discussed in class in English with classmates tutored by the teacher.

3. Seminars/Oral Presentations consist of an oral presentation of the content of the laboratory practices and/or theorical and practical cases related to the nervous system by the groups of alumni, preferably in English.

4. Laboratory practices consistin the design and performance of an experimental procedure of a scientific question related to the nervous system. Students will do the practical part in the lab supervised directly by a teacher and at the end they will write a report. Additionally, students will be able to have specific tutorials. Laboratory practices are mandatory to examine and pass the course. The laboratory practices will be carried out partially in ATTENDANCE BASIS (Schedule:15:00-19:00h) in reduced groups in the laboratories of the Biochemistry Unit of the Dept. of Biochemistry and Molecular Biology of the School of Medicine (Medicine Building, Tower M2) and partially NON-ATTENDANCE of personal work related to the experimental practice (bibliographic search, preparation of results, writting report, etc ...).

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.

Activities

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Laboratory practices	15	0.6	1, 2, 13, 4, 5, 9, 8, 6, 7, 14, 3
Master classes	31	1.24	1, 12, 11, 2, 13, 4, 5, 10, 9, 8, 6, 7, 3
Seld-learned exercises	5	0.2	2, 13, 4, 8, 6, 7, 14, 3
Seminar/Oral presentation	5	0.2	2, 13, 4, 5, 9, 8, 6, 7, 14, 3
Type: Supervised			
Preparation commented exercises	6	0.24	2, 13, 4, 14, 3
Report lab practices and oral presentation	6	0.24	1, 11, 2, 13, 4, 10, 9, 8, 6, 7, 14, 3
Tuthorials	5	0.2	1, 12, 11, 2, 13, 4, 8, 14, 3
Type: Autonomous			
Personal study	70	2.8	1, 12, 11, 2, 13, 4, 5, 10, 9, 8, 6, 7, 14, 3

Assessment

The knowledge acquired will be evaluated in different tests in a continuous way, except for unique evaluation. At the end of all theoretical classes the student will be examines in a final exam consisting of a written test of 10 short questions of all the subject matter of the course. The final written exam will mean 50% (100% for unique evaluation) of the mark of the subject, the rest will be given by the activities that have been done continuously throughout the course (see below). The final exam is compulsory and only students that fail can attend the recovery exam, keeping notes of the activities carried out throughout the course. The recovery exam will never be for a note to go up. The "non-evaluable" will reflect non-attendance to the final compulsory exam.

Format of the evaluations:

Unique evaluation:

- Final written exam: Students are bot obligated to perform the laboratory practices, the commented exercises and seminars/oral seminars, and their evaluation will consist of a final written exam performed in the same moment and day of the exam of continuous evaluation, and if failed will have the opportunity for a recovery exam.
Calculation of the final grade: 100% of the written final test.

Continous evaluation:

- Final written exam:

The obligatory written exam will consist of 10 short questions that the students will have to answer individually in approximately ½ page each one. In this test you can ask about any part of the subject that has been explicitly given or related to the theoretical classes, exercises commented, practices or seminars. The mark of the written exam will account for 50% of the final mark.

- Self-learning exercises:

Exercises that will be carried out during the class-by-class during classroom practices will consist of tutored self-study classes. Theassessment will be done through tests written in English that aim to reflect the achievement of competences, as well astheknowledge of concepts explained in the theoretical classes. Each exercise will have a score of 1 to 10. The overall grade for these exercises will count 20% in the final grade.

- Laboratory practices:

Laboratory practices are mandatory. The evaluation of the practices will include the realization of the practice of laboratory using experimental methodology and the written report of the obtained results (NO PRESENCIAL). The practical note will correspond to 15% of the final grade of the subject. The students will obtain the "Non-Valuable" qualification when the absence exceeds 20% of the programmed sessions or score 0.

- Seminars/Oral Presentations:

Each group of students will present orally (PRESENCIAL) to the rest of the students and professors the results obtained in the laboratory practices or clinical or scientific cases that they have done. Students and teachers will be able to ask questions and the latter will evaluate the presentation of each student individually. The note of the seminar will correspond to 15% of the final grade.

Calculation of the final score: The final grade for the course will be calculated as follows: the grade for the final written exam will be 50% of the final grade for the course, while the grade for the continuous assessment exercises (commented exercises, laboratory practices and seminars) will represent 50% of the final grade for the course.Requisites to pass: In order to pass the subject, the final grade of the course will be equal to or greater than 5 out of 10. It will also be essential to obtain at least 4.5 out of 10 points in the final written exam.

Recovery exam:

Students that do not pass the minimum score (total score of 5 and 4.5 score in the written exam) may voluntarilyassist to a recovery test, the grade from which will replace the one obtained from the final written exam. The only recoverableassessment activity is the writtenexam, while the exercises, laboratory practices and seminars are NOT recoverable. The final grade for the course will be calculated as detailed in the previous section Calculation of the final grade. The recovery exam will give no the right to an Honors degree.

To participate in the recovery, students must have been previously evaluated in a set of activities, the weight of which is equivalent to a minimum of two thirds of the total grade for the subject or module. Therefore, students will obtain the qualification of "Not Evaluable" when the evaluation activities carried out have a weighting of less than 67% in the final qualification.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Commented exercises	20 % of the final score	2	0.08	2, 13, 4, 10, 9, 8, 6, 14, 3
Final Exam	50 % of the final score	3	0.12	1, 12, 11, 2, 13, 4, 5, 10, 9, 6, 14, 3
Laboratory Practices	15 % of the final score	1	0.04	1, 12, 11, 2, 13, 4, 5, 10, 8, 6, 7, 14, 3
Seminars	15% final score	1	0.04	12, 2, 13, 4, 5, 10, 8, 6, 7, 14, 3

Bibliography

To check disponibility of electronic documents, book and scientific journals at UAB library see: https://ddd.uab.cat/pub/guibib/224929/bibrecdigitals.pdf

BOOKS

BASIC NEUROCHEMISTRY: Molecular, Cellular and Medical Aspects (Seven edition) 2005. Scott Brady; George Siegel; R. Wayne Albers; Donald Price.

https://ebookcentral.proquest.com/lib/UAB/detail.action?docID=288993

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https://www.clinicalkey.es/#!/browse/book/3-s2.0-C20100650358

MOLECULAR NEUROPHARMACOLOGY (2nd edition) 2009. EJ Nestler, SE. Hyman, RC. Malenka. McGraw-Hill Medical.

PRINCIPIOS DE NEUROCIENCIA (2001) (4ª edició). E.R. Kandel, J.H. Schwartz & T.M. Jessell. McGraw-Hill Interamericana

CELLULAR AND MOLECULAR NEUROPHYSIOLOGY (2015) (4a Edició). C. Hammond. Academic Press

https://www.sciencedirect.com/book/9780123970329/cellular-and-molecular-neurophysiology

ELECTRONIC RESOURCES: Real/animated videos

JoVe

https://www.jove.com

https://www.jove.com/education/5/neuroscience

https://www.jove.com/research/journal/neuroscience

Software

Microsoft Word, Excel