Universitat Autònoma de Barcelona

2019/2020

Neurochemistry

Code: 101918
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OT	4	0

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Other comments on languages

The teaching materials (slides, exercises etc...) will be written partially or totally in English. The exercises of the seminars will be presented and discussed at class in English.

Teachers

José Rodríguez Álvarez

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

- Contribute to public discussions on cultural matters.
- Describe biomedical problems in terms of causes, mechanisms and treatments.
- Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
- Develop independent learning habits and motivation to continue training at postgraduate level.
- Develop independent learning strategies.
- Develop scientific knowledge, critical reasoning and creativity.
- 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.
- Generate innovative and competitive proposals for research and professional activities.
- Identify and understand the advances and challenges of research.
- Plan and implement laboratory analysis experiments and procedures belonging to the biomedical field.
- Show respect for the ethical and legal aspects of research and professional activities.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. 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.
2. Contribute to public discussions on cultural matters.
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. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
6. Develop independent learning habits and motivation to continue training at postgraduate level.
7. Develop independent learning strategies.
8. Develop scientific knowledge, critical reasoning and creativity.
9. Generate innovative and competitive proposals for research and professional activities.
10. Identify and understand the advances and challenges of research.
11. Show respect for the ethical and legal aspects of research and professional activities.

12. Understand the basic mechanisms of cell and tissue physiology.
13. 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: 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: NEURODEGENERATIVE DISEASES

7. BIOCHEMICAL AND PATHOLOGICAL ASPECTS OF NEURODEGENERATIVE DISEASES

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

Methodology

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

1. The theoretical classes will be taught in the form of lectures for the whole 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 Virtual Campus of the UAB.

2. Commented seld-learned exercises: At the end of each chapter, the students will solve some theoretical-practical cases, called "Self-taught 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. The seminars will consist of an oral presentation of the content of the laboratory practices by the groups of alumni, preferably in English.

4. The laboratory practices will consist in the design and realization of an experimental procedure to solve a scientific question related to the nervous system. The students will carry out the practical part tutored by a teacher and will have to make a pertinent report of the practice. Additionally students will be able to have specific tutorials.

The main points of the teaching methodology of Neurochemistry are the following:

Magistral classes: Theoretical classes that will be taught continuously three days a week. Each theoretical theme will feature at least one Research Seminar in English.

Commented self-learned exercises: At the end of each chapter, the student will have to answer and solve problems or theoretical-practical exercises that the teacher will have put forward in advance. Exercises written in English will be submitted to the teacher beforehand, which will be corrected, and later discussed in class.

Seminars: Oral presentation in groups of several students, preferably in English, of the results obtained from the laboratory practices.

Laboratory practices: Laboratory practices are mandatory to examine and pass the subject. They will be carried out in the laboratories of the Department's Biochemistry Unit. of Biochemistry and Molecular Biology of the Faculty of Medicine (Fac. Medicine, Tower M2) during the month of November. Each group of students will carry out a tutored practice for a teacher for 3 days. Hours: 3:00 p.m. - 7:00 p.m. The student will present an individual written English report of the practice in a format previously defined by the coordinator with a maximum of 3 sheets that will include all the graphs and figures of the results obtained. In addition, each group of students will present the results of the practice in the form of Seminar, preferably in English, to the rest of classmates.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Commented exercises	5	0.2	1, 12, 2, 4, 8, 7, 6, 5, 13, 3
Laboratory practices	15	0.6	11, 1, 12, 4, 8, 6, 5, 13, 3
Master clasess	31	1.24	11, 1, 12, 2, 4, 8, 5, 9, 10, 3
Seminar/Oral presentation	5	0.2	11, 1, 12, 2, 4, 8, 7, 6, 5, 10, 13, 3
Type: Supervised			
Preparation commented exercises	6	0.24	1, 12, 2, 4, 8, 7, 6, 5, 9, 10, 13, 3
Report lab practices and oral presentation	6	0.24	11, 1, 12, 2, 4, 8, 7, 6, 5, 9, 10, 13, 3
Tuthorials	5	0.2	11, 1, 12, 2, 4, 8, 7, 6, 5, 9, 10, 13, 3

Type: Autonomous			
Personal study	70	2.8	11, 1, 12, 2, 4, 8, 7, 6, 5, 9, 10, 13, 3

Assessment

The knowledge acquired will be evaluated in different tests in a continuous way. 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% 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:

- 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 commented exercises:

Exercises that will be carried out during the class-by-class during classroom practices will consist of tutored self-study classes. The assessment will be done through tests written in English that aim to reflect the achievement of competences, as well as the knowledge 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 report or written report of the results obtained. 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.

- Seminars/Oral presentation:

Each group of students will present orally 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.

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.

Assessment Activities

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

Bibliography

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