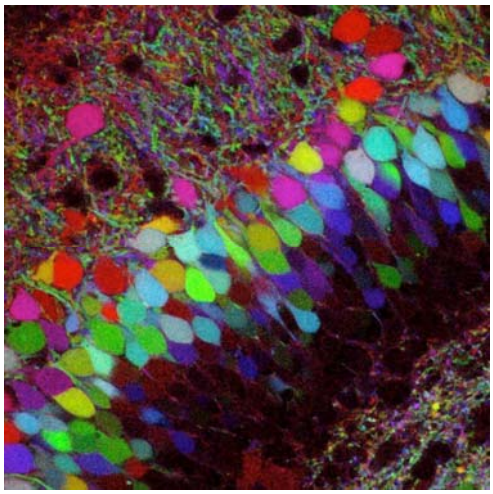
NEUROSCIENCE. HUMAN BIOLOGY. THIRD YEAR

Degree / Course: Degree in Human Biology
Course: 3rd
Term: 3rd
Number of credits: 4 credits
Number of students per course: 25
Language or languages of instruction: English
Teaching staff: Fernando Giráldez, Francisco Muñoz, Miguel Valverde, Jose M Fernandez, Ruben Vicente, María Moscoso, Marta Portero, Fernando Berrendero, Andrés Ozaita, Rafael Maldonado, Patricia Robledo.
Coordination: Fernando Giráldez.



1 Introduction to the course

Neuroscience is a multidisciplinary study of the brain. It includes many levels of explanation, from the molecular to the behavioural and cognitive. These strategies have several origins and traditions: morphology, neurophysiology, pharmacology, molecular biology, neurology or psychiatry. It is therefore the paradigm of a multi- and interdisciplinary area of science. This new approach to the study of the biological brain has opened enormous possibilities for understanding the "big problems" of the brain: consciousness, perception, memory, neurological and psychiatric diseases, neurodegenerative diseases, etc.

The aim of this course is to provide a perspective on Neurosciences by examining specific areas in which they have made enormous progress in recent years. The program begins with a brief review of molecular and cellular biology of neurons and glia, focusing on the mechanisms of cell communication and plasticity, to enter fully into the consideration of the molecular neuropathology. This section includes a review of advances in diseases of great social importance and currently the subject of intense study like epilepsy, schizophrenia or Alzheimer's. The following block deal of so-called cognitive neuroscience, a field that blends traditional neurophysiology and psychology to address some of the fundamental problems of human knowledge: perception and memory. We treat here the problem of the development of the senses and perception and the processes memory, language and communication. Finally, a block devoted to examining the recent advances in neuropharmacology of psychiatric disorders and addictions, again another area of enormous medical and social impact. Lectures will be complemented by seminars in which they discussed problems, cases or items proposed by teachers and will be solved in group discussions.

2 Skills acquired

• Understanding the basic principles of Las Neurosciences, its multidisciplinary nature and scope of knowledge.
• To describe the basic processes of molecular and cellular biology of neurons and glia, and the mechanisms of cell communication and plasticity.
• Understanding the molecular basis of neuropathology, taking as examples epilepsy, schizophrenia and Alzheimer's disease.
• To describe the basic processes of organization and development of sensory systems and perception.
• Understanding the neural mechanisms of memory, language and communication.
• Understanding the principles of neuropharmacology and treatment of psychiatric disorders and addictions.

3 Contents

THEORY SYLLABUS

The electrical brain

1. Molecular and Cellular Biology of the neuron. Electrophysiology of LTP and LTD. Post-synaptic currents and field post-synaptic potentials.. (Prof. José Manuel Fernandez)

2. Interactions between electronics and the brain. (Prof. Francisco Munoz)

The unfunctional brain

3. Reticular stress and its implications in neuropathological processes. Alterations in calcium homeostasis and protein translation. (Prof. Rubén Vincent)

4. Diseases that affect ion transport in the membrane of the neuron and sensory receptors. Nerve conduction and channelopathies. Alterations in ion gradient. Epilepsy. (Prof. Miguel Angel Valverde)

5. Diseases affecting chemical neurotransmission I. Genetic and sporadic diseases. Pathological aggregation and oxidation. (Prof. Francisco Munoz)

6. Diseases affecting chemical neurotransmission II. The exocitotic complex and its functional coupling to ion channels. Poisons that affect the release, degradation and binding to neurotransmitter receptors. (Prof. José Manuel Fernandez)

7. Molecular pathophysiological brain aging. Cerebral oxidative metabolism. (Prof. Francisco Munoz)

8. Alzheimer's disease and amyloid-beta peptide: cellular and molecular basis of the disease. (Prof. Francisco Munoz)

Perception: the representation of the world

9. From the retina to the visual cortex. Processing visual information. Cells "on" and "off" and contrasts. Simple and complex cells. Construction of objects and categories. "The "face cells" (Prof. Fernando Giraldez)

10. The construction of colour. Colour illusions. Retinal processing of colour. Trichromatic theory of colour opposition. Bottom-up and top-down processing. (Prof. Fernando Giraldez)

11. The construction of the space. Binocularity and depth. Binocular rivalry. The keys monocular. The 3D vision. The "the" place cells ", the" grid cells "and Euclidean space. (Prof. Fernando Giraldez)

12. The construction of sound: from the cochlea to perception. The auditory space map. Development and plasticity of the auditory space. What we learn from owls and bats. (Prof. Fernando Giraldez)

Cognitive Neuroscience

13. Higher Complex Processes: attention, learning and memory (Prof. Marta Portero).

14. Higher Complex Processes: attention, learning and memory from the perspective of animal experimentation (Prof. Marta Portero).

15. Human Communication: Language Comprehension and Production. Brain Areas Involved, neural circuits and sensorimotor integration (Prof. María Moscoso).

16. Human Communication: Language Comprehension and Production. Brain Areas Involved, neural circuits and sensorimotor integration from the perspective of animal experimentation and human studies (Prof. María Moscoso).

New perspectives for the treatment of neurological and mental disorders

17. Parkinson's disease (Prof. Fernando Berrendero).

18. Psychopharmacology: drug addictions (Prof. Rafael Maldonado)

19. Current perspectives on the treatment of Obsessive-Compulsive Disorder (Dra. Patricia Robledo)

20. Nicotinic Acetil-choline receptors as therapeutic targets in CNS disorders (Prof. Fernando Berrendero).

21. Gene therapy. Lipid neurotransmission. Other techniques (Prof. Andrés Ozaita)

SEMINARS
Seminar 1 Neuropathology: José Manuel Fernandez
Seminar 2 Perception: Fernando Giraldez
Seminar 3 Cognitive Neuroscience: María Moscoso
Seminar 4 Neuropharmacology: Rafael Maldonado
Seminar 5 Neuropharmacology: Patricia Robledo

ORAL PRESENTATION: THE "CHALK TALK"
The students, divided in groups of two, will choose a research paper related to neuroscience. Each group will prepare an essay of no more than one page, including up to 550 words, figures (if required) and references, and develop an oral presentation of 10 minutes followed by 5 minutes discussion.

4 Evaluation

The assessment will be based on academic performance following scale (out of 10 points):

50%: Written test (continuous evaluation). There will be two written tests (short questions and problems), one for the first three blocks, lessons 1-12, and a second one for the remaining two blocks, lessons 13-21. The final mark will be the average of the two exams. Each exam will be marked on a scale of 10.
20%: Work in seminars. This will be evaluated during the activities of the seminars and discussion groups.
30%: Essay and oral presentation. Oral presentations (chalk-talks) will be held before three members of the teaching staff who will evaluate it.
The students may obtain up to one point by the active participation in presentations and seminars, the final mark being trunkated to 10.

Requirements: To overcome the activity, the student must participate in scheduled activities and add up to 5 points (50%) or higher among the different activities mentioned above. However, note that the mark obtained in each of the written tests must be above 5 over 10 for allowing further consideration.

Criteria for the recovery process: Students that after the evaluation process have not passed the course, have the option of a recovery test in the month of July. This will be a written test (short questions & problems) on lessons 1 to 21st. In no case the activity assessed during the teaching process can be recovered and the student will maintain qualification obtained during the course. Therefore, the final grade will correspond with results of the recovery test with the abovementioned requirements, plus the results of the continuous evaluation.

5. Bibliography and resources

5.1. Textbooks

KANDEL, ER, SCHWARTZ JH, JESSEL, TM SIEGELBAUM SA AND HUNDSPETH, A.J. (2013) Principles of Neural Science. Fifth Edition. McGraw-Hill, New York, USA

PURVES, D., HEAD, A., HUETTEL SA, LABAR KS, PLATT ML WOLDORFF, MG (2013) Principles of Cognitive Neuroscience, Second Edition., Sinauer Ass., Inc. Publishers, USA

5.2. Further reading

Will be provided along the course.

5.3. Teaching resources

Webpages:
Companion Website: http://www.sinauer.com/cogneuro/animations.html
Purves, D. Neuroscience http://www.ncbi.nlm.nih.gov/books/NBK10799/
Other pages and resources will be provided along the course.

6 Methodology

Lectures. Seminars and problem solving. Advanced seminars. Working individually and in groups.
Essay and oral presentation: students, divided into groups of two students choose a current scientific work, related to neuroscience and prepare an essay. The work is presented in an oral session 10 minutes with a time of 5 minutes of questions. Articles by seminars and "Chalk Talks" will be provided.