COURSE DATA

Data Subject	
Code	33067
Name	Neurobiology
Cycle	Grade
ECTS Credits	5.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Faculty of Biological Sciences	4	Second term

Subject-matter

Degree	Subject-matter	Character
1100 - Degree in Biology	16 - Fundamentals of health biology	Optional

Coordination

Name	Department
AGUSTIN PAVON, MARIA CARMEN	357 - Cellular Biology, Functional Biology and Physical Anthropol.
NACHER ROSELLO, JUAN	21 - Cellular Biology and Parasitology

SUMMARY

Neurobiology is an optional subject within the intensification in *Foundations of Health Biology* (FBS, from the Spanish *Fundamentos de Biología Sanitaria*), which uses both theoretical and practical approaches to the understanding of the nervous system. Within the degree of Biology, *Neurobiology* is located in the second half of the fourth year, simultaneously with the subjects *Immunology* and *Pathogens and Disease*. *Neurobiology* studies one of the two systems of regulation of animal organisms, the nervous system. The other, the endocrine system is studied during the first semester in *Endocrinology and Reproduction*.

The significance *Neurobiology* relays on the importance of the nervous system for animal function. Indeed, the physiology of the nervous system determines our mental functions, our individual identity (e.g. brain transplantation would, in fact, be body transplantation) and even the legal definition of live and death (electroencephalographic activity). On the other hand, neurobiology is one of the most active and fruitful fields of modern biology, as evidenced by the dimensions of the international meetings on Neurosciences (the USA Society for Neuroscience annual meeting, exceeds 30,000 attendees). The neurobiology course seeks to address the study of some basic aspects of the structure, function and

diseases of the nervous system, from a multidisciplinary perspective that covers from the cellular-molecular level to behavior. It also tries to give the student some ideas of how Neurobiology can be integrated with other disciplines related to the biology of health, such as endocrinology (neuroendocrinology) and genetics (genetics of neurological and mental illnesses).

To do so, we have programmed four types of activities (lectures, practical lab activities, seminars and tutorials) through which we will review the following topics:

- Development of the nervous system and adult neuroanatomy.
- Neurogenesis, neuronal migration and axonal growth
- Synaptogenesis, neuronal death and survival
- Neurons and glial cells
- Neuronal physiology: axonal transport, electrical activity and ionic channels
- Synaptic transmission and synaptic integration. Mechanisms of synaptic plasticity
- Axonal plasticity during early life: critical periods and experience
- Motor and sensory systems
- Learning and memory
- Neurodegeneration, neurodegenerative diseases and psyquiatric diseases

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

The student must have passed 120 ECTS

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1100 - Degree in Biology

- Conocer y saber aplicar el método científico.
- Capacidad de organización, planificación y gestión de la información usando bases de datos bibliográficas adecuadas.
- Utilización del vocabulario específico de la Biología sanitaria.
- Capacidad de resolución de problemas y toma de decisiones.
- Capacidad de elaborar artículos, informes o proyectos y de exponerlos a diferentes auditorios.
- Habilidad para el trabajo en equipo y en contextos multidisciplinares.
- Capacidad de análisis crítico de textos científicos.
- Aprendizaje autónomo y adaptación a nuevas situaciones.

- Potenciar la creatividad, iniciativa y espíritu emprendedor.
- Apreciación del rigor, el trabajo metódico, y la solidez de los resultados.
- Potenciación de la capacidad de liderazgo.
- Capacidad de utilización de herramientas matemáticas y estadísticas.
- Reflexión ética sobre la actividad profesional.
- Conocimiento de sistemas de gestión en tareas profesionales en Biología sanitaria.
- Conocer los principales métodos y técnicas experimentales aplicadas al estudio de las enfermedades humanas, su etiología y la efectividad de los tratamientos.
- Conocimiento de las enfermedades y disfunciones más frecuentes durante las distintas etapas de la vida.
- Comprender el desarrollo del sistema nervioso central y periférico y la estructura adulta en mamíferos.
- Comprender las bases celulares y moleculares de la función nerviosa.
- Conocer los fundamentos de la neurofarmacología.
- Entender las relaciones entre función cerebral y función mental.
- Conocer el sustrato biológico y la patogenia de las enfermedades neurológicas y mentales.
- Entender y evaluar críticamente las estrategias de tratamiento de las enfermedades neurológicas y mentales.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

- Use correctly the specific terminology and methodology of health biology, especially within the field of neurosciences
- Be aware and able to aptly manage the main sources of information in Biomedicine, especially in the field of neurosciences
- Use of methodology, as well as instrumental and conceptual techniques for professional development in the field of health biology
- Design simple experiments to test hypotheses in health biology, and to interpret their results
- Develop personal criteria relative to ethical issues associated with the professional work in health biology
- Prepare, present and discuss ideas on current topics in the field of health biology (neurobiology)
- Evaluate the usefulness and limitations of the use of animal models for the study of human diseases (neurological and mental)
- Identify the major divisions and the main centers of the central and peripheral nervous system and its main cellular elements
- Predict functional alterations caused by experimental intervention on the nervous system of experimental animals, and of local dysfunctions in the human brain
- Use antibodies to identify, locate and quantify antigens in the nervous system: apply these techniques to the study of the functional organization and neurochemistry of the nervous System
- Identify alterations of the nervous system, based on clinical (human) or experimental (animal) data and comparing them with the symptoms of neurological or mental pathologies

DESCRIPTION OF CONTENTS

1. BLOCK 1: DEVELOPMENT

1. Development, formation of the cephalic vesicles and the SNP. Neurogenesis, differentiation, radial and tangential migration in the cortex.

2. Neurotrophins, synaptogenesis, survival and neuronal death. Role in the development, degeneration and neurotoxicity.

2. BLOCK 2: STRUCTURE AND FUNCTION

3. Structure and neuronal function. Structure of Neuron and Synapse. Glia: role in development, the neural function and Neurodegeneration.

4. Neurotransmitters, receptors and synaptic transmission: pharmacological characterization. Generation of excitatory and inhibitory postsynaptic potentials. Biogenic amines, ATP, peptide neurotransmitters, non-conventional neurotransmitters: nitric oxide and endocannabinoids. Production, degradation and reuptake of the neurotransmitters: pharmacological potential.

3. BLOCK 3: SYSTEMS NEUROBIOLOGY

5. Sensory systems. Visual information: retina, circuits and Visual centers; Auditory information: organ of Corti, pathways and hearing centers; Olfaction and chemoreception; Information organization somato - and viscero-sensorial.

6. Motor systems: Organization and control of motor cortex to motor neuron systems.

7. Memory and learning. Cellular and molecular mechanisms: the NMDA-dependent LTP as a model. Types of memory and learning: characteristics, circuits and animal models. Alterations of memory.

4. BLOCK 4: NEUROPATHOLOGY

8. Neurodegenerative diseases: Parkinson's disease, Corea, dementia. Etiopathogenesis, therapy and perspectives.

9. Mental diseases: schizophrenia, bipolar syndrome and depression. Therapies, hypothesis and animal models.

5. PRACTICES

1. Macroscopic anatomy of the nervous system. Dissection if a mammalian brain. Comparative anatomy.

2. Microscopic anatomy: arrangement and mounting of a histological series of mouse brain tissue sections. Use of the histological atlas of the mouse brain.

3.Image analysis of microscopy photographs marked with immunohistochemistry.

4. Human neuroanatomy.Structure and function of different types of cortex.
Corticogenesis and analysis of an experiment of pulse and chase.

5. Study of the dopaminergic circuits of the basal ganglia and the reinforcement system. Basic principles of stereotaxy. Neuroanatomic tracers: analysis of an experiment.

6. Tests of immediate memory and working memory.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	33,00	100
Laboratory practices	15,00	100
Tutorials	2,00	100
Development of individual work	20,00	0
Study and independent work	46,25	0
Preparing lectures	4,75	0
Preparation of practical classes and problem	4,00	0
TOTAL	**125,00**	

TEACHING METHODOLOGY

In this subject we will apply the following teaching methodologies:

1. **Theoretical lessons**. Based on the expositive method/Master class and the study and resolution of questions related to the matter taught. These classes will be given to the complete group during an hour.
2. **Tutorials**. There will be two tutorials in groups of 16 students and sessions of 1 hour about topic complementary to the content of the subject.
3. **Practical classes**. They will be developed mainly in the laboratory in groups of 16 students. Practical classes will consist on macroscopic and microscopic observation of the nervous system from control, pathological or experimental material and the execution of the final phases of experiments related to the problems posed in the tutorials. At the end of the practical classes we

will perform sessions in the classroom or in the lab in order to discuss and unify the results.

EVALUATION

Every programmed activity will be evaluated by the professor and it will contribute to the final grade. Every activity will be graded between 0 and 10. It will be necessary to obtain a score equal to or higher than 5, although one of the two parts (theory or practice) could be compensated, but only with a mark higer than 4.

THEORY 60%

- Exam. The theoretical knowledge will be evaluated with an exam at the end of the term, following the calendar established by the Faculty Council. The exam will consist on questions for which the comprehension of the basic concepts of the subject is necessary, as well as the ability to use them to give plausible answers to small problems related to the neurological pathology or the experimental neurobiology.

PRACTICAL CLASSES 30%

- Attendance to these classes is compulsory, a single unjustified absence or 2 justified absences will be allowed.
- Exam. The student's achievement in the practical classes will be evaluated in a final exam, which can include the interpretation of macroscopic and histological images of the nervous system relative to experiments or pathologies. During the exam the student will be allowed to use the mouse brain atlas.

TUTORIALS 10%

Individual or two by two essay on a clinical neurological case.

IMPORTANT INFORMATION

Aula Virtual is considered the official noticeboard and the normal way of communication between the students and the professors. The calls for exams, news on alterations in the calendar, notifications of grades and exam revision schedule will be announced in this platform and it is the responsibility of the student to be aware of these communications, as well as to have the e-mail box provided by the University, in proper conditions to receive these communications. The students are also advised to use the University's e-mail account and no other in their communications with the professors. Messages from any other e-mail account will be ignored.

REFERENCES

Basic

- Carlson NR. 2018. Fisiología de la conducta. 12ª edición. Madrid: Grupo Anaya Publicaciones Generales. Edició anglesa, Physiology of Behavior, Pearson Educación. (de Allyn and Bacon)
- Purves D, Augustine, Fitzpatrick, Hall, LaMantia, McNamara, White. 2018. Neurociencia. 5ª Edició. Editorial Médica Panamericana. Sisena Edició anglesa de 2018, de Sinauer.
  La tercera edició està disponible en àngles en Pubmed: http://www.ncbi.nlm.nih.gov/books/NBK10799/
- Siegel Gj, Agranoff BW, Albers RW, Fisher SK, Uhler MD (2011). Basic Neurochemistry, 6th edition. Molecular, Cellular and Medical Aspects. Disponible en angles en Pubmed: http://www.ncbi.nlm.nih.gov/books/NBK20385/
- Squire LR, Berg D, Bloom FE, du Lac S, Ghosh A, Spitzer NC. 2012. Fundamental Neuroscience, 3ª edicion. Academic Press.
- Waxman SG (2005) From neuroscience to neurology: neuroscience, molecular medicine, and the therapeutic transformation of neurology. San Diego: Elsevier Academic Press.
- Kandel ER, Jesell T, Siegelbaum S, Schwartz JH, Hudspeth AJ. 2013. Principles of Neural Science. 5th ed. McGraw-Hill.

Additional

- Paxinos G, Franklin KBJ. 2001. The Mouse Brain in Stereotaxic Coordinates. Academic Press, San Diego.
- Paxinos G, Watson C. 2007. The Rat Brain in Stereotaxic Coordinates, 6th Edition. Academic Press, San Diego. Book w/ CD-ROM, Reference
- FULLES WEB
  Aquestes dues fulles web són molt útils per estudiar les pràctiques i aconseguir una visió tri-dimensional del cervell.
  Atles online del cervell del ratoli del Mouse Brain Library. Es un atles senzill i fàcil dusar, dimatges estàtiques del cervell del ratolí, que és el que més estudiarem al llarg de les pràctiques
  http://www.mbl.org/atlas170/atlas170_frame.html
  Material neurohistològic per observació amb java. Permet observar imatges com si foren una preparació, des duna visió panoràmica al detall que dona un microscopi a 200-400 augments. No és una animació, són imatges de talls reals de cervells de diferents espècies tractades amb diferents tècniques. Probablement serà útil al final de lassignatura, perquè requereix uns certs coneixements neuroanatòmics previs.
  http://brainmaps.org/index.php